An Intervention Framework for Safer Driver Behaviour on the SRN

1-065 Final Report

Lisa Dorn
Cranfield University
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Mira Mynett
Woodlands
Manton Lane
Bedford
MK41 7LW

Tel: +44 (0) 300 4704930

Mira.Mynett@highwaysengland.co.uk
Executive Summary

Improving journeys, making them safer and faster with more reliable journey times, is at the heart of Highways England’s priorities for the period 2020 to 2025. Highways England has unveiled ambitious plans to reduce the number of people killed/seriously injured (KSI) on the Strategic Road Network by 40% by 2020 as part of its longer-term goal to decrease this to zero. Road crashes cost the British economy £15 to £30bn p.a. (1.2 to 2.3% GDP) with a high proportion of total costs due to motorway and trunk road incidents. It is estimated that the direct cost to Highways England is about £2.1bn. Car occupants have made up the largest road user group in each casualty severity according to the most recent Reported Road Casualties Great Britain Annual Report, with vulnerable users all accounting for disproportionately more casualties based on total distance travelled. There is a clear social and economic basis to Highways England’s goal to decrease to zero the number of people harmed. To achieve their aims Highways England must address non-compliant driver behaviour.

The present work was commissioned by Highways England as part of their five-year Road User Compliance Action Plan. The objectives of the work are to identify priority non-compliant behaviours to be addressed and to develop implementation plans for effective interventions for behaviour change to support a reduction in KSI casualties. Many interventions for road safety have unclear or unrealistic aims, are poorly piloted and weakly evaluated (Sullman and Dorn, 2015). Ensuring that interventions are evidence-based and systematically implemented using a safe systems approach will increase the chances of an impact on driver behaviour and a reduction in KSI casualties.

Several phases of research were undertaken for this project. For the first phase a literature review was conducted to categorise the ‘Active ingredients’ (or Behaviour Change Technique - BCTs) for behavioural change. Given that there is an extensive scientifically robust evidence base with proven techniques for changing behaviour in health psychology literature, academic studies of successful interventions within this discipline were reviewed. The literature review found that the most common BCTs across successful interventions were: Providing instructions; Prompting the self-monitoring of behaviour; Providing feedback on performance; Providing opportunities for social comparison and planning for support or social change. These BCTs were mapped across interventions as part of implementation plans designed to improve road safety for key driver behaviours.

For the next phase of the research, a number of factors were taken into account to identify the ‘top eleven’ driver behaviours for closer investigation with regards what interventions have been found to be most effective. These factors included the results of an interview study with frontline Highways England staff (reported elsewhere in an interim report for the current project); an evidence review by the Transport Research Laboratory, KSIs and customer satisfaction ratings for poor driver behaviours on the SRN.

Driver Behaviour

- Inappropriate speed
- Distraction (mobile phone use)
- Close Following
- Driver fatigue
- Seatbelt use
- Drink driving
- Drug driving
- Lane hogging
- Inappropriate driving in bad weather
- Vehicle roadworthiness
- Red X compliance

For the next phase of the research an academic literature search was undertaken for all top eleven behaviours including an online search of local, national and international interventions that aimed to
reduce the risk for each driver behaviour in turn. Three priority behaviours were then selected based on KSIs, customer satisfaction and the availability of reliable benchmark data to monitor the impact of interventions. In 2015 the number of KSIs for each of these three behaviours were 241 for inappropriate speed, 114 for close following and 20 for mobile phone use. In addition, of the customers angered by an aspect of poor driver behaviour in 2016 according to a Highways England satisfaction survey, 35% said it was due to speed, 43% reported it was due to close following and 48% reported that seeing drivers using their mobile phone whilst driving made them angry. Therefore the priority behaviours selected were inappropriate speed, close following and mobile phone use.

Three implementation plans of evidence-based countermeasures for these behaviours were delivered as part of the current research project and mapped across engineering, education and enforcement intervention types. The implementation plans included a multitude of different factors including the rationale, evidence base, whether the interventions contained the key BCTs identified in the earlier health psychology literature review, evaluation and stakeholder governance. Multiple internal and external stakeholders took part in workshops and interviews to identify interventions already in place and their willingness to work jointly with Highways England on the delivery of the implementation plans.

To support a reduction of KSI casualties on the SRN the output from this research recommends several next steps for Highways England. First, it is recommended that the findings in this report are fed into the Highways England Compliance Action Plan to secure agreement with internal stakeholders on the structure and content of the implementation plans for speeding, close following and mobile phone use. Second, it is recommended that Highways England engages with a broad range of stakeholders to ensure that road safety messages are consistent. This involves using the stakeholder management plan and terms of reference for close collaborative working to improve the non-compliant behaviour in question. For example, image processing of non-compliant behaviours such as close following might be selected to benchmark the behaviour. Stakeholders will need to agree what constitutes close following and determine what might be an appropriate response from an enforcement, engineering and educational perspective. Third, it is recommended that the road user types need to be targeted for specific interventions contained within the relevant implementation plan to identify the situations where non-compliance is more likely and where baseline monitoring of the priority non-compliant behaviour could be established. Fourth, it is recommended that perhaps one or two interventions are piloted to identify any practical constraints or limitations. The findings from the pilot could then be fed back and the procedures adapted accordingly. Finally, it is recommended that the interventions are rolled out in a consistent and concise way across the entire SRN with full monitoring of data before, during and after the intervention to evaluate effectiveness for improving compliance and reducing KSIs.
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1.0 Introduction

Improving journeys, making them safer and faster with more reliable journey times, is at the heart of Highways England priorities for the period 2020 to 2025. Highways England has unveiled ambitious plans to reduce the number of people killed/seriously injured (KSI) on the Strategic Road Network (SRN) by 40% by 2020 as part of its longer-term goal to decrease this to zero. Road crashes cost the British economy £15 to £30bn p.a. (1.2 to 2.3% GDP) with a high proportion of total costs due to on motorway and trunk road incidents. It is estimated that the direct cost to Highways England is about £2.1bn. Car occupants have made up the largest road user group in each casualty severity according to the most recent Reported Road Casualties Great Britain Annual Report, with vulnerable users all accounting for disproportionately more casualties based on total distance travelled. There is a clear social and economic basis to Highways England’s goal to decrease to zero the number of people harmed. To achieve their aims Highways England must address non-compliant driver behaviour. Highways England are particularly looking for greater public engagement towards a common goal of compliance on the SRN that is expected to lead to improved customer satisfaction.

The SRN is an engineered environment where there is an expectation that road users will behave in certain ways, except they do not. Plus, the number of motoring offences detected in England and Wales has more than halved between 2004 (4.33million) and 2015 (1.57million). The Transport Select Committee recommended that if enforcement levels continue to fall, technology will become more essential in road traffic law enforcement. Technology has already automated many aspects of road traffic law enforcement. The Government must review procedures, including Home Office Type Approval (HOTA) to enable wider application and efficiency. Enforcement technologies now offer wide ranging potential applications and high standards of accuracy and reliability.

The present work was commissioned by Highways England as part of their five-year Road User Compliance Action Plan. The objectives of the work are to identify users of the strategic SRN who are more likely to be non-compliant, and to identify which non-compliant behaviours should be addressed (Narroway, 2014). Highways England plan to develop effective interventions for behaviour change to support a reduction in KSI casualties on the SRN.

Highway England’s Health and Safety Five Year Plan establishes a series of measures to significantly improve performance, key to the current work are actions are to identify factors involved in causing vulnerable user casualties and to develop a menu of initiatives to reduce KSIs. Therefore, by reducing traffic collisions and costs, the current project will be an important part in ensuring Highways England meets its key commitments: making the network safer; helping vulnerable users and achieving real efficiency (contributing to the £1.2bn savings by 2020 target). This work also assists and informs the achievement of other areas of focus during the first road period, namely:

- **Improving user satisfaction** (commitment to achieving 90% satisfaction on the NRUSS)
- Supporting the smooth flow of traffic to minimise delay and inconvenience to road users caused by accidents.
- **Encouraging Economic Growth** by working to minimise delay on the SRN caused by accidents/poor driver behaviour.
- **Better environmental outcomes** by improving driver behaviour, with vehicles one of the main sources of CO₂ emissions.
- Keeping the network in good condition, often negatively impacted by poor driver behaviour and accidents.
This final report summarizes the work undertaken to date following the main phases of the research as shown in the diagram below.

1.1 Road Safety Interventions: The Three E’s

Since 1950, road safety interventions have been classified into the three E’s: Engineering, Education, and Enforcement (Learoyd, 1950). Road engineering interventions are preventative measures involving physical engineering or structural changes to the road layout or road design that directly affect road user behaviour. Engineering approaches attempt to change behaviour via the use of design, construction and modification of physical systems such as traffic calming measures, road design, and passive and active in-vehicle safety systems.

Education covers all measures that aim to influence driver behaviour by promoting knowledge and understanding of self as driver and traffic rules and situations through training and strengthening and/or changing attitudes towards risk awareness, personal safety and others. Education is defined as attempting to change the knowledge and behaviour of road users ranging from media campaigns, classroom-based and in-vehicle training including innovative new approaches such as simulator-based training (Sullman, et al., 2015), in-vehicle monitoring systems (Toledo, et al., 2012) and online hazard perception training (Isler, et al., 2011).

Enforcement of traffic laws and regulation interventions focus on road safety rules and ensuring compliance through legal enforcement. Enforcement includes the development and application of laws and regulations covering a range of interventions to ‘control’ road user behaviour such as police patrols, driver testing, traffic regulations, speed cameras, vehicle standards and laws regarding road design.

Common across all forms of interventions is the need to influence or nudge driver behaviour. Behavioural change sits at the centre of developing interventions to tackle big social and health problems across issues as diverse as obesity, alcohol use, nutrition, physical activity and smoking. Equally, driver behaviour is a social and health related problem that has a huge impact on Highways England. Highways England is therefore seeking to understand driver behaviour and influence how and why drivers behave as they do and to develop interventions that have the best possible chance of improving compliance and ultimately road safety. This is the focus of this report.

1.2 Behavioural Change

When it comes to behavioural change, the traditional approach is to tell people what to do and punish them when they fail to do it. Halpern et al (2015) makes the case for moving towards the ‘full cooperation model’ in which people engage in the design, implementation and evaluation of policy and practise. Highways England are moving rapidly towards this model with their customer panels, stakeholder groups and cooperative working with other agencies towards a common goal. The focus for the design of interventions is on enabling and empowering individuals to make a change. However, there are legacy issues that need to be tackled to continue this forward momentum. New innovative interventions should consider not only punishing non-compliant behaviour but on incentivising and rewarding positive choices in how people use the SRN.
From a Highways England perspective, interventions are not about doing things to road users to make them change but working with and for them to provide the support they need to make a change. Interventions that focus on enabling encouraging and supporting behavioural change among target groups are therefore required. Responsibility lies with Highways England, their agencies, Government departments and agencies, private organisations and individual road users to create the conditions in which SRN users feel able to and want to make more productive, healthier and safer choices for not only their own benefit but for the benefit of others too. Such interventions need to be supported by systems to facilitate a behavioural change. A commitment to change must be a personal choice as people resist coercion, but to shift behaviour a number of different systems within the SRN environment need to be operating together to achieve the goal of behavioural change.

Vulnerable Road Users on the SRN

According to the World Health Organization’s report in 2013, road traffic crashes kill at least 1.24 million people and injure 50 million each year. About half of the world’s road traffic deaths occur among motorcyclists (23%), pedestrians (22%), and cyclists (5%), collectively known as vulnerable road users. The definition of ‘vulnerable road users’ (VRU) includes pedestrians, cyclists, and motorcyclists of all age groups. ‘Vulnerable road users’ are categorised by the amount of protection they have from other motorised traffic.

The VRU also extends to those with an increased risk of being involved in a crash. McCarthy and Barrow (2016) analysed the root causes of 159 fatal collisions that occurred on the SRN in 2014 and identified the potential countermeasures that could either avoid or reduce the injury severity of these collisions. The analyses provided information relating to risk factors by age, gender, vehicle type and road type. 43 fatal collisions involved a single road user type and dominated by loss of control collisions on straight roads or corners. 126 fatalities demonstrate that 71.6% of all people killed had a precipitating action that contributed to the collision.

In most cases the journey purpose was unknown (70). However, when the journey purpose was known (24), 58% were carrying out the journey as part of work (14 of 24). Commercial drivers of HGVs weighing over 3.5 tonnes tend to have more severe consequences in the event of a crash because of their size and weight compared to other road users. In 2009 over 4,200 fatalities involving HGVs were reported—12% of the total number of fatalities although HGVs only make up 2% of the EU vehicle fleet. Van drivers also represent a particular risk on the SRN probably due to work-related pressures (Grayson and Helman, 2011).

When designing interventions to reduce KSIs on the SRN consideration of target groups is essential.

1.3 Feedback, Motivation and Safer Driving

When feedback follows our actions, it is the consequence to the behaviour that affirms or contradicts our decisions. Positive (supportive) feedback tells us we are correct and motivates us to keep doing what we are doing. In contrast, negative (corrective) feedback informs us of a mistake and motivates us to stop a particular behaviour and try another approach. Motivating drivers to avoid adverse consequences and move towards the benefits of safe driving requires feedback. Feedback might be external (e.g. via telematics) or internal (e.g. via self-reflection). When people choose to change their behaviour, they adjust their motivation and beliefs (person factors) to be consistent with their actions.

One of the problems associated with unsafe driving practices such as using a mobile phone, close following and speeding is that corrective feedback is rarely given unless apprehended by law.
An Intervention Framework for Safer Driver Behaviour: Introduction

enforcers. Similarly, supportive feedback for safe driving is rarely given unless other road users acknowledge courtesy and consideration or the driver congratulates himself or herself for a safe drive.

The motivating consequences for a behaviour becomes the directing activator for the next behaviour. Natural feedback from convenience or a faster end to a journey often competes with a safer way to drive. However, taking the time to drive safely can develop a habit that could be equally motivating as driving at risk. Facilitating a behavioural change requires that drivers understand how their actions can protect them from adverse consequences immediately on their current journey as well as in some future situation. Those adverse consequences might include a number of situations to avoid including a higher fuel bill, increased levels of stress due to the extra demand that high risk driving requires, avoiding teaching loved ones that it’s OK to take a risk whilst driving etc. A behavioural change requires a large element of education to increase self-awareness and understanding on the behaviours that can lead to adverse consequences and the behaviours that can lead to a positive outcome but educational interventions have had a difficult history. Future developments in driver education must consider behavioural change techniques (Sullman and Dorn, 2015).

1.4 Safe Systems Thinking

In a recent report by the International Transport Forum (2016), data from countries with a pioneering approach to road safety countries show that about 30% of serious crashes are caused by deliberate violations and risk-taking behaviour, while the majority result from simple errors of perception or judgement by otherwise compliant persons. The notion that human beings are faultless road users is flawed and at odds with the approach adopted by other transport modes such as aviation, shipping, rail transport or occupational health in general. In the transport field, behaviour is guided through system design and builds changes that provide protection for people even where they make a mistake.

A ‘Safe System’ approach is holistic and proactive, managing and combining elements of the road transport system to guide users to act safely to prevent crashes. When crashes do occur they reduce the impact forces to mitigate the risk of serious injury or death. In this way, a Safe System approach is not reactive based on analysis of past crashes, but proactive by assessing the risks inherent in a road network. A Safe System approach identifies priority interventions that prevent fatalities and serious injuries when crashes take place.

There are four guiding principles which consider: that people make mistakes that can lead to road crashes; that the human body has a limited physical ability to tolerate crash forces; and that while individuals have a responsibility to act with care and within the traffic laws and regulations, there is a shared responsibility with those who design, build, manage and use roads and vehicles to prevent crashes and to provide post-crash care. The final principle is that all parts of the system must be strengthened in combination to multiply their effects, so help protect road users in the event that one part of the system fails. A Safe System requires understanding and managing the complex and changing interaction between operating the network, vehicles, road infrastructure and road user behaviour, in a holistic and integrated way. Reason (Reason, et al., 2006) used the “Swiss Cheese” model of injury causation, showing how active and latent failures can open a trajectory of accident opportunities and that a layered system of defences will avoid exposing a single point of weakness that would otherwise lead to injury.

Measures to increase safer traffic behaviour on the one hand include mandatory measures that present the user with no choice (though in reality a subset of users decide to ignore these mandates). Examples include the use of safety belts, speed bumps, signals and speed limits. Mandatory measures are universal in that they do not take into account actual traffic situations, and they are usually...
enshrined in rules, and the law enforcement, coupled with fines, is the primary mechanism to get users to adopt these measures (a shove or a smack). The idea is that the desired behaviour should become a universal habit (buckle up, obey a stop-sign, don’t speed), and undesired behaviour should be punished independent of the context of that behaviour.

These systems essentially take driver behaviour out of the emergency loop and act autonomously. In order to do so without large numbers of false positive events, these Advanced Driver Assistance programs (ADAS) will only act when an acute hazard is detected with a very high degree of confidence, and the magnitude of the hazard crosses a threshold value.

Stigson (2008) reviewed fatal crashes in Sweden categorising crashes based on the factors that contributed to its outcome and found strong interactions between three system components (vehicles, road infrastructure and road users), but that road-related factors were most strongly linked to a fatal crash outcome. Later, Stigson et al. (2011) reported that while vehicle safety standards have a potentially major beneficial effect on vehicle occupants’ serious injuries, road-related factors were most strongly linked to fatal crash outcomes. This suggests that Highways England has a strong role to play in developing the appropriate road infrastructure and signage if KSI on the SRN are to be reduced.

While a number of countries including the UK have adopted Safe System principles, translating these into practice in the infrastructure delivery may be difficult. This is partly because road and roadside infrastructure design guidelines are often based on the need to maximise mobility and may not necessarily take an injury prevention approach. Design standards generally rely on drivers making the right decisions, for instance keeping a safe distance from a lead vehicle. Our literature review found that very few studies have been undertaken into human factors related responses to road infrastructure (Kennedy et al, 2005).

2.0 Methodology

2.1 The Interventions Framework

Creating an environment of maximum choice requires the coordinated application of a number of interventions to influence driver behaviour. Many interventions for road safety have unclear or unrealistic aims, are poorly piloted and weakly evaluated (Sullman and Dorn, 2015). Ensuring that interventions are systematically implemented will increase the chances of success and also help to identify how they can be refined. An embedded approach is required taking into account all the systems that impact on driver behaviour including the human operator and the vehicle in which they are travelling on the SRN.

Taking into account the different approaches in place that attempt to influence driver behaviour, to categorise them an interventions framework is proposed. French and Blair-Stevens (2009) developed the DICES intervention framework to consider the diverse and occasionally diametrically opposed methods to influence behaviour:

1. DESIGN – Creates the environment and procedures that support self and community development and safety
2. INFORM – Informs and communicates facts and attitudes, and may seek to persuade and suggest behaviours
3. **CONTROL** – Using the power of the law and regulation as a body of rules and having binding force to incentivise and penalise the behaviour of individuals, organisations and markets for social good

4. **EDUCATE** – Informs and empowers critical reasoning, creates awareness about benefits and develops skills for change and personal development

5. **SUPPORT** – Government and other collectively funded products and services provided to support mutually agreed social priorities.

Each element of the interventions framework links and overlaps. It is important to harness the benefit of each approach to achieve targeted behavioural goals e.g. improved compliance on the SRN relating to speed, mobile phone use and close following. Reliance of one level of the framework can create unintended consequences. For example, a focus on control-based approaches such as an over-reliance on law enforcement could decrease customer satisfaction when using the SRN. A coordinated effort is required to improve compliance on the SRN with input from a number of agencies and systems.

An example of the application of the intervention framework for using a mobile phone whilst driving might include the following:

- **DESIGN** - includes some practical physical output that has been designed specifically to change behaviour. For example, an app that automatically switches off the phone when it detects that the person is driving
- **INFORM** - consider all interventions that provide fact-based information to road users. For example information about the dangers of using a mobile phone whilst driving
- **CONTROL** - includes all interventions designed to exert some control over behaviour instructing road users on the rules and the laws that the must follow. For example, to enforce rules of mobile phone use by deploying Closed Circuit Television (CCTV) in Highways England vehicles and refer this evidence to the police
- **EDUCATE** - includes approaches that require the development of certain competencies such as self-reflection, skills or attitudinal change. For example, educating on the dangers of using a mobile phone whilst driving by demonstrating the limitations of the driver’s information processing capacity
- **SUPPORT** - includes making resources or services available to support a behavioural change. For example an insurance company giving parents a free app to monitor their children’s mobile phone use whilst driving.

### 2.2 Exchange Modes

Systems thinking therefore requires consideration of interactive variables between two human domains (the person and their behaviour) operating within system components. Three domains: environment, person and behaviour are interactive, dynamic, and reciprocal. A change in a factor within one domain influences other factors in that domain, and eventually has an impact on factors within the other two domains. For example, changes in an environmental factor such as congestion affects driver behaviour (e.g. close following) and can increase anger; and behavioural change usually results in some change in the environment (a collision).

Most interventions have primarily focused upon “fixing the driver” whereas systems thinkers consider that road traffic injury prevention requires a focus on proactive activities upstream from an incident, injury or fatality.

Thaler and Sunstein (2008) suggest that if a particularly unfortunate behavioural or decision making pattern is the result of cognitive boundaries, biases, or habits, this pattern may be “nudged” toward a better option by integrating insights about the very same kind of boundaries, biases, and habits into
the choice architecture surrounding the behaviour – i.e. the physical, social, and psychological aspects of the contexts that influence the behaviour and in which our choices take place. In this way, nudges can promote a more preferred behaviour rather than obstruct it. They argue that such nudges may avoid some of the disadvantages of traditional regulation such as costly procedures and ineffective campaigning, unintended effects of incentivising behaviours, and invasive choice regulation, such as bans. However, nudge theory has been criticised for not helping people make long-term behaviour changes or identify the psychological factors that predict long-term behavioural changes. It is therefore important to consider other exchange modes when attempting to influence people’s behaviour.

Exchange modes that facilitate behavioural change do so either through an active decision on the part of the driver or by passive involvement. According to French (2011) there are four basic “forms” of exchange that can be used by Governments and public institutions to bring about positive social change. These “forms” of exchange include the popular ‘nudging’ (Thaler and Sunstein, 2008) which has been criticised for failing to take into account the psychological determinants of the behaviours that they are trying to change (van der Linden, 2013). French has therefore extended the exchange modes to consider other legitimate “forms” of exchange as well as nudging. These can be called ‘shoving’, ‘hugging’ and ‘smacking’.

French (2011) classified types of feedback on whether the feedback is positive (rewarding desired behaviour) or negative (punishing undesired behaviour), as shown in Figure 1 below. As a second dimension Highways England makes a distinction between feedback directed at conscious cognitive processing or at a more subconscious level. Many road safety interventions fail to reach their potential because the way they present traffic users with situational information and/or behavioural choices is ineffective: The presentation of the situational information or choices appeal to the deliberating, consciously decision-making user instead of the average real user, for whom negotiating traffic is primarily a habitual task requiring little thought.

Thanking drivers for maintaining an appropriate speed through roadworks is an example of ‘hugging’. The principle of reciprocity ‘do for me and I’ll do for you’ can influence traffic culture with something as ubiquitous as speeding, yet this approach is less often adopted within the interventions aimed at changing driver behaviour.

A ‘hugs’ and ‘smacks’ intervention leads to a conscious or considered decision to make a behavioural change as the road user is more actively involved in the process. For these types of interventions, the driver may make a voluntary change in their behaviour. For ‘nudge’ and ‘shove’ interventions driver decision making is more passive and response to these exchange modes is more automatic and less conscious. As these types of exchange modes are introduced to nudge or shove the driver without any conscious involvement on their part, there is little control over whether the driver has regular exposure to these interventions. For example, behaviour will only be shoved if the driver regularly uses speed bumps and a driver can only be nudged with a media campaign if they have regular access to it. Largely these interventions depend on mileage, exposure, access etc. These types of interventions may lead to an involuntary change in driver behaviour.
An Intervention Framework for Safer Driver Behaviour: Methodology

Figure 1 – Schematic of “forms” of exchange. Adapted from French, 2011

- **Hug**: Incentive/Reward
  - Eg. Speed feedback - smiley and sad face
  - Eg. Insurance reward for safe speed

- **Smack**: Disincentive/Punish
  - Eg. Penalty fine for speeding
  - Eg. Road bump to reduce speed

- **Nudge**: Automatic/Unconscious Passive Decision
  - Eg. Road bump to reduce speed

- **Shove**: Active decision
  - Conscious / Unconscious
  - Eg. Penalty fine for speeding

PellFrischmann
2.3 An Intervention Framework

It is further suggested that together with these four forms of exchange there are five basic types of intervention that can be used to bring about change. These two elements can all be brought together in a proposed intervention framework. According to French (2011) the selected mix will be much more likely to bring about the socially desired change because it is informed by the preferences and consent of the majority of citizens.

<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inform</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Educate</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Support</td>
<td></td>
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</table>

*Table 1 – An intervention Framework (French, 2011)*

By combining the DICES model with the exchange modes discussed above an intervention framework was constructed for the three target behaviours speeding, mobile phone use and close following.

Initial searches for each topic were carried out using Google and Google Scholar, with broad search terms relating to the topic of interest. Further search terms were selected based on commonly-occurring words and phrases in the most relevant results of initial searches. Academic journal databases were accessed (primarily ScienceDirect, EBSCOhost, Taylor and Francis Online, and PsycInfo) where relevant content was indicated through initial searches and corresponding searches were made within the databases.

Once relevant interventions were sourced, they were categorised according to the main exchange mode and the main intervention approach being utilised. The intervention matrices for target behaviours are shown below. Some interventions located in a particular cell could be included in other cells but were categorised based on their main orientation and impact. For example, driver diversion courses have both an element of education and an element of punishment. However, its main purpose is to provide a consequence for offender drivers apprehended by the police and is therefore classified as a ‘smack’.
3.0 Health Behaviour: A Literature Review of Behavioural Change Techniques

3.1 Introduction

Behavioural insights are findings from research in the field of behavioural science (which encompasses disciplines such as psychology, economics and sociology) that provide evidence about why people behave in a certain way, and what can be done to influence their decisions. The focus is less about conscious decisions around weighing up the costs and benefits of different decisions but more about behaviours that are subconscious or automatic as is often the case with driver behaviour. Understanding behavioural insights has the potential to make interventions more effective and guide drivers towards making small changes, or making small changes to the environment to ‘nudge’ automatic changes in behaviour by presenting different choices to encourage adoption of the desired behaviour.

Public health practitioners use a wide variety of interventions which are designed to improve health and wellbeing, with each intervention including one or more behaviour change technique(s) (BCTs). BCTs are observable, non-reducible components of an intervention which are designed to change behaviour. There are now decades of research that have focused on defining and testing various BCTs. In 2008 an attempt was made to provide a more rigorous methodology for characterising intervention content (Abraham and Michie, 2008). This was followed by the CALO-RE taxonomy, which defined 40 discrete BCTs designed for smoking cessation (Michie, et al., 2013, Appendix A). Most recently, Michie and her colleagues proposed a taxonomy containing 93 non-overlapping BCTs, which were arranged into 16 groupings (Behaviour Change Technique Taxonomy version 1 - BCTTv1; Michie, et al., 2015). There have been several other attempts to develop an agreed upon taxonomy, but these are amongst the most commonly accepted.

For the current study, the Abraham and Michie (2008) taxonomy of 26 BCTs will be used to classify BCTs in the health literature which has been cited over 1200 times to date and a shorter taxonomy is more conducive to the identification of patterns. The 26 BCTs are labelled and briefly described in Table 2.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Provide information about behaviour health link.</td>
<td>General information about behavioural risk, for example, susceptibility to poor health outcomes or mortality risk in relation to the behaviour.</td>
</tr>
<tr>
<td>2. Provide information on consequences.</td>
<td>Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behaviour.</td>
</tr>
<tr>
<td>3. Provide information about others’ approval.</td>
<td>Information about what others think about the person’s behaviour and whether others will approve or disapprove of any proposed behaviour change.</td>
</tr>
<tr>
<td>Technique</td>
<td>Definition</td>
</tr>
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<td>-----------</td>
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</tr>
<tr>
<td>4. Prompt intention formation.</td>
<td>Encouraging the person to decide to act or set a general goal, for example, to make a behavioural resolution such as “I will take more exercise next week”.</td>
</tr>
<tr>
<td>5. Prompt barrier identification.</td>
<td>Identify barriers to performing the behaviour and plan ways of overcoming them.</td>
</tr>
<tr>
<td>6. Provide general encouragement.</td>
<td>Praising or rewarding the person for effort or performance without this being contingent on specified behaviours or standards of performance.</td>
</tr>
<tr>
<td>7. Set graded tasks.</td>
<td>Set easy tasks, and increase difficulty until target behaviour is performed.</td>
</tr>
<tr>
<td>8. Provide instruction.</td>
<td>Telling the person how to perform a behaviour and/or preparatory behaviours.</td>
</tr>
<tr>
<td>9. Model or demonstrate the behaviour.</td>
<td>An expert shows the person how to correctly perform a behaviour, for example, in class or on video.</td>
</tr>
<tr>
<td>10. Prompt specific goal setting.</td>
<td>Involves detailed planning of what the person will do, including a definition of the behaviour specifying frequency, intensity, or duration and specification of at least one context, that is, where, when, how, or with whom.</td>
</tr>
<tr>
<td>11. Prompt review of behavioural goals.</td>
<td>Review and/or reconsideration of previously set goals or intentions.</td>
</tr>
<tr>
<td>12. Prompt self-monitoring of behaviour.</td>
<td>The person is asked to keep a record of specified behaviour(s) (e.g., in a diary).</td>
</tr>
<tr>
<td>13. Provide feedback on performance.</td>
<td>Providing data about recorded behaviour or evaluating performance in relation to a set standard or others’ performance, i.e., the person received feedback on their behaviour.</td>
</tr>
<tr>
<td>14. Provide contingent rewards.</td>
<td>Praise, encouragement, or material rewards that are explicitly linked to the achievement of specified behaviours.</td>
</tr>
<tr>
<td>15. Teach to use prompts or cues.</td>
<td>Teach the person to identify environmental cues that can be used to remind them to perform a behaviour, including times of day or elements of contexts.</td>
</tr>
<tr>
<td>Technique</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>16. Agree on behavioural contract.</td>
<td>Agreement (e.g., signing) of a contract specifying behaviour to be performed so that there is a written record of the person’s resolution witnessed by another.</td>
</tr>
<tr>
<td>17. Prompt practice.</td>
<td>Prompt the person to rehearse and repeat the behaviour or preparatory behaviours</td>
</tr>
<tr>
<td>18. Use follow-up prompts.</td>
<td>Contacting the person again after the main part of the intervention is complete.</td>
</tr>
<tr>
<td>19. Provide opportunities for social comparison.</td>
<td>Facilitate observation of non-expert others’ performance for example, in a group class or using video or case study.</td>
</tr>
<tr>
<td>20. Plan social support or social change.</td>
<td>Prompting consideration of how others could change their behaviour to offer the person help or (instrumental) social support, including “buddy” systems and/or providing social support.</td>
</tr>
<tr>
<td>21. Prompt identification as a role model.</td>
<td>Indicating how the person may be an example to others and influence their behaviour or provide an opportunity for the person to set a good example.</td>
</tr>
<tr>
<td>22. Prompt self-talk.</td>
<td>Encourage use of self-instruction and self-encouragement (aloud or silently) to support action.</td>
</tr>
<tr>
<td>23. Relapse prevention (relapse prevention therapy).</td>
<td>Following initial change, help identify situations likely to result in readopting risk behaviours or failure to maintain new behaviours and help the person plan to avoid or manage these situations.</td>
</tr>
<tr>
<td>24. Stress management.</td>
<td>May involve a variety of specific techniques (e.g., progressive relaxation) that do not target the behaviour but seek to reduce anxiety and stress.</td>
</tr>
<tr>
<td>25. Motivational interviewing.</td>
<td>Prompting the person to provide self-motivating statements and evaluations of their own behaviour to minimize resistance to change.</td>
</tr>
<tr>
<td>26. Time management.</td>
<td>Helping the person make time for the behaviour (e.g. to fit it into a daily schedule).</td>
</tr>
</tbody>
</table>

Table 2 – Definitions of the 26 Behaviour Change Techniques (Abraham and Michie, 2008)

There have been several studies investigating the use of BCTs within interventions using statistical techniques to identify which ones are the most effective. For the most part, these reviews show similar outcomes, but there are differences according to different behaviours and different target audiences. It should be noted that even the most effective interventions typically have only a medium effect on...
intentions to perform the behaviour, and an even smaller effect on the behaviour itself (e.g. McDermott, et al., 2016). Using BCTs does not guarantee that an intervention will be effective in changing behaviour but it will increase the chances of success.

Given that there is an extensive scientifically robust evidence base with proven techniques for changing behaviour in the health psychology literature this literature review aimed to categorise the ‘Active ingredients’ (or BCTs) within the interventions that led to a change in health-related behaviour

### 3.2 Method

PsychInfo, Medline and Scopus databases were searched for health behaviour change outcomes using behavioural interventions. The aim of the literature review was to identify which BCTs were more commonly associated with successful behaviour change. Over 150 articles were downloaded and read. The total number of successful interventions in which each BCT was present appears to be the best means upon which to judge BCT performance, given the low numbers for many BCTs and the relatively large failure rates. The original plan was to review the literature concerning interventions in obesity, physical activity, diet, drugs (including alcohol and smoking) and sexual health however it was quickly determined that relatively few studies on addictions and sexual health could be used as the interventions had only vague BCT descriptions. In addition, addictive behaviours need medical treatment and this would have an impact on the behavioural change outcome and obscure the impact of the BCTs. It was therefore determined that the focus should be on the most common interventions to reduce or manage obesity in non-clinical participants and analysed for the following criteria:

1. The study must be a peer-review published paper with an impact factor
2. The study must have included an intervention on a diet or physical activity-related behaviour or both
3. The study must take body weight and adiposity measurement of or at baseline and follow-up to provide objective evidence of the effectiveness of the intervention
4. The study must have used several BCTs
5. The study was classified for whether the intervention was statistically significant at changing behaviour (or not)
6. The presence of a control group
7. The study used non-clinical samples (i.e., not undergoing treatment for a health condition).

### 3.3 Results

From the original 150 papers sourced, each paper was then carefully reviewed (see Appendix A) using the above criteria. This led to the selection of 22 studies for in-depth review. The BCTs within each paper were then recorded according to Abraham and Michie’s (2008) 26-item taxonomy above based on studies summed across all health behaviours (obesity, physical exercise, diet and nutrition).

The findings from this in-depth literature review are shown in Table 3 and Table 4 below:-
### Table 3 - Most common BCTs found within successful interventions

<table>
<thead>
<tr>
<th>BCTs</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide Instructions</td>
<td>(77% n=17)</td>
</tr>
<tr>
<td>Prompt Self-Monitoring of Behaviour</td>
<td>(73% n=16)</td>
</tr>
<tr>
<td>Provide Feedback on Performance</td>
<td>(54% n=12)</td>
</tr>
<tr>
<td>Provide Opportunities for Social Comparison</td>
<td>(54% n=12)</td>
</tr>
<tr>
<td>Plan Support or Social Change</td>
<td>(54% n=12)</td>
</tr>
</tbody>
</table>

### Table 4 - Least common BCTs found within successful interventions

<table>
<thead>
<tr>
<th>BCTs</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide information about others approval</td>
<td>(4% n=1)</td>
</tr>
<tr>
<td>Prompt Identification as a Role Model</td>
<td>(4% n=1)</td>
</tr>
</tbody>
</table>
### 3.4 Implications

Taking each of the five BCTs in turn, Table 5 outlines some of the suggestions about the implications for each of these BCTs if they are to be incorporated into a behavioural intervention.

<table>
<thead>
<tr>
<th>BCTs</th>
<th>Description</th>
<th>Implications</th>
</tr>
</thead>
</table>
| Provide Instructions          | Telling the person how to perform a behaviour and/or preparatory behaviours | 1. Campaigns could aim to instruct drivers on how to reduce speed  
2. Campaigns could instruct on preparatory behaviours such as preparing for a journey on the SRN  
3. Interventions could aim to instruct drivers on the rules governing speed, mobile phone use and close following  
4. Interventions could aim to instruct drivers on the acceptable behaviours with regards to speed, mobile phone use and close following |
| Prompt Self-Monitoring of Behaviour | The person is asked to keep a record of specified behaviour(s) (e.g., in a diary) | 1. App-based monitoring of driver behaviour to record speed, mobile phone use, driver fatigue etc. could be introduced.  
2. DVSA drivers record for learner drivers could be extended for post-test period  
3. In social media campaigns encourage self-reflection of triggers to unsafe driver behaviours and self-monitoring its impact |
| Provide Feedback on Performance | Providing data about recorded behaviour or evaluating performance in relation to a set standard or others’ performance, i.e., the person received feedback on their behaviour | 1. Feedback could be given in a number of different ways including via the vehicle, an app, by another person or via on-road matrix message  
2. Feedback could be given to help the driver to understand their progress and relative risks and safety  
3. Feedback that encourages driver behaviour to be adjusted over time to best mobilise the direction and/or intensity of efforts  
4. Provide feedback in association with goals e.g. as insurance-based telematics use driver scores |
### BCTs

<table>
<thead>
<tr>
<th>Description</th>
<th>Implications</th>
</tr>
</thead>
</table>
| Facilitate observation of non-expert others’ performance for example, in a group class or using video or case study | 1. Interventions could encourage social comparisons (e.g. workshops for commercial drivers and ‘significant others’ as an individual e.g. parents for young drivers) to encourage safe driving  
2. Observation of safe behaviour by ‘influential other’ who holds power within a group e.g. identifying a popular driver as a role model  
3. Design a video to demonstrate safe driving behaviours and encourage self-reflection on own behaviour  
4. Use case study data to show how others have benefited from making a change |

| Prompting consideration of how others could change their behaviour to offer the person help or (instrumental) social support, including “buddy” systems and/or providing social support | 1. Parents and friends encouraged not to phone while they are driving and to be understanding when they don’t answer their phone or text whilst driving.  
2. Young drivers could pledge to support each other to drive safely via social media  
3. Incentivise social support for safe driving in a fleet-based company |

### Table 5 – Outline of some of the suggestions about the implications of each BCT.

### 3.5 Limitations

There are several limitations that should be acknowledged:

1. The target of change (e.g., obesity, physical activity, diet) varied across the 22 studies
2. Each study reviewed had many different outcome measures (e.g., BMI, pedometers) and this might have had an influence on the chances of an intervention being judged as successful
3. There was a wide variability in the people delivering the intervention and this may have had an influence on the effectiveness of the intervention
4. In many cases across the 22 studies the duration of the intervention was quite short
5. The number of participants varied from one study to the other thereby affecting the chances of achieving a significant effect of the intervention on behavioural change
6. The specification of the control group treatment may have been a limitation given that several control groups also appeared to be exposed to BCTs
7. There were different combinations of behaviours to change (e.g., obesity was tackled though exercise, diet and reducing sedentary activity in some interventions)
8. The length of the follow-up period varied from one study to another and may have had an impact on whether an intervention was judged to be effective in changing behaviour.
3.6 Conclusions

What can we learn from this literature review? BCTs are very rarely used in road safety interventions (Fylan and Stradling, 2014) and could be used alone or in combination with other BCTs to bring about a change in road user behaviour.

Primary research to develop a body of knowledge regarding BCT effectiveness for improving young driver safety is required. Recent research has identified that most pre-driver and young driver interventions do not have the desired impact (Sullman, et al., 2015) and that one of the reasons for this could be the absence of appropriate BCTs in these interventions.

It must also be acknowledged that this is only a cross section of the research, rather than an exhaustive review. A broader and more inclusive review of the literature should be undertaken at a later date when utilisation of the common terminology proposed by Michie et al (2015) and the request for more complete reporting have had time to become common practice.

The findings from this literature review will be used to map across the interventions selected in the design of an implementation plan for three priority behaviours; speeding behaviour, mobile phone use whilst driving and close following. The interventions will be assessed for whether they include the five BCTs as part of the implementation plan. This will enable a degree of confidence that behavioural change techniques are present in the interventions being selected.

4.0 Safer Driver Behaviour Stakeholder Engagement

4.1 Introduction

In order to influence driver behaviour and improve customer compliance when using the SRN, Highways England needs multi-stakeholder engagement. This is not only to inform Highways England about the kinds of activities undertaken by stakeholders with a common aim of improving road safety but also to work collaboratively if and where possible.

Stakeholders have multiple and wide-ranging input on road safety. Their support is likely to increase effectiveness of the selected interventions for the Safer Driver Behaviour Research Project and ultimately impact on KSIs and customer satisfaction. In a recent study by TRL (Fleetwood, 2016) 125 stakeholders were identified and mapped by power and interest and categorised by primary (e.g. Police, The AA etc.) secondary (e.g. THINK! NDORS etc.) and tertiary stakeholders (e.g. RIDDOR, ANPR etc.). A stakeholder maturity index was then applied to plot 1) current attitudes and activities in tackling non-compliance 2) individual power 3) stakeholder type. At the top of the triangle organisations include DfT, NPCC, APCE, DVLA, DVSA, CPS and NDD. These stakeholders take a ‘hard’ enforcement stance whereas at the bottom of the triangle, stakeholders take a soft approach to educate and influence. The report concludes that for the 1-065 priority behaviours of speed; mobile phone use; and close following, stakeholder workshop groups should include a mixture of stakeholder types from across the triangle.

4.2 Selection of Key Driver Behaviours

Research commissioned by Highways England published between 2015 and 2016 has identified a number of non-compliant driver behaviours that are associated with crash involvement and impact on operational efficiency and maintenance as well as affect customer satisfaction. These driver behaviours are:-
An Intervention Framework for Safer Driver Behaviour: Inappropriate Speeding Behaviour

Speeding
Drink-driving
Using a mobile phone while driving
Not using a seatbelt

‘FATAL FOUR’

Close following
Roadworthiness
Driver fatigue
Lane discipline

Additional behaviours were also identified via an interview study with frontline Highways England staff working on the SRN. This study is reported in an interim report for the current project. The following driver behaviours were revealed as leading to incidents on the SRN:

- Red X Compliance
- Driving in bad weather
- Drug driving

The following sections of this report investigate all top eleven driver behaviours and what interventions have been employed to influence each behaviour. Of particular interest is the evidence for whether interventions have led to safer driver behaviour and reductions in KSIs as this will be the primary goal for the selection of interventions for implementing a reduction in KSIs on the SRN.

The top eleven behaviours were presented to the stakeholders to investigate the approach they are taking to influence these behaviours.

4.3 Stakeholder Engagement Aims and Objective

The stakeholder engagement research phase followed the same principles as outlined by the Transport Research Laboratory by selecting a broad range of different stakeholders according to power and interest as well as the selection of stakeholders from the primary, secondary and tertiary groups. The aims and objectives for stakeholder engagement were:

1. To utilise stakeholder experience and expertise to identify interventions already in place for the priority and shortlisted non-compliant behaviours.
2. To determine the nature of the interventions stakeholders are delivering to tackle priority non-compliant behaviours.
3. To determine the nature of the evidence that these interventions have changed driver behaviour and led to KSI reductions.
4. To investigate what other innovative interventions stakeholders consider could be implemented to support KSI reductions.
5. To explore which interventions can only be implemented by the stakeholder, jointly with Highways England or by Highways England only.

4.4 Methodology

Researchers conducted five classroom-based stakeholder workshops and sixteen one-to-one telephone interviews for key individuals who were unable to attend a workshop. The classroom-based
workshops consisted of between 3 and 6 participants to ensure that full contributions could be made and recorded. All but one of the workshops were tape recorded and in this instance, two members of staff from Pell Frischmann took extensive notes. Participants were seated around a table to maximise interactions and took two hours. One-to-one telephone interviews took approximately one hour to complete.

The Stakeholder Engagement: Content and Structure

The workshop and interview sessions were divided into four sections. Firstly, scene setting covering introductions and an outline of the 1-065 research project aims and objectives. The researcher then presented the project shortlist of non-compliant behaviours to seek the views from stakeholders on identifying and prioritising the top 11 non-compliant behaviours.

The second section focused on the interventions stakeholders are currently delivering targeted to the top 11 selected non-compliant behaviours including detailed questions regarding the format of the intervention and its practical limitations. The third section considered the evidence-base underpinning the interventions to understand the extent to which they may have changed driver behaviour. The final section covered whether the stakeholders were engaged in any innovative interventions to support KSI reductions and their willingness to collaborate with Highways England. Next steps and follow-up documents were requested. The workshops and interviews were transcribed for further analyses.

Participants

Five Stakeholder workshops were held and consisted of seventeen members of staff from Highways England along with the following representatives from external organisations:-

- The Camping and Caravanning Club
- Road Safety Analysis (RSA)
- Central Motorway Police Group (CMPG)
- The British Horse Society
- The DfT on behalf of policy heads in RULIS
- Motor Insurance Bureau (MIB)
- Road Safety GB (RSGB)
- The Chartered Institution of Highways and Transportation Road Safety Panel (CIHLT)
- National Fire Chiefs Council
- Motorcycle Industry Association (MCIA)
- Chief Fire Officers Association (CFOA)

Sixteen one-to-one interviews took place with external representatives from the following organisations:-

- Roadsafe
- Parliamentary Advisory Council for Transport Safety (PACTS)
- The Road Safety Trust
- The Royal Automobile Club (RAC)
- THINK!
- The Freight Transport Association (FTA)
- The Institute of Advanced Motorists
- Williams Lea Tag
- Driver and Vehicle Standards Agency (DVSA)
- The Royal Society for the Prevention of Accidents (RoSPA)
- The Automobile Association (AA)
An Intervention Framework for Safer Driver Behaviour: Inappropriate Speeding Behaviour

- Brake the road safety charity
- Road Safety GB
- West Mercia Police
- Surrey Fire and Rescue
- Greater Manchester Fire and Rescue.

4.5 Results

Before the start of the workshop and interviews, all participants were asked to complete a short checklist list of the top 11 priority behaviours that our research has identified as being associated with casualties on the SRN. Participants were asked to rate each behaviour in terms of high, medium and low priority for reducing casualties on the SRN.

![Expert Judgement of Priority Behaviours](image)

The figure shows that the top two behaviours judged to be high priority were inappropriate speed, and distractions both of which agree with the priority behaviours selected for this project according to our earlier research. The third priority behaviour, close following was not judged to be as high a priority as driver fatigue or drug and drink driving however. Indeed, statistics from the SRN in 2015 suggest that driver fatigue contributed to 145 KSIs whereas close following contributed to 114 KSIs. Close following was partly selected given that it is possible to monitor a change in behaviour using camera systems on the SRN. Expert judgements are based on specific expertise and experience and this is likely to have had an impact on how each behaviour was rated.

**WORKSHOP 1: 30th March 2017**

This workshop included representatives from the Camping and Caravanning Club and six members of staff from Highways England.
What work is being carried out to address driver behaviour?

- Within Highways England the fatality study is continuing to identify the root cause of accidents showing key behaviours that contribute to KSI (drink and drug driving, distraction etc.).
- Participants discussed engagement forums for Major Projects to identify physical problems (vario-guard), psychological insight and 55-60 speed limit in roadworks trials still ongoing.
- A study has been undertaken some years ago into the effectiveness of chevron markings but results are not currently known.
- CPC training for commercial vehicle drivers has considered the dangers of driving through roadworks. Sensors in carriageway that detect uneven roads could be used to determine headways (close following).
- NOMS feeding into MOG to support roadworks bookings with the aim of providing more accurate and granular information.
- Driving for Better Business scheme useful to manage fleet risk.
- National Motorcycle and Towing Working Groups are capturing user / customer views focussing on particular communities.
- Social media is being used to capture views (Facebook, Twitter).
- Study on ‘tipping points’ following a delay in a journey.
- Customers who do not journey plan tend to use unacceptable behaviour when facing a delay.

What work is being carried out in relation to Distraction?

- Engaging with driving instructors and DVSA targeting new drivers was considered a great opportunity to educate the driving instructor regarding the key behaviours that should be passed on to learners such as the importance of vehicle roadworthiness and mobile phone use.
- Highways England is working with Babybox which has a very large captive audience and engaging with this organisation and others to pass on vital messages.
- There are already companies out there giving out key messages and Highways England is tapping into this rather than replicating the effort.
- Highways England is heavily involved with NRPIF and have a national steer involving other national agencies. Targeted approach through the Compliance Framework.

What work is being done around trying to change behaviours?

The workshop participants discussed that research is being carried out but that they would like to see empirical evidence to see which behaviours are causing the most incidents. Work has been carried to determine interventions particularly aimed at commercial drivers. Initial data is available regarding the HGV cab on the network under the control of various police forces with a plan to repeat the exercise next year to determine if behaviour has been influenced.

What work is being done to influence driver behaviour in relation to drink/drugs?

At the development stage with NRPIF as Highways England aims to fund all road policing units to drug test at every incident attended and report back monthly. This will provide an evidence base more quickly than is currently the case.

Effectiveness of current interventions

Monitoring is underway to measure effectiveness of various interventions around commercial drivers in terms of both KSI savings and journey time savings. Benefits Realisation Capture Form is being brought into use. Work is being carried out in conjunction with Road Safety Analyses that will give
insight into customer behaviour linked to categorisation. Focus Groups are being used to measure actual reactions to various situations.

**Which interventions will have the largest impact on KSIs?**

There is a consensus that current sources of data are not particularly helpful in determining causal factors of KSIs. Other organisations are not keen to share data with Highways England for commercial reasons.

**Concerns around risk to interventions, engagement with stakeholders?**

Internal issues with communications, hampered by what is allowed on roadside variable message signage. Highways England is using external stakeholders as a communication tool and therefore may be losing control. Towing Working Group has yet to communicate with its external members. Communications is seen as a large blocker to getting the message out to customers.

**Quick Wins / Added Value?**

- Members of Camping and Caravanning Club could be targeted for communications from Highways England
- Highways England could do more to market itself – media, merchandising
- Increased visibility of traffic officers

**WORKSHOP 2: 30th March 2017**

This workshop included representatives from Road Safety Analysis, Central Motorway Police Group and three members of staff from Highways England.

**What work is being carried out to tackle ignoring signs and signals?**

- A review of VMS policy particularly with regard to inaccurate messaging which leads to non-compliance and signing for severe weather.
- The roll-out of technology with regard to the detection of close following. Close following equipment should also be able to detect lane hogging
- Red-X and hard shoulder misuse – Survey work has been undertaken on the awareness of Red-X. The use of targeted warning letters for non-compliance. Red-X non-compliance will be enforced by the end of 2017.
- National Driver Offenders Rehabilitation Scheme (NDORS) Smart Motorway course is being introduced. Survey of customers that had been on course has been conducted. Customer Focus is designed to provide insight rather than evaluate interventions.

**What work is being carried out to change driver behaviour?**

- Recent education campaign delivered within Berkshire County Council. “Blazed and Wasted” campaign – very much a traditional road safety campaign taken to various events where people were more likely to be drinking and drug taking. Target audience was young males. Evaluated based on behavioural intentions, heightened awareness of risk. No control group.
- Cameras are being fitted in 200 traffic officer vehicles. Implementation of better detection of incidents aimed towards more accurate signage and subsequently better compliance.
- Not wearing a seatbelt often goes undetected. Vehicle technology could be introduced to stop the vehicle starting unless the seatbelt is fastened but a recognition that technology can be bypassed. Education may assist. An on-line course for offenders is not a sufficient deterrent and has not been evaluated as to its effectiveness.
- The effectiveness of education especially the proposed new Motorway course delivered by NDORS is not known. Evaluations have shown that most people enjoy the courses but
effectiveness for behavioural change is not established. There was discussion around Environmental Speed Limits and how these can be communicated (first one implemented on M1).

- Distraction was considered a key behaviour amongst HGVs drivers. Customer insight has identified HGV close following as a key issue. Lane discipline was discussed in association with HGV close following with behaviours tending to cluster together.
- The view was expressed that fatigue-related incidents amongst HGV drivers seem to have declined.
- Discussions focussed around lane hoggling and close following and whether this is an issue in relation to KSIs. Consensus was that this is more of an issue for congestion, journey time reliability than KSIs per se.
- Discussions focused around towing, tyre pressure and running out of fuel. There are reported incidents of fatalities related to running out of fuel according to certain participants.

What are some best practice ideas that may have an impact on KSIs?

The workshop discussed smart Motorway as a package that should include a programme that considers design, monitoring behaviour, campaigns etc. to tackle non-compliance. Vehicles could be fitted with equipment that allows windows to be smashed / seatbelts cut in case of an incident where the occupants are trapped. Discussions around potential interventions took place such as smart-phone based telematics and text messaging and black box technology as a method of improving driver behaviour.

Practical constraints to impacting an intervention based on enforcement?

Lack of road policing resource has a significant impact on the ability to enforce the traffic rules. There was discussion around possible partnership working. Highways England could target low level non-compliance to leave the police to target high level non-compliance.

Quick wins / Added Value?

- Dealing with speed – a catalyst for other things and there are already tools available
- High penalties for not wearing seatbelts
- More road police officers
- More targeted use of penalty fines

WORKSHOP 3: 3rd April 2017

This workshop included representatives from the British Horse Society, the DfT on behalf of policy heads in RULIS and two members of staff from Highways England.

What work to tackle KSIs is being carried out?

DfT’s interventions are based on legislation and campaigns. Behaviour change campaigns are being targeted at young drivers. There is work ongoing in relation to hazard perception training. Highways England’s current work to detect close following was also discussed. There have been off-road tests but on-road tests have still to commence. Baseline data will be collected to allow evaluation.

What work is being carried out in relation to Drink and Drug Driving?

Recent education campaign delivered within Berkshire County Council called “Blazed and Wasted” campaign – very much a traditional road safety campaign taken to various events where people were more likely to be drinking and drug taking. Target audience was young males. Evaluated based on behavioural intentions, heightened awareness of risk. No control group has been used.
A drink driving re-offenders course to include drug driving is being trialled by DVSA. A pilot has been observed to see if drivers convicted of drink driving offences object to drug driving also being included. Risk Solutions is carrying out an evaluation of the drug driving offence and whether it changes behaviour.

What interventions are available that can impact on Distraction whilst driving?

Cameras are being fitted in 200 traffic officer vehicles but there is little appetite amongst police forces to deal with offences unless there is evidence that a major incident was caused. It is understood that Highways England may be looking at a project that captures all available information on the use of mobile phones in vehicles.

Are there any innovative interventions that you are aware of?

- Changing driver behaviours around efficient driving which has a knock-on effect of reducing aggressive acceleration and potentially claims and KSIs. LightFoot funds from Innovate UK looking at the roll-out of efficient driving to a wider audience as it has been successfully used in fleet driving. The Energy Savings Trust work looking at the safety benefits around efficient driving.
- British Horse Society is launching a Ride Safe Award. Part two of the campaign is to educate riders to appreciate / acknowledge good driver behaviour along with adopting other good habits such as wearing high visibility jackets. There are however no plans to evaluate the approach. British Horse Society also collects data around horse/rider-related incidents and is to commission TRL to assess the data.
- The use of Virtual Reality to improve driver behaviour will be the topic of research funded by the DfT.

WORKSHOP 4: 3rd April 2017

This workshop included representatives from the MIB, RSGB, CIHT and the National Fire Chiefs Council including two members of staff from Highways England.

What different interventions are being used to tackle distraction?

- Highways England is supporting the DFT’s mobile phone use campaign and will use the messages developed by DfT through its own channels.
- Insurance ‘black box’ technology appears to be having a positive impact on young people.
- Campaigns are targeting not only the driver but also those who influence the driver; passengers, parents.

What can be done to influence driver behaviour?

- Parents could be encouraged to lead by example in carrying out vehicle checks.
- Discussion around vehicle technology and the negative impact that this could have on vehicle checks being carried out. Mismatch between vehicle manufacturers and highway infrastructure design.
- An expectation and awareness of getting caught appears to be more powerful than the penalty.
- Camera evidence used to convict more offences would be a very quick win.
- Police seizure powers for uninsured vehicles had a huge impact when introduced but is becoming diluted as police manpower is reduced.
- DVLA is not feared.
- As interventions are found to be effective there needs to be investment to ensure that they are kept relevant.
Enforcement should be sold as a customer service to Highways England.
Education should start at a very early age.
Enforcement can work and its effectiveness is measurable. The effects of engineering are also measurable. Education is a key part but delivery needs to be common, effective and proven.
Highways England advertising campaigns for safer driving

**WORKSHOP 5: 7th April 2017**

This workshop included representatives from MCIA, CFOA and four members of staff from Highways England.

**What can be done to reduce inappropriate speed?**

- Speed limits should be set appropriately and rapid changes to speed limits should be avoided gantry to gantry.
- Trust is a big factor for Highways England as customer insight shows that messages are not trusted.
- There is a Signal Setting Review exercise due to take place within Highways England during 2017.
- A discussion around speed limits in roadworks and safety when travelling at 70mph where fixed vario-guard barriers are in place.
- A trial is currently underway to capture customer reactions to 55/60mph speed limits in roadworks.
- A guide to Road Safety Route Treatments aimed at non-motorway routes is available.
- The guide highlights the difficulty in obtaining data that is conclusive that speed is a contributory factor.
- Cheshire Fire and Rescue Service school sessions to address speed has been evaluated but not robustly.

**Inappropriate driving for the conditions – weather-related.**

The workshop participants noted that inappropriate driving for the conditions can include driving too slowly as well as too quickly. An automatic reduction of speed limit in heavy rain was suggested. Segmentation was discussed and the findings of the work is used to target campaigns within Highways England. There is the potential for an intervention around the way companies’ approach driving in bad weather conditions with their employees by cancelling meetings, and the choice of venue for events.

**What can be done to influence the fleet driver behaviour?**

- Large companies have structured fleet risk management policies in place but smaller companies may not have the same approach.
- Large operators are already doing the right sort of thing – some more than others - but smaller operators need to be educated.
- HSE does not investigate road accidents in relation to work-place deaths.
- Highways England is embodying a Safe Systems approach but Safety Leadership can make a big difference.
- Risk assessment is not carried out properly. Tyre tread checks have been carried out at the entry to MSAs could be used in poor weather conditions.
- The Tyre Safe Campaign was discussed as an example of good practise.

**What interventions are you aware of around vehicle roadworthiness?**

- The workshop participants considered that running out of fuel could be made a criminal offence as there have been fatalities linked to this.
- Significant behavioural issue around vehicle road worthiness
• Highways England recent vehicle check campaign has not been received very well by some customers.
• The driving test could be used to introduce vehicle checks.
• The MOT could be a touchpoint for drivers to educate them on vehicle roadworthiness all year round.

What interventions are you aware of around drink and drug driving?
• There was a discussion around hard hitting campaigns such as the campaign depicting a pile of coffins in Thailand and a car wreck left by the side of the road.
• Cheshire FRS has a ‘Think’ car in which an actual vehicle involved in a fatal collision.
• The participants mentioned some videos used in Northern Ireland that includes a conversation with young people around the contents of the film and what can be done to avoid the situation.
• Behavioural Change courses are run by RSGB and used to educate road safety education staff as to how best to pass on the message.

What interventions are you aware of around fatigue?
• Highways England looking at a specification for rest areas on Expressways.
• DMRB standard for lay-bys will also be updated.
• No work being undertaken in relation to alignment design in relation to fatigue.

What interventions are you aware of to address driver behaviour?
• Discussion around Red-X and hard shoulder misuse and whether the compliance campaign is adding to congestion.
• Compliance Monitoring Tool – map-based portrayal of the Smart Motorway network with data back to 2015. Phase 1 is complete and Phase 2 is underway. Base data is available to allow evaluation of campaigns to take place.
• Use of ‘merge like a zip’ signage to overcome late merging issues.
• Issues around unclear signage need to be addressed.
• Middle lane hogging campaign questioned – does this behaviour cause KSIs?
• Close following is to be monitored on M3 and warning letters issued.
• Discussion around close following and the use of chevrons on M56 – chevrons are not spaced correctly for SSD at 70mph.
• Lane discipline – use of median / centre line measures to stop cross over is also relevant to fatigued driving.
• The use of average speed cameras to improve journey reliability as well as a reduction in KSIs.
• Journey planning is not generally undertaken – most customers expect to be told of problems during the journey.

Summary findings from one-to-one Interviews

1. Measuring the effectiveness of the interventions

There were many different interventions mentioned by those interviewed (see Appendix B). However, when asked for details regarding the effectiveness of their interventions, in relation to reducing the number of KSIs, very little evidence was reported. There were no Randomised Controlled Trials (RCT) reported, which are the gold standard for evaluating interventions. The most common responses to this question were that they: had not directly evaluated their interventions (n=4); used surveys or happy sheets (n=7); or they relied on social media “hits”, downloads, press interest, or other methods of identifying interaction with the public, such as the number of followers (n=4). Claims data was
mentioned by one participant, another reported using case studies, while another mentioned an evaluation which involved assessing actual driving behaviour before/after the intervention, but this included a small number of drivers, there was no control group and behaviour was only measured immediately after exposure. There was also evidence mentioned regarding speed cameras. Finally, an evaluation of NDORS was also mentioned by one of the participants, but this evaluation is planned to be completed in 18 months.

2. Practical limitations affecting the effectiveness of interventions

The most common limitation mentioned (n=5) was being able to evaluate any impact of the interventions stakeholders were engaged in delivering on actual driver behaviour. This was followed by problems with the lack of funding available for evaluation (n=6) and related to that, getting funders/senior managers interested in evaluating the intervention. Finally, one participant mentioned they had difficulties getting enough staff/contractors to carry out the intervention.

3. How stakeholders work with Highways England

Most of the participants reported that they collaborate with Highways England by helping to promote their campaigns and advice on social media (n=6). Three respondents reported that they were on committees and forums with Highways England staff, one respondent reported that they worked very closely with Highways England during campaigns (at an early stage) and one reported having a very good working relationship with Highways England already. Most of the participants were already working with Highways England (n=9), with one stating that they could not do more and the remaining eight reporting that they could engage more closely with Highways England. All of the remainder (n=4) who answered this question stated that they would be very happy to engage with Highways England more closely (n=5).

4. Working with Highways England to give added value

There were only three responses to this question. Firstly, it was mentioned that stakeholders could work together to mutually promote interventions and messages, particularly those related to the Strategic Road Network. Another comment was that Highways England could help them to feed information to their customers when they are most susceptible to road safety messages (e.g., when getting an MOT). Transition points onto the roads leading onto the SRN were mentioned in one interview as a way in which a closer alliance with Highways England could be beneficial. Several other comments were made regarding obtaining funding from Highways England (n=3) for various road safety activities.

4.6 Conclusions

The stakeholder engagement phase of this research investigated the nature of the interventions stakeholders are delivering to tackle priority non-compliant behaviours. However, virtually no evidence was presented that these interventions have changed driver behaviour and led to KSI reductions. However, some interventions with evidence of effectiveness were investigated further including Safe Drive Stay Alive, Highways England’s Compliance Monitoring Tool, in-vehicle technology and the Van Excellence code among others. Several stakeholders also discussed the importance of enforcement and how this could be improved via Highways England. Hazard perception skills for safer driving were also mentioned as well as the need for a well-structured national campaign to increase awareness of appropriate behaviour on the SRN for target groups. Implementation plans will focus on selecting interventions that have an evidence-base and enable a joined-up approach taking into account existing work undertaken by stakeholders to address driver behaviour.
All stakeholders expressed a willingness to engage with Highways England and this research has led to closer ties as well as a better understanding of the kinds of interventions that are being undertaken both internal and external to Highways England. That the overwhelming majority of interventions mentioned had not been evaluated is a challenge when it comes to recommending what can be implemented to improve KSIs on the SRN. The following literature reviews for the eleven key driver behaviours will consider the interventions presented by stakeholders to investigate whether there is supporting literature for effectiveness for changing driver behaviour.
5.0 Inappropriate Speeding Behaviour

Inappropriate speeding behaviour can refer to both excessive speed and driving too slowly. Inappropriate driving in bad weather is covered in section 13. Exceeding the speed limit and excessive speed is a behaviour that has been associated with fatalities on the SRN.

5.1 Impact of Inappropriate Speed

In 2015 inappropriate speed was a contributory factor to 436 road deaths, 28% of the total. Sixteen per cent of fatalities (247) had ‘exceeding the speed limit’ as a contributory factor in the accident, and a further 12% (189) had a vehicle ‘travelling too fast for the conditions’ (DfT, 2016). Evidence from a variety of sources, e.g. in-depth accident investigations, conviction data, and self-report surveys, indicates that male drivers and young drivers are more likely to speed. Analysis of in-depth accident data found that male drivers under the age of 30 were over-represented in speed-related collisions, and this was particularly so for males aged under the age of 21.

Excessive speed for the circumstances (leading to loss of control and failure to timely spot hazards) is a high-level risk factors. It has been estimated that speed is a factor in 30% of crashes (OECD/ECMT report on Speed Management). It also increases the severity of the consequences of a crash, both for those in the vehicle(s). However, speeding is common across all road types. A 30-minute online survey was conducted by the RAC in mid-May 2016 with 1,714 motorists in the United Kingdom (UK). The sample of interviewed motorists was nationally representative in terms of age, gender, socio-economic group, UK regions and car ownership (private vs. company car). The survey found that the tendency to speed is increasing every year with 70% admitting to speeding on the motorway in 2016 compared with 67% in 2011. The findings showed that men were more likely to report speeding (77%) as were people aged between 25 and 44 (73%). Higher socioeconomic grouping was more represented across those who reported speeding (76%) as were those road users driving over 10,000 miles per year (83%). Over 90% of those who drive under the influence of alcohol also reported speeding.

Even in countries which have made significant investment across a number of different types of interventions to shape behaviour, it could be argued that more innovative attempts to educate and inform road users could be implemented. More of the same type of interventions may only achieve marginal improvements in speed-related Killed or Seriously Injured (KSIs). It has been argued that if speed could be reduced by just 1-3 mph there could be 10%-30% reduction in collision injuries (Molin and Brookhuis, 2007).

5.2. Speeding Interventions

There have been widespread attempts to change speeding behaviour amongst drivers and these include legislation, speed limit enforcement, incentives, educational interventions and in-vehicle feedback technologies. Effective speed management policies are likely to include an integrated package of measures, including credible speed limits, enforcement, education and engineering. Different approaches and messages are likely to be required for different segments of the driving population.

Interventions can be categorised according to the three ‘E’s’ of traffic safety; Engineering, Enforcement and Education. From an engineering perspective, we know that properly signed, maintained, lighted, smartly designed roadways, vehicles, in-vehicle technology and their safety systems contribute to traffic safety. Road engineering interventions are preventative measures involving physical engineering or structural changes to the road layout or road design that directly...
affect road user behaviour and have the potential to prevent road traffic injuries among the most vulnerable.

Enforcement of traffic laws and regulation interventions refer to setting up road safety rules and ensuring compliance from road users through legal enforcement. These include, for instance: speed cameras, speed limits, speed zones, red light enforcement cameras, use of daytime running lights for two-wheelers, mandatory use of helmets, traffic signal regulation etc. Examples of a combination of engineering and the enforcement of regulatory and legislative interventions include: speed limit enforcement with speed reduction measures.

Engineering interventions and regulatory and law enforcement interventions affect the road environment and minimize vulnerable road user exposure to road traffic injuries by reducing the amount of energy; by preventing the inappropriate release of energy in the environment; by interposing a physical barrier or separating the released energy from susceptible structures; and by strengthening the legal framework on road safety rules and regulations.

Road safety education covers all measures that aim at positively influencing driver behaviour by promoting of knowledge and understanding of traffic rules and situations, via an improvement of skills through training and experience and/or strengthening and/or changing attitudes towards risk awareness, personal safety and the safety of other road users.

Most interventions designed to reduce speed rely on engineering and enforcement with the research evidence being quite good. For example, speed cameras have been found to reduce speeds by approximately 5mph. Vehicle activated flashing signs can reduce speeds by around 4mph. Sign only measures seem to lead to an average 2mph reduction in speed, (which is reduced to 1mph in 20mph zones). Areas with signs-only limits, public awareness and enforcement campaigns can lead to a further reduction of around 3mph according to the road safety charity Brake.

5.3 Engineering Interventions

Turner et al (2009) make a distinction between primary and supportive road safety treatments. Primary treatments represent an important step towards a Safe System and supportive treatments provide incremental safety gains but not to a level that would create a Safe System. An example of a primary treatment might be a median barrier that will mostly eliminate fatal head-on crashes by preventing overtaking, while a supportive treatment would be a wide centreline with rumble strips that will make them less likely. Primary treatments should be employed where possible.

There are many interventions from an engineering perspective that attempt to reduce speeding behaviour. An error resistance approach identifies ways of preventing users from making errors leading to serious injury or death. This approach relies heavily on changes to the infrastructure through improving road surfaces, road layout and installing barriers. For example, roundabouts are used for higher speed traffic and operate as a speed management device. The highest risk of fatalities and serious injuries occur on rural roads due to the high variation in speeds and road design.

One approach is to improve error tolerance for rural roads by removing static hazards but effects tend to be incremental. Another approach is to encourage safer vehicles. While occupants of private cars are over-represented amongst KSIs vulnerable road users (VRU) such as motorcyclists, fleet drivers, pedestrians and cyclists have relatively high crash rates and often not fully integrated into road engineering design. Lower traffic speeds, vehicle safety features and greater separation of road users are some of the developments to improve the situation for VRUs.
On the other end of the spectrum sit measures that address infrequently occurring but dangerous situations (where safety margins become very narrow): In-vehicle technology (e.g. Anti-lock Braking Systems (ABS), Autonomous Emergency Braking (AEB) and Electronic Stability Control (ESC). AEB is an advanced safety technology that can help drivers avoid or mitigate collisions with other vehicles or vulnerable road users. Multiple real world studies including a recent report from the Insurance Institute for Highway Safety in the United States show that AEB technologies can reduce injury claims by as much as 35%. AEB systems use forward looking radar, cameras or optical sensors or a combination of these sensors to help quickly and accurately detect impeding vehicles, pedestrians and potentially other obstacles. That information can then be used to apply the brakes to provide up to one g deceleration of brake force in an effort to avoid or mitigate collisions. AEB helps provide constant monitoring of the road ahead and is designed to assist the driver by automatically applying the brakes if they do not respond in an imminent crash situation.

ESC is the most significant advance in vehicle safety since the introduction of the seat belt and one of the most important crash avoidance systems currently available. In the European Union (EU), where ESC became a mandatory requirement in all new cars from 1st November 2014 it is estimated that since 1995 at least 188,500 crashes involving injury have been avoided and more than 6,100 lives saved by ESC. ESC is now mandatory in Australia, Canada, the European Union, Israel, Japan, New Zealand, Russia, South Korea, Turkey and the USA and will soon also be in Argentina. However, Global New Car Assessment Program (NCAP) believes that the current ESC global fitment rate of just over 60% of new passenger cars and light duty vehicles is too low and wants this to be raised to 100% by 2020.

Other engineering interventions use gateways or threshold treatments to mark a change in speed environment and often include road markings to narrow the perceived width of road, the installation of large speed limit signs, etc. These types of engineering interventions influence driver perceptions and thereby encourage safer driving. Drivers tend to travel faster on wider roads, as roadway narrowing and treatments at bends can increase the perception of risk. Small changes such as narrowing the perceived lane width using painted markings can lead to somewhat slower speeds. Kennedy et al (2005) state that "Reduced speeds might be generated by: more complex environments (greater cognitive load); enclosing a distant view; breaking up linearity; creating uncertainty; increasing roadside activity; emphasising a change of environment (e.g. village boundary); or making use of the properties of natural traffic calming (e.g. winding road)". Perceptual techniques which make the environment seem more complex or less safe (i.e. they increase perceived risk and not actual risk) include traffic calming works with a number of design elements, such as: context; scale; proportion; roadside activity; and road surfacing. Reduction in speeds at treatment locations, with corresponding reduction in crashes have been reported Kennedy et al (2005).

5.4 Effect of Telematics on Reducing Speed

Telematics is a compound word that combines Telecommunication and Informatics. Vehicle telematics is the technology of sending, receiving and storing information via telecommunication devices in vehicles. It is a wireless data service that allows for the exchange of information through computer systems, wireless communication technology, Global Positioning Systems, and Text to Speech technology. As such, it is somewhat of a catch-all term covering many diverse technologies to collect data and enforce behaviour to improve safety, monitor activity, increase economy and reduce insurance premiums. This section will focus on In-Vehicle Event Data Recorder (EDR) or “Black Box”
telematics and their potential impact on speeding when associated with some form of incentive such as a reduction in insurance premium or cashback.

Horrey (2012) suggests various types of data may be collected via telematics for monitoring driver behaviour, such as, vehicle speed and location, acceleration and braking patterns, and fuel consumption. Some systems provide video of the traffic environment as well as inside the vehicle, to provide details surrounding critical triggering events. Also, what drivers are doing can also be monitored, including instances of seatbelt non-compliance, inattention and distraction, fatigue or other behaviours or driver states (e.g., Misener et al., 2007). Many devices utilise custom algorithms, based on monitored inputs, to determine whether or not a critical event has occurred. Summarising studies of both commercial and private (teen) drivers Horrey concludes that there is a positive shift in behaviour along a number of variables, such as reduced collision rate, fewer trigger events such as speed and lower vehicle damage and claims cost for fleet companies.

Hickman and Hanowski (2001) reported 37% and 52% reductions in safety-related events per 10,000 miles in two commercial carriers following implementation. Similarly, Lehmann and Cheale (1998) found crash reductions of up to 30% for fleet drivers after the implementation of monitoring systems. However, a few studies offer evidence that the effects of the intervention are not sustained indefinitely — the rates return to pre-treatment levels after a period of time, which varies across study (ranging from 4 to 10 months in the reported studies; e.g., Toledo and Lotan, 2006; Musicant, Lotan, and Toledo, 2007). So whilst the studies do suggest an improvement, it can decline if methods are not used to increase and sustain buy-in to the method.

The Effect of Telematics and Insurance Incentives on Driver Behaviour

There is some evidence that monitoring driver behaviour via a black box/smartphone and increased parental supervision can significantly reduce risk for the young novice driver. Simons-Morton et al. (2011) in a study using recording systems that collected data on driving performance and occupant characteristics during their first 18 months of licensure found that the presence of adults reduced crash/near crash rates by 75%. However, crash/near crash rates were very much higher in teenagers with risky friends suggesting that risky driving may be socially influenced and so may be significantly reduced by the correct supervision and monitoring.

A number of insurance companies have emerged that utilise schemes to offer differential insurance rates to young drivers. Companies such as Ingenie, DirectLine, Co-operative insurance, Fair Pay insurance, IKube and many others offer schemes that require the fitting of in-car recorders or downloading an app for their smartphone to monitor speed etc. in order to qualify for more favourable premiums. Ippisch (2010) suggests that there are three possible advantages of telematics within insurance; all of these are particularly relevant to the young driver who normally suffers from very high premiums. More risky drivers are likely to change their behaviour as the possibility of increased premiums becomes a reality. Finally, bad drivers not prepared to change will leave for another company or be forced out as a penalty for driving badly (Ippisch, 2010).

A study evaluated whether Pay-As-You-Drive (PAYD) insurance improved young driver safety (Bolderdijk et al., 2011). PAYD delivers incentives for safe driving and penalises unsafe driving. Prior to the start of the study, participants’ cars were equipped with GPS devices and participants were randomly assigned to a financial incentive or control group. The experiment comprised four phases, pre-measurement, intervention phase 1, intervention phase 2, and post-measurement. During pre-measurement (November–December 2008) and post-measurement (May–June 2008), participants’ driving behaviour was monitored, but had no financial consequences. During the intervention phases,
participants in the incentive group could earn a reward for adapting their driving behaviour (a discount on their insurance premium of up to 50 Euros per month). Participants in the incentive groups could track their performance during the intervention phases by logging into a personalised website to show their speed violations, mileage, and night-time driving, along with the discount they would receive if they continued to drive in the same manner as the previous week. Participants in the control group were told that they would always receive the maximum discount of 200 Euros at the end of the experiment, irrespective of their driving behaviour. The control group did not receive feedback on their driving behaviour.

The intervention period was divided into two phases, each lasting two months (intervention phase 1: January–February 2008, intervention phase 2: April–May 2008). The monthly 50 Euros discount was divided into three components: 30 Euros was designated as a reward for keeping to the speed limit, 15 Euros for reduced mileage, and 5 Euros for avoiding driving at night during the weekend. The maximum discount participants could earn during the two intervention phases was 200 Euros. Participants received penalty points based on the average speed over fixed intervals, along with mileage and night time driving. The more penalty points participants collected, the lower their monthly reward for keeping to the speed limit. Excessive speeding (driving 20% over the speed limit) as well as speeding during the weekend night-time hours incurred extra penalty points. The GPS devices allowed the researchers to test the effects of PAYD on actual speed choice, rather than speeding attitudes, intention, or self-reported behaviour.

Analyses showed that, relative to pre- and post-measurement, as well as the control group, the introduction of a PAYD insurance incentive significantly reduced speed violations with the strongest effects on 50, 80 and 100 km/h roads. No effects were found for mileage and night-time driving. This may be because the largest reward was for not speeding. A small number of participants were interviewed who reported that reducing mileage and avoiding night-time driving were very difficult and therefore it was easier to change speeding behaviour. Only a limited number of participants visited the website during the intervention suggesting that feedback was not as important as a financial incentive.

In a field trial in Sweden using Intelligent Speed Adaptation devices (ISA) in-vehicle, drivers were given a 30% reduction on insurance premiums but if they drove over the speed limit this discount would be reduced. Feedback via ISA reduced the proportion of speeding more than the incentive alone, particularly on rural roads, but the discount also had a significant effect on speeding behaviour (Lahrmann, 2012).

5.5 Educational Interventions

Recent work, (e.g. Meirambayeva, et al., 2014) shows that speed-related crashes may be made up of a relative few people excessively exceeding the speed limit as well as the collective impact of a relatively large proportion of drivers exceeding the speed limit by a small amount (about 10km/h over the speed limit) (The International Transport Forum, 2016). A safe system and in particular educational interventions, would aim to target both groups of road users.

Educational Campaigns: Speeding

In a randomized controlled trial where speeding behaviour, goal intentions and theoretically derived motivational pre-cursors of goal intentions were measured at both baseline and at one month follow up, using self-report questionnaires (Brewster, et al., 2015). The study found that immediately after baseline, the experimental group (n=117) specified implementation intentions using a volitional help
sheet, which required the participants to link critical situations in which they were tempted to speed with goal-directed responses to resist the temptation. The control group (n=126) instead received general information about the risks of speeding. Whilst the experimental group reported exceeding the speed limit significantly less often at follow up than did the control group, this effect was specific to ‘inclined abstainers’ (over 45% of the overall sample of participants who reported speeding more than they intended to at baseline and were therefore motivated to reduce their speeding). However, there are potential methodological problems of using self-report as a proxy for driver behaviour (af Wåhlberg, et al., 2010).

A review of health behaviours (Fylan, et al., 2006) led to recommendations that highlighted the role of changing drivers’ perceptions of themselves as a speeding driver and to formulate and rehearse reactions and behavioural responses to specific situations in which they might speed. The report recommended that speeding interventions concluded that might be designed to:

1. Undermine the perception that speeding is associated with benefits – do you really get there quicker? Do you really get ahead of other traffic?
2. Promote the idea that there are costs, other than accidents, associated with speeding – less money to spend because of increased insurance costs or a speeding fine; having to rely on other people to drive you around because you are banned from driving;
3. Promote the idea that drivers have control over their speed and that barriers to driving slowly are easy to overcome – it is easy to take your foot off the accelerator; a skilled driver is one who drives at the appropriate speed; leave plenty of time to get to your destination;
4. Undermine the effect of normative pressure on driving fast – how ‘cool’ is it to drive fast to impress a friend? Are you sure your mates are really impressed by your fast driving? Are you one of the herd or are you a skilled driver who adopts an appropriate speed?
5. Promote the affective benefits of driving more slowly – feeling less anxious; feeling in control.

In a review of speeding interventions by Fylan et al (2006) a number of approaches outlined below show wide-ranging differences in the combination of approaches used in the interventions reviewed. These approaches were found to map onto several of the models of health-related behaviour:

1. Information and education (cognitive strategies) are provided by a number of the speeding interventions, which examine the principles of good driving, facts about speeding (including statistics) and hazard perception
2. Enforcement messages are also used, which focus on the consequences of speeding (e.g. fines, speed cameras) and may include presentations by police officers
3. Instruction, modelling or skill rehearsal are included in some of the speeding interventions which have a practical component involving a driving session with an instructor and also which focus on situations where maintaining the speed limit can be viewed as difficult. Such interventions may also include a demonstration drive to show more appropriate behaviour.
4. Attitudes are targeted by a number of the courses that focus on participants’ perceptions of the acceptability of speeding
5. Framing is covered to some degree by interventions that focus on the negative outcomes, and this may include a talk from a paramedic who has attended a road-side collision, a victim or a relative of someone who has died or information from a police officer
6. Barriers are tackled by interventions that focus on the excuses provided by clients regarding their speeding behaviour (e.g. did not see speed limit sign, did not know the road). This is most likely to be an interactive approach and may offer the opportunity for joint problem-solving.
7. Attributions are targeted by interventions that focus on responsibility awareness, and that the driver (rather than employers or other road users) is responsible for the speed at which he or she drives
8. Reminders are provided by some of the speed interventions in the form of booklets, key rings, etc., mailed to drivers some months after their attendance on a course. These remind drivers about the course content to encourage adherence to the speed limit.

Elvik in his study (2016), based on a theoretical perspective underpinning road safety campaigns, came to the conclusion that road user behaviour is subjectively rational and suggested that campaigns should be developed using bounded rationality. Elvik also suggested that driving violating behaviour can be expected of road users as these can be regarded as apparent failures of rationality – something that drivers are motivated to avoid. For example, an apparent failure of rationality is one that road users can discover on their own or readily agree with if told by others. Such failures of rationality include. Based on this model, Elvik (2016) proposed several ways how to motivate the road users to change behaviour by making them aware of the deviations from rationality:

1. **Unconscious errors.**
   A large part of road user behaviour is automated. Automated behaviour does not require conscious choices to be made; it simply unfolds naturally without requiring effort. In a Danish trial of Intelligent Speed Adaptation (ISA; Lahrmann, 2012), drivers were informed by a voice message when the speed limit was exceeded. The system was informative only and did not prevent speeding. It was nevertheless found that the message alone reduced speeding. These example shows that by informing drivers about errors they may not be aware of committing, one can influence behaviour.

2. **Not choosing the best option.**
   A common failure of rationality is to succumb to a temptation a driver knows should be resisted. Driving home when alcohol has been consumed is an example. In the short run, it is usually judged to be the best choice. Alternative transport may be difficult to obtain, and is likely to be more expensive and take longer. Moreover, the driver will need to go back to get the car later. These are hassles one avoids by simply driving home. If road users accept that their choices were not the best, even if no adverse consequences arose from them, it is possible to motivate them to avoid repeating choices they may regret.

3. **Wishful thinking.**
   Wishful thinking denotes beliefs that are influenced by desires; beliefs one holds because it is pleasant to hold them, not because there is evidence to support them. Wishful thinking is a very common deviation from rationality, but road users may not realise they are victims of it. Most road users have a positive self-image. Elvik believes the only way of eliminating such thinking is by getting involved in difficult situations one would have avoided by adopting a larger safety margin.

4. **Lack of knowledge.**
   If a road user is highly motivated to perform a certain behaviour, but fails to do so correctly, informing the road user about the correct way to perform the behaviour can have a large effect.

5. **Failures of co-ordination.**
   Road users need to co-ordinate their actions to avoid accidents and thereby prevent unnecessary delays in traffic. When road users fail to do so, they are likely to notice it and be motivated to adopt a more optimal behaviour.

These factors could be taken into account when designing a campaign to reduce speed on the SRN.

**Young Driver Education**

An intervention delivered to those attending a number of driving schools at the two biggest cities in Estonia was evaluated by Paaver et al, (2013). The control group (n=517) consisted of young learner drivers attending the same driving schools, but received no additional intervention. The intervention group (n=1058) took part in a session that included a 45-minute lecture and 45 minutes of group work conducted as a regular driving school lesson. The intervention focused on impulsivity as a personality
feature and an information processing style that is partly biologically determined and associated with risky behaviour in traffic. The aim was to enable young people to recognise impulsive tendencies in themselves; potential situational factors triggering impulsive behaviour and asked to identify situations in which they were likely to behave in an impulsive manner or to take risks such as driving too fast. A cognitive behaviour therapy approach was taken to teach self-regulation and self-monitoring techniques. In the group section of the intervention participants were asked to complete a task which involved: identifying the psychological factors involved in motor vehicle crashes; estimating their own risk for this kind of crash and generating ways to decrease the risk.

The outcome measures were crashes and traffic infringements which were recorded by the police and the traffic insurance databases over the 12 months following the intervention. The intervention group had almost half the number of traffic violations for speeding as those in the control group and this difference was much larger for those with low and medium levels of impulsivity (those high in impulsivity were less affected by the intervention). There was no difference between the groups for crash involvement, but the sample size was quite small and the intervention quite short. The main weaknesses of this study are that the period of data collection should have been longer, as the large difference in the number of violations indicate that there was a difference in the driving behaviour for the treatment group, but this was not reflected in the crash statistics.

Glendon and Walker (2013) conducted a study with 83 young drivers aged 18 to 25 years in Australia who completed a questionnaire measuring typical and recent speeding behaviours. Participants reported their reactions to 18 anti-speeding messages used on Australian roads and 18 new anti-speeding messages developed from the Protection Motivation Theory (PMT) on the perceived effectiveness of the message for themselves and for the general population of drivers, and also the likelihood of themselves and other drivers driving within the speed limit after viewing each message. Overall the PMT model-derived anti-speeding messages were better than jurisdiction-use anti-speeding messages in influencing participants’ reported intention to drive within the speed limit. Severity and vulnerability were the most effective PMT components for developing anti-speeding messages. The findings provided support for using a theoretical basis drawn from the literature on health behaviours as an effective foundation. However, this study used self-report measures of speed and would need to be replicated with a larger sample and use objective measures of speeding behaviour.

Safe Drive Stay Alive

Safe Drive Stay Alive (SDSA) and other variations along the same theme but with different names is a multi-agency intervention which is produced by a road safety partnership between the local councils and the emergency services. The SDSA campaign is designed to reach passengers, new drivers and pre-drivers in an emotive and hard-hitting way, in order to influence their attitudes and subsequent behaviours on the road. It is aimed at vulnerable road users including young pre-learner, learner and newly licensed drivers (17 to 25 years old) and involves a live show with video and testimonials graphically demonstrating the impact of a young driver collision. There are normally three speakers from the emergency services and two speakers who share their own personal experiences of loss or permanent disability. These speeches are also supplemented by pictures and a video re-enactment of a motor vehicle crash. The presentations are designed to be delivered in a local theatre over a period of one and a half hours.

SDSA aims to influence young people’s attitudes towards five risk factors (distractions, seat belt use, drunk and drug driving, speeding and peer pressure to drive in a risky manner). The overriding goal is
to increase awareness of their vulnerability on the roads, as well as the potentially terrible and serious consequences of driving (Poulter and McKenna, 2010).

Therefore, the SDSA programme relies on a combination of fear arousal and imparting knowledge of the consequences of being involved in a crash. Unfortunately, these approaches do not have solid evidential backing, particularly not as the sole behaviour change techniques (Fylan and Stradling, 2014).

The SDSA programme has been evaluated but this review concentrates on the most recent evaluation (Fernandez-Medina, et al., 2015), as previous evaluations have been of an older version of the programme (Ashworth, et al., 2007; Poulter and McKenna, 2010). The evidence surrounding the effectiveness of the programme comes mainly from a quantitative survey conducted by Fernandez-Medina and colleagues but also includes evidence from several focus groups. Twelve focus groups were performed with SDSA attendees, which showed that the students received the programme well and the programme was able to engage attendees through the personal stories and emotional impact. However, recall of the key messages was poor.

The quantitative survey used scales from the Driver Attitudes Questionnaire (Parker, et al., 1996), the Driving Behaviour Questionnaire (Reason, et al., 1990). The evaluation included a treatment group who attended SDSA and a control group which did not take part in SDSA. The treatment group was sourced from schools attending SDSA, while the control group was recruited via a research and marketing agency. The two groups of participants were surveyed once prior to the treatment group taking part in the programme, three to 13-weeks after SDSA attendance and lastly 4 to 7-months after attendance.

The results found no improvement for most attitudes and behavioural intentions investigated (e.g. mobile phone use, self-reported violations, the three aspects of peer pressure, or self-reported speed). It should also be noted that one of the three aspects of peer pressure had very low alpha reliability (0.562) and thus should not have been included in the evaluation. With regards to drink and drug driving, two of the three factors were unreliable (alpha = 0.550 and 0.554), and it was one of these unreliable factors which demonstrated a significant improvement. Finally, one of the two seat belt attitudes was also significantly different, with the SDSA group improving significantly, relative to the control group. The authors of the evaluation report state that there was little evidence that SDSA had resulted in any improvement in attitudes or self-reported behaviour.

The evaluation relied solely on self-report, which may be influenced by social desirability bias and the participants were not randomly allocated to the two groups, meaning that it is possible that the two groups differed in some important way which may have influenced the results. Indeed the researchers reported that the two groups were not equal on several variables. In addition there was a very large degree of participant attrition for both groups, meaning that it is very likely that the final sample were different in some important way from those who dropped out of the study. It should also be noted that the attrition rate is not clearly described in the report, but there were 183 in the control group and 784 from the treatment who only completed the first questionnaire and took no further part in the study. Finally, the large number of statistical comparisons means that perhaps any significant findings were simply due to chance.

More recently, innovative additions to the programme have been made notably by Surrey Fire and Rescue Services, Greater Manchester Fire and Rescue Service, Devon and Somerset Fire and Rescue Services among others. For example, Surrey and Greater Manchester Fire and Rescue Services work together across geographical boundaries delivering similar live ‘performances’ with similar aims,
objectives, formats, content and outcomes. In combination they reach large numbers of vulnerable drivers and passengers (22,000pa). A recent evaluation employed large sample sizes and consistently monitored self-reported behaviour over time. This evaluation also used a comparison group and the findings showed that many of the self-reported improvements in behaviour that were evident three months after the intervention were also present at 12 months. In particular the evaluation demonstrated improvements in social norms, attitudes and willingness to avoid risky behaviours such as speeding.

Fosdick (2017) evaluated SDSA using the format of a main presentation and 2-4 follow-up sessions using SDSA GM’s Follow-up Tutor Resource, and reported improvements in social norms, attitudes and willingness which persisted after 12 months. The difference in findings between studies examining single-presentation versions of SDSA and those with follow-up sessions indicates that follow-up is important in maximising effectiveness.

Building Resilience amongst young people

Sensserick et al (2009) suggested that interventions can be divided into ‘driver focussed’ programmes which focus on driving risks and ‘resilience focussed’ programs which focus more broadly on reducing risk taking and building resilience. ‘Resilience focussed’ in this context means arming young people with strategies to deal with potentially dangerous situations and encouraging them to make safe decisions. Programs that do build resilience have the potential to reduce road crashes (Senserrick, et al., 2009; Ivers et al., 2009). For example, the ‘Reduce Risk Increase Knowledge’ RRISK programme, which operates in Australia is resilience focussed and helps young people to adopt safe behaviours, giving them strategies that encourage safe driving, such as managing pressure from peers, checking how much a designated driver has had to drink and generally encouraging young people to make informed decisions about road safety. The programme aimed to empower young people with the knowledge, attitudes and skills to make informed decisions about drug and alcohol use as well as driving. Participants in the study agreed to the researchers having access to their police records relating to road safety (i.e. crashes and infringements). Therefore, the outcome measures for this study were the number of police recorded infringements and crashes, as recorded by the NSW Police, over an average period of two years (differed due to the fact that they got their licences at differing times).

The RRISK programme has been shown to reduce the risk of a crash among young drivers by 44% (Senserrick, et al., 2009). The findings are part of Australia’s DRIVE study of 20,000 young drivers, and offer some evidence that a resilience focussed young driver intervention, which takes a whole-of-community approach has had a positive effect on crash statistics. Senserrick et al. (2009) compared the RRISK programme to a one-day workshop that focused mainly on safe driving issues (n=1676). The programme was a community-based initiative to address young driver crashes, fatalities and injuries through the delivery of practical road safety education. The workshop involved community members, police, driving instructors, drug and alcohol educators, financial services and individuals recovering from a crash. The programme targeted an increased awareness of road safety issues and aimed to develop positive attitudes towards speed, fatigue, alcohol and seat belts.

The two groups were compared to a large cohort (n=20,882) of newly licensed drivers who had been recruited specifically to act as a control group, while minimising bias and ensuring substantial heterogeneity (Ivers, et al., 2009). Over the two-year follow up period, the two treatments groups did not differ from the overall cohort with regards to driving infringements (motoring offences/moving violations). Further, in line with the findings from Section 2, there was no reduction in the crash
involvement of those who had attended the driver-focused programme. In contrast the more general resilience focused intervention was associated with a 44% reduced relative risk of crash involvement. In addition, research using self-report also found significant improvements in knowledge, attitudes and behaviour, compared to those that did not attend the programme (Zask, et al., 2006). The authors conclude that programmes which focus more generally on reducing risks and on building resilience have the potential to reduce crashes (Senserrick, et al., 2009).

The Van Excellence Code for Safer Driving

Van Excellence is a scheme facilitated and managed by the Freight Transport Association (FTA) to recognise excellence and improve operational standards. At its heart is the Van Excellence Code which is a Code of Practice outlining best practice in van operations. The suite of training incorporates Operator Accreditation, a Small Fleet Programme, a range of events, a Guide to Van Excellence, a range of training courses, and FTA Van Services including consumables, inspections and telematics products. Van fleets are a difficult group to target and yet they are significant in their numbers and their exposure level on the SRN. The FTA Van Excellence initiative offers a practical framework against which van operators can measure their compliance with best practice standards, and benchmark themselves against comparable fleets with a view to improving safety and efficiency. The use of telematics as a core tool offers significant safety benefits by giving drivers real-time feedback and providing fleet managers with an objective data-driven report on their drivers' behaviour on the road.

Setting a standard and accrediting operators who meet that standard incentivises other operators to join. Offering an "in-group" identity, through use of a logo that accredited operators may use, which is associated with quality, safety and confidence in the user, encourages operators to incentivise their drivers to take part. The focus on cost savings that can come with adopting best practice procedures reinforces the appeal to fleet operators. A number of case studies are reported on the Van Excellence website indicating a positive impact on fleet driver behaviour.

5.6 Enforcement Interventions

Compliance with speed limits has improved in the past few years particularly on 30mph roads. The percentage of cars exceeding the speed limit has fallen on every road type since 2001. The number of Fixed Penalty Notices (FPNs) issued for speeding has also decreased over recent years, but this is in parallel with opportunities to complete a Speed Awareness Course rather than receive a FPN.
Spot speed cameras can be used to enforce speed limits at an individual location by monitoring the speed of vehicles when in view of the camera. Spot speed cameras can either be fixed or mobile and should be used as part of a combination of route treatment measures.

When the camera has detected a vehicle travelling above the posted speed limit, a photograph is taken which is then reviewed by a law enforcement officer and an infringement notice issued to the registered owner of the vehicle.

Some of the benefits associated with spot speed cameras include; a reduction in the instances of vehicles travelling in excess of the speed limit in the vicinity of the cameras and potentially an increased awareness to drivers that they are travelling in an area with a road safety issue.

Average Speed Enforcement Cameras (ASECs) are a route-based road safety treatment which is used to enforce speed limits along a route by monitoring a vehicle’s average speed between two locations. The technology can also be used to monitor journey times, bus lane enforcement and for congestion charging. An ASEC scheme consists of a set of cameras at the entry and exit points of a section of road with a time-stamped photo taken of each vehicle as it enters into the area. Automatic Number Plate Recognition (ANPR) software checks that the vehicle has not exceeded the sign posted speed limit, based on the time stamps and the known distance between the cameras. If an infringement has occurred then a law enforcement official will manually confirm the contravention before an infringement notice is issued to the registered owner. ASECs are only considered a mid-term solution until a permanent solution has been implemented, they should also not be applied as a standalone road safety measure and only introduced where there are speed-related collisions spread out along a route. The benefits of an ASEC scheme include a reduction in the number of collisions and casualties along a route and improvements to traffic flow and air quality. A number of evaluations originating from the UK have been conducted by Speed Check Services (now Vysionics), who are the primary manufacturer of average speed enforcement camera technology used in England, Scotland and Northern Ireland. These evaluations have investigated the impact of the approach on road crashes and related injuries in association with a number of installations across the country, typically using a naïve before-after analysis approach with pre- and post-implementation periods ranging from two to eight years. The results of these evaluations demonstrate a decreasing trend in KSI crashes after the installation of average speed enforcement in the magnitude of 33% to 85%. Reductions in minor injury crashes were also noted across a number of evaluations. However, it is important to note that statistical significance testing, the control of confounding factors (including regression-to-the-mean) and the use of appropriate comparison areas were absent from all these evaluations. Average speed
cameras encourage lower speeds over a prolonged distance rather than site-specifically, and considerable safety benefits are being observed (Soole, et al., 2013).

**Speeding Behaviour in Response to Enforcement**

Drivers who speed believe there is a lower chance of being caught than those who do not speed (Guppy, 1993), and the less chance drivers think there is of being caught, the faster they drive (Stradling and Campbell, 2003). Police enforcement produces only temporary changes in driver behaviour in which reductions in speed are mainly limited to times of deployment (Casey and Lund, 1993), and when drivers have passed the enforced area they speed up again (Shinar and Stiebel, 1986).

Drivers regularly adapt their speeding behaviour in the presence of speed cameras, and such behavioural modifications either at the site of the camera or otherwise more often than not lead to punishment avoidance as the speeding behaviour goes undetected. Research has shown that punishment avoidance can encourage continued offending (Freeman and Watson, 2006; Piquero and Pogarsky, 2002). Indeed, punishment avoidance may do more to reinforce speeding behaviour than punishment does to discourage it (Fleiter, et al., 2010; Fleiter, et al., 2007). Innovative approaches to speed enforcement that enable more widespread enforcement are required to reduce opportunities for avoiding detection and associated punishments.

An evaluation of new stringent penalties for street racing exceeding the speed limit by more than 50km/h in Canada that included an immediate seven-day vehicle impoundment, licence suspension prior to conviction. After conviction drivers could expect to receive a fine of between $2000 and $10,000, six penalty points, up to six months imprisonment and licence suspension for up to two years for a first offence. For second offences, drivers could lose their licence for up to ten years. An evaluation of this racing legislation showed a significant reduction in speed at three sites comparing before and after the new legislation was introduced. Modelling was applied to the monthly extreme speeding convictions in Ontario from 2003 to 2011, to assess the impact of the new legislation, separately for male drivers (intervention group) and female drivers (comparison group). The results indicated that per licensed driver, 1.21% of 16 to 24-year-old male drivers and 0.37% of 25 to 64-year-old male drivers had their licenses suspended between 2007 and 2011. This contrasts to female drivers: 0.21% of 16- to 24-year-old female drivers and 0.07% of 25 to 64-year-old female drivers had their licenses suspended during the same time period. A significant intervention effect of reduced extreme speeding convictions was found in the male driver group, though no corresponding effect was observed in the female driver group. Deterrence theory can explain these findings showing that certain, swift, and severe sanctions can deter risky driving behaviour (Meirambayeva, et al., 2014). Keall and Newstead (2013) took crash data from Australia and New Zealand and showed that high-performance vehicle owners under the age of 25 were nearly 70% more likely to crash than older owners of such vehicles. The authors estimate that a potential 0.4% to 2.5% injury rate reduction would be possible if young drivers could be restricted from driving high performance vehicles. In many cases, young drivers are deterred from driving high performance vehicles due to high Insurance premiums.

**Effect of Speed Cameras on Speed and Crash Involvement**

Speed cameras are effective in reducing speed and casualties in Europe (UK, Sweden and France) and in Australia and Canada. Twenty-six studies were evaluated for a pre/post reduction in the proportion of speeding vehicles and it was found that this ranged from 5% to 70%. Pre/post reductions of 50% to 65% were reported in the proportion of speeding vehicles travelling >15km/h over the speed limit. Compared with controls, the relative improvement was from 1% to 15% for average speed and from...
14% to 65% for speeding. All studies reporting crash outcomes reported an absolute pre/post reduction in all crashes and injury related crashes. In the vicinity of camera sites these pre/post reductions ranged from 14% to 72% for all crashes, 8% to 46% for injury crashes, and 40% to 45% for crashes resulting in fatalities or serious injuries. Compared with controls, the relative improvement in pre/post-crash numbers resulting in any type of injury ranged from 5% to 36% (Wilson, et al., 2006).

5.7 Conclusions

Exceeding the speed limit is one of the main contributing factors to road traffic crashes. Speed is a continuous driver behaviour in which levels of risk change dependent upon the level of behavioural input. Speed may be more amenable to behavioural interventions as shown across several studies (e.g. Brewster et al, 2015). While road engineering and enforcement can reduce driving speeds, their measurable effects are limited to those locations on the road network where they operate. Educational interventions (e.g., media campaigns) should have a wider influence on driver behaviour because they are designed to motivate safe driving. However, speeding is habitual and this may interfere with the process of understanding the risks of driving too fast. Converting motivations to avoid speeding into action is the biggest challenge for educational interventions. Recently, there have been some successful approaches in driver education, namely a follow-on element to Safe Drive Stay Alive and work undertaken in Australia on building resilience.

Recommendations

- An analysis of speed data collected from the SRN and its link with crash involvement would help to identify which aspects of speed to focus on when designing an intervention as well as being required for benchmarking purposes.
- An integrated package of measures, including credible speed limits, enforcement, education and engineering would support the introduction of interventions to tackle inappropriate speed on the SRN.
- One area that is rapidly growing is ‘black-box’ insurance schemes and could be promoted by Highways England as a method of improving driver behaviour on the SRN.
- Different interventions and messages may be required for different segments of the driving population on the SRN and these could be taken into account in an educational campaign.
- Educational campaigns could take into account bounded rationality to address driver motivations not to comply with the road traffic rules.
- SDSA with 2-4 follow-up sessions using Tutor Resource show improvements in social norms, attitudes and willingness which persisted after 12 months and is recommended as an educational intervention for young drivers.
- Resilience building amongst young drivers may also be a fruitful method for reducing speed-related KSIs on the SRN. Work to adapt content for a UK context is recommended.
- It is recommended that Highways England support the FTA Van Excellence Code to ensure more van operators are complying with better road safety standards.
- Average speed cameras encourage lower speeds over a prolonged distance rather than site-specifically, and considerable safety benefits are being observed. Further use of this technology is recommended.
- Innovative approaches to speed enforcement that enable more widespread enforcement are required to reduce opportunities for avoiding detection and associated punishments.
5.8 Speeding Intervention Matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address speeding and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘hug’.
Table 6 – Speeding intervention matrix

<table>
<thead>
<tr>
<th></th>
<th><strong>Hug</strong></th>
<th><strong>Nudge</strong></th>
<th><strong>Shove</strong></th>
<th><strong>Smack</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>Smiley SID ¹</td>
<td>Community speedwatch, warning letters ²</td>
<td>Traffic calming measures (highway engineering) ³</td>
<td>Penalties for speeding ⁴</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td>Wipe off 5 ¹⁹</td>
<td>Use of VMS to provide regular reminders to keep speed down ¹¹</td>
<td>Guidance documents explaining risks ¹⁰</td>
<td>Advertising illustrating potential consequences ⁹</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>A real-time in-cab verbal coaching device inthinc’s tiwiPro® ²²</td>
<td>Alerts in physical road environment ⁵</td>
<td>Average speed cameras ⁶</td>
<td>Speed cameras ²³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Road Safety Toolkit contains ²⁰</td>
<td>Road Safety Toolkit ²⁰</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Australian toolkit of engineering designs ²¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Educate</strong></td>
<td>Coaching and group discussions ¹⁶</td>
<td>Online coaching-based intervention modules ¹³</td>
<td>Telematics and behavioural analysis of excess speed incidents with feedback ¹⁴</td>
<td>National Speed Awareness ⁷</td>
</tr>
<tr>
<td></td>
<td>Developing driving skills amongst young drivers ¹⁸</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>Reward safe speed measured using telematics ¹²</td>
<td>App for parents to monitor their children’s driving ¹⁷</td>
<td>Driver monitoring and feedback using telematics ⁸</td>
<td>Cost minimisation for drivers detected as safe using telematics ¹⁵</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NETS employees speed awareness campaign ²⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Van Excellence Code ²⁵</td>
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</tr>
</tbody>
</table>

1. **Smiley SID**

Speed Indicator Devices (SIDs) alternating speed with smiley or sad faces have been used extensively since 2003. Transport for London (TFL) research found speed reductions in response to SIDs, but with a strong novelty effect, supporting the importance of changing sites regularly.
2. Community speedwatch, warning letters

Community Speedwatch is very popular in the UK but there is no joined-up evaluation of the programme available and no local authorities have published independent evaluations in the public domain. In the US, Blume et al. (2000) reported positive effects of a very similar scheme in their paper “The Effectiveness of a Community Traffic Safety Program”.

3. Traffic calming measures

Traffic calming measures have been in use since the 1970s, with most of the well-established versions (such as urban speed humps and chicanes, and open-road transverse rumble strips) consistently supported by evaluations, e.g. (Layfield and Webster, 1998; Othman, et al., 2015), and UK data-driven analyses and review of third party findings such as those reported by RSO at http://www.roadsafetyobservatory.com/HowEffective/roads/traffic-calming). Speed humps and raised platforms can be effective in ‘shoving’ drivers to slow down, especially in high risk areas with vulnerable road users. There are limitations of this type of intervention given that traffic calming devices can impede emergency vehicles and cause discomfort for some road users and some treatment designs can be hazardous.

4. Penalties for speeding

Penalties of three points, rising depending on severity of speeding event https://www.gov.uk/speeding-penalties and potential disqualification at 12 points under “totting-up”. Speed limit reviews need to reflect the function of a road and types road users and need to be realistic and so that drivers will be more likely to comply. Speed limits should be set in accordance with scientifically robust findings on human behaviour and performance, as well as human biomechanical tolerance limits. Speed limits are set based on popular opinion or by adopting the 85th percentile speed at which drivers choose to travel on a given road but a more well-informed decision based on the latest research such be made. New guidelines introduced to magistrates' courts across England and Wales from April 24th 2017 means that serious offenders could face a maximum possible penalty of £2,500 - a big jump from the current £1,000. Fines for motorists caught going well above the speed limit will start from 175% of their weekly income rather than the existing level of 100%. The new guidelines mean those caught driving at more than 101mph in a 70mph speed limit could be disqualified for up to 56 days. If caught going between 31 and 40mph in a 30mph zone drivers will get three penalty points and a fine of between 25 and 75% of weekly income.

5. Alerts in physical road environment

Gateways or threshold treatments mark a change in speed environment and often include pavement markings to narrow the perceived width of road, large speed limit signs and pavement markings and other features. These types of engineering interventions from a design perspective work to influence the driver perceptions for safer driving. Drivers tend to travel faster on wider roads so pavement narrowings and treatments at curves may work by increasing the perception of risk. Small changes such as narrowing the perceived lane width using painted markings can lead to somewhat slower speeds. French and Canadian black silhouettes of people who have been killed on the roads so pavement narrowings and treatments at curves may work by increasing the perception of risk. Small changes such as narrowing the perceived lane width using painted markings can lead to somewhat slower speeds. French and Canadian black silhouettes of people who have been killed on the roads so pavement narrowings and treatments at curves may work by increasing the perception of risk.

6. Average speed cameras

A number of evaluations originating from the UK have been conducted by Speed Check Services (now Vysionics), who are the primary manufacturer of average speed enforcement camera technology used in England, Scotland and Northern Ireland. These evaluations have investigated the impact of the approach on road crashes and related injuries in association with a number of installations across the country, typically using a naive before-after analysis approach with pre- and post-implementation periods ranging from two to eight years. The results of these evaluations demonstrate a decreasing trend in KSI crashes after the installation of average speed enforcement in the magnitude of 33% to 85%. Reductions in minor injury crashes were also noted across a number of evaluations. However, it is important to note that statistical significance testing, the control of confounding factors (including regression-to-the-mean) and the use of appropriate comparison areas were absent from all these evaluations. Average speed cameras encourage lower speeds over a prolonged distance rather than site-specifically, and considerable safety benefits are being observed (Soole, et al., 2013), e.g. http://www.bbc.co.uk/news/uk-scotland-tayside-central-38458586
7. National Speed Awareness

First time offenders with offences conforming to certain criteria can take part in the National Speed Awareness Course (NSAC) instead of receiving points and a fine. [https://ndors.org.uk/courses/](https://ndors.org.uk/courses/)

8. Driver monitoring and feedback using telematics

The majority of hardware specific and smartphone based telematics systems detect speeding events and provide feedback either directly to the driver or to the system owner to pass on to the driver. With the increase in insurance pay-how-you-drive systems (e.g. [www.admiral.com/littlebox](http://www.admiral.com/littlebox)) it is likely that increasing numbers of drivers will receive telematics feedback in response to speeding incidents.

9. Advertising illustrating potential consequences

Road safety advertising has shifted focus to address potential consequences of speeding but without the traditional “shock tactics” of the immediate aftermath of a crash. Using the longer-term impacts triggers anticipated regret, a component of TPB strongly research-evidenced as effective in determining behavioural choices. [http://think.direct.gov.uk/video-speed.html](http://think.direct.gov.uk/video-speed.html), [https://www.youtube.com/watch?v=Cvja-PASEg](https://www.youtube.com/watch?v=Cvja-PASEg)

10. Guidance documents explaining risks


11. Use of VMS to provide regular reminders to keep speed down

Variable Message Signs can be effectively used to periodically remind drivers to keep speed down (Neuman, et al., 2009).

12. Reward safe speed measured using telematics

Telematics can be used to measure safe speed behaviour and rewards can be applied to reinforce behaviour, e.g. Mazureck and van Hattem (2006) Rewards for safe driving behaviour: Influence on following distance and speed, Transportation Research Record No. 1980 - [http://www.roadsafetyobservatory.com/Evidence/Details/10450](http://www.roadsafetyobservatory.com/Evidence/Details/10450). The use of a coaching app to offer feedback and incentives to change road user behaviour has potential. As vehicles become more connected and software-controlled large area (TFT) displays are used more and more in the instrument panel, it is expected that in-car apps that do not rely on the driver’s smartphone become feasible. This provides the opportunity for feedback/incentives integrated within the HMI of the car itself. The use of a cloud-based algorithm to decide what feedback and/or incentive to offer, to which driver and at what time/location is novel and could also be used for speed management

13. Online coaching-based intervention modules

Online e-learning modules are available to address the risks of speeding and the underlying factors that bring out speeding behaviour in drivers. A2om offer modules including several about speed based on coaching principles to provide an effective behavioural intervention. To assess the effectiveness of these modules, a study to evaluate the effects of a young offender program with Thames Valley Police called the Young Drivers Scheme (YDS). Speed reoffending rates were monitored for participants compared with a number of other driver groups all below 25 years of age. One of the groups had been through a SAS for those that had been caught speeding consisting of a 2.5h, classroom based group session (20 to 24 participants), aimed specifically at the problem of speed and speeding. The FPN group consisted of three sub-groups of drivers: those who had already taken a SAS course within a three-year period before their current offence and had been caught committing another offence but were not eligible to be offered another course, those who drove excessively fast, and those who declined to take the SAS course. These drivers therefore had a somewhat different past, as compared to the YDS and SAS driver groups. Finally, a control group of young drivers was recruited via an e-mail campaign. Data on driving offences for all driver groups were provided over a period of six months after each participant had completed the YDS and the SAS as well as offences committed by those belonging to the control group and those who received a FPN. The findings showed a significant reduction in the number of offences and penalty points for the YDS, while this was not the case for drivers who had been fined
only (FPN), or had taken part in the SAS. The results seem to indicate a positive effect of the YDS that resulted in a detectible behavioural change (af Wåhlberg, et al., 2011) supporting the use of e-learning modules to extend the learning period by several weeks.

14. Telematics and behavioural analysis of excess speed incidents with feedback

Telematics systems are now capable of identifying excess speed incidents and triggering communication with the driver to analyse the factors underpinning the driver’s decision to speed at that time, and to provide feedback and coaching input to help the driver recognise similar components of future situations and avoid the same behavioural outcome. The use of a coaching app to offer feedback and incentives to change road user behaviour has potential. As vehicles become more connected and software-controlled large area (TFT) displays are used more and more in the instrument panel, it is expected that in-car apps that do not rely on the driver’s smartphone become feasible. This provides the opportunity for feedback/incentives integrated within the HMI of the car itself. The use of a cloud-based algorithm to decide what feedback and/or incentive to offer, to which driver and at what time/location is novel and could also be used for speed management.

15. Cost minimisation for drivers detected as safe using telematics

Reinforce safe speed by keeping insurance premiums to a minimum for pay-as-you-drive system users detected as unlikely to speed.

16. Coaching and group discussions

Coaching interventions (e.g. Mercedes Benz Driving Academy) and group discussions (see Gregersen, et al., 1996), behavioural workshops. Past studies have shown that lasting behavioural change can be achieved using driver workshops, where groups of drivers share their experiences. This may be appropriate for fleet drivers but is not very practical for non-professional drivers. For non-professional drivers, the last time they have any form of training is when they take their driving test. One-to-one coaching and driver workshops are just too time-consuming and costly for widespread adoption. Some very basic coaching measures are available in-vehicle (e.g. a message to take a break if you have been driving for more than two hours). For example, using graphic prompts on the dashboard and/or audible warning chimes. The Mercedes system Attention Assist is linked to the car’s navigation system to show the driver the next locations where coffee and/or fuel are available, and goes further to provide a choice in adopting a desired behaviour. A new EU research programme called MeBeSafe will use the data gathered by in-vehicle sensors to provide frequent (daily, weekly or monthly), objective feedback and online tools (such as social media, gamification) to promote peer-learning— thereby much reducing the cost of driver coaching.

17. App for parents to monitor their children’s driving

- UK [https://www.ingenie.com/?soe=gadsnbandgclid=CMMnu9_SutdECFXz0wod-VEEqQ](https://www.ingenie.com/?soe=gadsnbandgclid=CMMnu9_SutdECFXz0wod-VEEqQ)
- [https://www.directline.com/car-insurance/telematics/black-box](https://www.directline.com/car-insurance/telematics/black-box)

18. Developing driving skills amongst young drivers

Developing driving skills amongst pre-drivers including appropriate speed [https://www.youngdriver.eu/](https://www.youngdriver.eu/)

19. Wipe off 5

In August 2001, the TAC launched the first phase of its ‘Wipe off 5’ campaign targeting the issue of low-level speeding and dispelling the myth that traveling even a few kilometres over the legal limit is safe. Eight subsequent ‘Wipe off 5’ campaigns – emphasising that small reductions in speed can make the difference between life and death - have been launched in the past six years. These campaigns have varied in nature. Some have focused on the consequences of speed not just for the victims but on the family of the driver while others have taken a more statistical, scientific approach to demonstrate the 'lower speed, lower impact' approach. During the time of these campaigns, there have been some significant improvements in community attitudes
towards speeding and also in behaviour. For instance according to Sweeney Research people who report they speed most or all of the time has fallen from 25% to 11%. Market research surveys also show that the ‘Wipe off 5’ concept is generally understood by Victorian motorists and is having a positive effect on their driving behaviour. Since the commencement of the campaign, Vic Roads has reported a drop in average travel speeds in 60, 70 and 80km/h speed zones. http://www.tac.vic.gov.au/road-safety/tac-campaigns/speed/the-wife

20. Road Safety Toolkit

The Road Safety Toolkit provides free information on the causes and prevention of serious road crashes. Building on decades of road safety research, the Toolkit helps engineers, planners and policy makers develop safety plans for car occupants, motorcyclists, pedestrians, bicyclists, heavy vehicle occupants and public transport users. The Road Safety Toolkit is the result of collaboration between the International Road Assessment Programme (iRAP), the Global Transport Knowledge Partnership (gTKP) and the World Bank Global Road Safety Facility. ARRB Group, Kate McMahon and John Fletcher (TRL) provided expert advice during the Toolkit’s development. Austroads provided permission to use concepts and information from Austroads safety engineering toolkit (www.engltoolkit.com.au) in this website. The Austroads toolkit fulfils a similar purpose to this website, although it is aimed at Australian and New Zealand practitioners specifically. There is a three-minute introductory Video providing a brief overview of how to use the Toolkit. http://toolkit.irap.org/default.asp?page=treatment&tid=48. There is a toolkit for safe speed.

21. Australian toolkit of engineering designs

The Road Safety Engineering Toolkit is a reference tool for road engineering practitioners in state and local governments. It outlines best-practice, low cost, high return road environment measures to achieve a reduction in road trauma. The Toolkit seeks to reduce the severity and frequency of crashes involving road environment factors. Provision of safer roads and roadsides is a major area of gain under the National Road Safety Strategy 2003 – 2010 and is a strategic priority area for Austroads research. The Toolkit draws together existing road safety engineering knowledge as far as possible into one Toolkit for easy access by practitioners. The presented knowledge has been updated with recent experience from local and state government agencies, and with the results of comprehensive road safety research reviews. The Toolkit is a ‘living’ document including updates and revisions, so that more recent safety ‘wins’ are captured and disseminated. The information included in the Toolkit is based on extensive research into the effectiveness of crash countermeasures. Nonetheless, the Toolkit is not a replacement for sound engineering judgement or good design. In-depth investigation is required at locations which have a crash history or high crash risk to identify causes or potential causes of crashes. If necessary, seek professional advice from practitioners specialising in road safety engineering. http://www.engltoolkit.com.au/default.asp

22. A real-time in-cab verbal coaching device inthinc’s tiwiPro®

A real-time in-cab verbal coaching device called inthinc’s tiwiPro® monitoring devices were installed in 3,500 vehicles. The device would speak to the driver when they committed a speeding violation and would give them 15 seconds to correct their behaviour. For the first month, they turned off the coaching instruction and just recorded driver behaviour. The fleet drove a total of 2.3 million miles and recorded over 184,000 speeding violations, 52 per driver. The following month the verbal coaching was turned on and scores dropped. One additional advantage to providing verbal coaching in the cab is that it allows fleet supervisors to manage on an exception basis by only being alerted to drivers that ignore the coaching and continue to break the policy. DeLeonardis et al (2014)) evaluated the device and the findings suggest that the verbal alerts provided were successful in producing short-term changes in driving behaviour. Overall, the average proportion of speeding above the alert threshold declined significantly during the course of the treatment phase, indicating that the presence of alerts does have a deterring effect on speeding behaviour. Once the alerts were silenced, there was evidence suggesting a sustained change in driving behaviour for some participants. http://fleetsafetyandefficiency.org/behavior-modification-driver-safety/

23. Speed cameras

Average speed cameras encourage lower speeds over a prolonged distance rather than site-specifically, and considerable safety benefits are being observed (Soole, et al., 2013).
24. NETS employees speed awareness campaign

Drive Safely Work Week™ (DSWW) has been an annual campaign sponsored by the Network of Employers for Traffic Safety (NETS) for many years in the US. NETS have recently updated the structure to focus more tightly on changing specific behaviours, and the campaign materials are now offered on a quarterly basis, with modules focused on specific driving behaviours. This includes a speed module of materials include meaningful activities that reinforce the program’s safe-driving messages and include:

- Employer Launch Letter and Email
- Employee Fact Sheet
- Speed Safety PowerPoint Presentation
- Pledge Cards
- Posters
- Social Media and E-mail Graphics
- How to get started:
  - Schedule your Drive Safely Work Week
- Post social media announcements throughout the week
- Distribute employee fact sheet
- Conduct speed training workshop/webinar
- Print and post posters as reminder

25. The Van Excellence Code

Van Excellence is a scheme designed by some of the best van operators in the UK; facilitated and managed by FTA to recognise excellence and improve operational standards. At its heart is the Van Excellence Code which is a Code of Practice outlining ‘what good looks like’ in van operations. With The Code established, the accreditation scheme has been developed to allow operators to ensure their standards of operation meet the requirements as laid out in the Code. [http://www.vanexcellence.co.uk/about/what-is-van-excellence.html](http://www.vanexcellence.co.uk/about/what-is-van-excellence.html)

Some OBD II plug in devices gives drivers visual and/or auditory feedback on speeding in-vehicle. They can also give haptic feedback by making the driver press harder on the pedal to be able to keep the speed above a pre-set level. In an on-road trial in Sweden a 10-15% decrease in collisions was found when informative ISA systems were used compared with 10-24% when active systems automatically reduced speed (Biding and Lind, 2002).
6.0 Using a Mobile Phone whilst Driving

Using a mobile phone while driving may be on the increase. A RAC report published in September 2016 showed that 31% of motorists used a handheld mobile phone whilst driving compared with 8% in 2014. The number of drivers who said they sent a message or posted on social media rose from 7% to 19% in the same period, while 14% said they had taken a photograph or video while driving.

6.1 The Impact of Mobile Phone Use whilst Driving

There is little doubt that using a mobile phone can lead to crashes. The DfT reported that in 2013 mobile phone use was a contributing factor in 422 casualties (less than 1% of all road casualties (DfT, 2014)). This increases to 1.5% for fatal crashes but there may be an underestimation due to the difficulties of recording retrospectively. The use of a mobile phone whilst driving is one of the ‘Fatal Four’. Several studies have suggested about a four-fold increase in crash involvement but there is a lack of robust evidence linking legislative approaches to compliance and actual behaviour change (Caird, et al., 2004). This could be due to drivers covertly using a mobile phone whilst driving so that its prevalence may be little known. The general approach for addressing mobile phone use whilst driving focuses on legislation and enforcement. However, compliance with legislation will require a combination of effective enforcement in combination with educational methods of behaviour change.

Most research has found that talking on a mobile phone is more dangerous than talking with a passenger. The common conception is that passengers are able to better regulate conversation based on the perceived level of danger, therefore the risk is negligible. For example, a study that compared passenger and mobile phone conversations concluded that the driver performs better when conversing with a passenger because the traffic and driving task can become part of the conversation. Drivers holding conversations on mobile phones were four times more likely to miss the highway exit than those with passengers, and drivers conversing with passengers showed no statistically significant difference from driving alone (Charlton, 2009).

6.2 Methodologies for investigating Mobile Phone Use and Crash Involvement

Case-crossover designs may be a more effective way of investigating the risks of using a mobile phone whilst driving. Here, verification of crash-involved drivers’ mobile phone use from their phone company’s billing records can be examined. In Australia, McEvoy et al. (McEvoy, et al., 2005) examined crashes serious enough to injure the drivers and found that mobile phone use while driving was associated with a four-fold increase in crash risk. In agreement with Redelmeier and Tibshirani (1997), they found no difference in the crash risk between handheld and hands-free mobile phone use.

Wilson et al (2002; 2003) used a sample of 3,869 drivers in the Vancouver area. Observers were posted at 42 intersections. The researchers noted various characteristics and the driver was incorporated into the sample. The researchers did the same for the non-user drivers that followed. This approach produced a sample composed of an equal number of users and non-users. A follow-up review of the drivers’ records established that 452 of the 3,869 drivers had been involved in 513 collisions, which were reported to the police, between 1997 and 2000 and that the mobile phone users were 13% more likely to be involved in an “at-fault” collision than non-users.

Asbridge, Brubacher and Chan (2013) studied drivers involved in crashes where police reported mobile phone use (n=312) and matched drivers (according to age, sex, suspect alcohol/drug impairment, crash type, date, time of day, geographical location) with no police record of mobile phone use.
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(n=936). These were drawn from data held by the Insurance Corporation of British Columbia Traffic Accident System. This research found that using a mobile phone while driving increased the odds of an “at fault” crash by 70% when compared with drivers who did not use a mobile phone while driving.

6.3 Hand Held Vs Hands Free Mobile Phone Use

In naturalistic studies, drivers are continuously monitored in vehicles instrumented with video cameras, accelerometers, and other technology whilst they go about their everyday activities. Klauer et al. (2006) found that hand held (HH) mobile phone conversations were associated with a non-significant increase in the likelihood of an at-fault crash or near-crash among 109 drivers of passenger vehicles. However, dialling using a HH mobile phone was associated with a 2.79 times increase in at fault crashes and involvement in near-misses. Nevertheless, there were very few crashes (less than 50) in their study which may have influenced the result.

In support of the previous study, Olson et al. (2009) found that conversations on HH phones did not significantly increase the risk of being involved in a safety-critical event, but dialling was associated with an almost six-fold increase in the likelihood of a safety-critical event. However, slightly contrasting findings were made in a naturalistic study. The 100-car study found that dialling a hand held device increased crash risk by almost times, while talking or listening on a hand held device increased crash risk by 1.3 times (Dingus, et al., 2006). Many studies have found that HH and hands free mobile phone use whilst driving is just as dangerous. (e.g. Caird, et al., 2004; Horrey and Wickens, 2006a; Laberge-Nadeau, et al., 2003; Lamble, et al., 1999; Matthews, et al., 2003; McEvoy, et al., 2005; Recarte and Nunes, 2003; Redelmeier and Tibshirani, 1997; Strayer, et al., 2006; Strayer and Johnston, 2001).

A U.S. study (Fitch, et al., 2013) investigated the effects of distraction from the use of three types of mobile phones: (1) hand-held (HH), (2) portable hands free (PHF), and (3) integrated hands-free (IHF).

Results show that drivers talked on a mobile phone 10.6% of the time the vehicle was in operation. Talking on a mobile phone, of any type, while driving was not associated with an increased safety-critical event risk. Visual-manual (VM) subtasks performed on an HH mobile phone, however, were associated with an increased risk. VM HH mobile phone subtasks were found to significantly increase the percentage of time drivers took their eyes off the forward roadway, while talking on an HH mobile phone significantly decreased the percentage of time drivers took their eyes off the forward roadway.

Another U.S. study (Xiong, et al., 2015) used naturalistic data to provide a natural and realistic way to examine mobile phone use while driving. Driving speed while using a mobile (conversation or visual/manual tasks) was compared to two baselines when crossing an intersection. The results showed that drivers drove slower when using a mobile for both conversation and visual/manual (VM) tasks compared to baseline conditions. With regard to mobile phone conversations, drivers were more likely to drive faster during the day time compared to night time driving and drive slower under moderate traffic compared to under sparse traffic situations. With regard to VM tasks, there was a significant interaction between traffic and mobile phone use conditions. This study suggests that drivers might self-regulate their behaviour based on the driving situations and demand for secondary tasks.

Other research has shown that it is the increased cognitive workload involved in holding a conversation, not the use of hands that causes the increased risk (Recarte and Nunes, 2003; Strayer, et al., 2003a; Strayer and William, 2001). Furthermore, research appears to suggest that having a hands-free device may actually encourage drivers to use their mobile phone more often when driving (Gras, et al., 2007; Pöysti, et al., 2005), thereby increasing risk.
6.4 Texting and Driving

The scientific literature on the dangers of texting while driving is limited. A simulation study at the Monash University Accident Research Centre in Australia has provided strong evidence that both retrieving and, in particular, sending text messages has a detrimental effect on a number of critical driving tasks. Specifically, negative effects were seen in detecting and responding correctly to road signs, detecting hazards, time spent with eyes off the road, and (only for sending text messages) lateral position.

The Virginia Tech Transportation Institute released preliminary findings of their study of driver distraction in commercial vehicles. They examined 4,452 safety-critical events, which included crashes, near crashes, crash-relevant conflicts, and unintended lane deviations. 81% of the safety critical events had some type of driver distraction. Text messaging had the greatest relative risk, with drivers being 23 times more likely to experience a safety-critical event when texting (Olson, et al., 2009). The low number of scientific studies may be indicative of a general assumption that if talking on a mobile phone increases risk, then texting also increases risk, and probably more so.

Tucker et al (2015) reports on the prevalence of texting while driving and other risky driving behaviours by age and gender in two large samples aged 16 to 19 years in Canada. In Study one (n=6,133), males reported more frequent texting while driving and speeding than females and 16 year olds reported frequent texting while driving than older participants. In Study two (n=4,450) conducted two years later, males again reported more frequent texting while driving, however there was no difference in the rate of talking on the phone while driving among males and females. Participants also reported on experiences that led to a significant reduction in their texting while driving. The most common reasons were the perceived danger of texting while driving, laws and fines against texting while driving, and observing close-calls and accidents experienced by other people. This study suggests an increase in the penalty for mobile phone use is recommended and came into force in the UK in April 2017.

6.5 Engineering Interventions

Phone Blocking Apps

Holland and Rathod (2013) reported an effect of a ringing mobile phone on the more cognitively demanding components of driving, specifically hazard avoidance and speed control when a mobile phone call is heard amongst younger, less experienced drivers. More automatic level vehicle control skills were not significantly affected by a mobile phone ring tone. Lindqvist and Hong (2011) have proposed that drivers experience “social pressure and [a] perceived need to answer a phone call or text message as soon as they arrive”. Similarly, Nemme and White (2010) have suggested that texting behaviour may be affected by an “expectation of reciprocity” where drivers feel “compelled to quickly read or return” text messages they receive (p. 1264).

As enforcement is difficult under current levels of roads policing and education takes time to filter through, more direct means of managing smartphone use may be effective in reducing in-vehicle distraction by using a mobile phone. Smartphone apps can block and divert incoming phone calls and messages, and restrict user interaction with the device whilst the vehicle is in motion. This intervention would be particularly useful for fleets as they are in a better position to enforce app usage. Among private motorists, those who are willing to use the app may be more safety-oriented and therefore already less prone to using the phone whilst driving.
In a study in Israel, half of the participants were willing to try a phone blocking app, despite 73% using their phone for calls and 35% for texts whilst driving (Musicant et al, 2015). Delgado et al (2016) state that of the three completed studies of smartphone applications to block mobile phone use while driving, all of them demonstrated a reduction in mobile phone use while driving (Creaser, Edwards, Morris, & Donath, 2015; Ebel et al, 2015; Funkhouser & Sayer, 2013). In the largest study to date, involving 274 novice teen drivers followed for one year, the rate of text messages sent per mile driven for each given month post licensure was at least 5 to 10 times higher in the control group (0.05 to 0.20 texts per mile driven) than in the blocking group (0.0 to 0.02 texts per mile driven) (Creaser et al., 2015). The number of text messages sent tripled by one year since licensure in the control group compared with the first 8 months of driving. On the other hand, the rate remained stable in the blocking group (Creaser et al., 2015). However, behavioural engagement strategies will likely be necessary to enable the success and sustainability of mobile phone blocking indicating a low likelihood of use beyond the study.

The South Australian Road Safety Action Plan aims to reduce serious casualties by at least 30% by 2020. One of their actions was to “Promote voluntary use of technology solutions that block incoming phone calls and messages while driving”. An evaluation of three Android based smart phones apps claiming to block incoming phone calls and messages on both iPhones and Android-based smart phones were selected for a trial. Following pre-trial testing, the main field trial used a corporate vehicle fleet. The results showed that the technology had some practical and technological limitations including battery drain and inability to switch the phone back on after a drive. Consequently, participants ‘swiped off’ the software or disabled the blocking. It is essential that if such an approach were to be used in the UK that the technology is fully trialled.

Ponte et al (2016) reviewed one technology (‘Technology A’) that required software to be installed on mobile phones, while the other (‘Technology B’) used software in addition to external Bluetooth hardware that paired with the phones. A sample of 104 study participants who regularly drove a corporate fleet vehicle trialled Technology A and 28 trialled Technology B for a period of one month in November 2015 during which their phones were blocked only on weekdays. Their attitudes and behaviour with regard to phone use while driving, and their impressions of the phone blocking technologies that they experienced during the trial, were assessed using pre- and post-trial questionnaires.

Participants generally gave a negative appraisal of the two technologies, especially Technology A with some reliably issues. Technology B received a more favourable appraisal with around two thirds of the participants being satisfied with its performance but battery drain was reported as a problem. Despite some negative appraisals the trial did result in reductions in mobile phone use behaviour. There were increases during the trial in the likelihood of participants ‘rarely’ or ‘never’ making or answering calls, or reading text messages, regardless of which technology they trialled. The results suggest that phone blocking products may provide a useful method of changing mobile phone use behaviour while driving. However, the reliability and usability of the products need to improve to reach higher ratings of user acceptance and approval.

It may be possible for fleet managers to influence drivers’ mobile phone use more effectively as observed in a naturalistic driving study of American truck drivers (Hickman and Hanowski, 2010). Here, drivers’ levels of mobile phone use while driving were consistent with fleet or company rules rather than with state legislation. Given the findings into the outcomes of legislation prohibiting various forms of mobile phone use while driving for which resources may be lacking, consideration needs to be given to alternative methods of controlling phone use while driving.
It appears that ignoring a mobile phone call whilst driving is not enough, switching it off or setting to silent is safer (or blocking it altogether). Therefore, interventions to support mobile phone blocking whilst driving are recommended.

**Alternative Interfaces**

People are increasingly reliant on their smartphones and while hands-free use remains legal in the UK it is unlikely that smartphone use behind the wheel will be eradicated. People seems to want to stay connected to the outside world via their phone at all times so an engineering intervention that could be beneficial to explore is safer ways of interacting with the phone whilst driving. It may be possible to minimise the distraction placed on the driver by their interaction with the device by using alternative methods such as voice control, gestures, and heads up displays (HUDs). Some smartphone apps enable interaction with the device other than with touch to reduce diversion of attention and reduce workload. What is the evidence that this approach is beneficial?

Recent research shows that using verbal commands reduces the likelihood that the in-vehicle task will require glances away from the road of at least two seconds, which is the critical duration linked with impaired vehicle control and increased risk of crashes (Filtness et al., 2013). Combining voice input with a HUD, using technologies like Google Glass, provides a compounded safety benefit, as Tippey et al (2014) found in their study using average steering rate as a measure of control. The similarity between baseline and Google Glass conditions reflected how well drivers performed compared with touch texting and voice-to-text conditions.

Research has indicated that drivers feel their concentration and driving performance is better using voice interaction compared with handheld interaction (Terken et al., 2011). Studies observing non-texting speech interfaces while driving indicate that speech interfaces are less mentally taxing and promote more eyes-on-road time (Tsimhoni & Green, 2001). When attempting to perform driving and texting tasks in parallel, competition for the same resources can lead to a decrement performance and increase the risk of unsafe driver behaviours (Horrey and Wickens, 2007; Tsimhoni & Green, 2001).

### 6.6 Educational Interventions

**Classroom based and online courses**

An NDORS course called ‘What’s Driving Us?’ is a short classroom based course (three hours plus a 15 minute break) targets offenders who have committed a wide range of offences including using mobile phones while driving. The course consists of an interactive presentation and discussion to explore a number of myths about using the phone whilst driving and reviews a number of driving scenarios. These courses have not been evaluated and further work could investigate whether there is a detectable change in driver behaviour and whether any change is sustained. An alternative police diversion course for drivers caught using their mobile phone is offered by several police forces.

This is a behaviourally-focused, interactive, pathway-based online education module to inform drivers of the true risks of mobile phone use in terms of divided attention increasing cognitive demand, stress and distraction. It is designed to illustrate the magnitude of the effects of mobile phone use on driving performance. It also focuses on the potential far-reaching impact of being involved in a crash resulting from mobile phone distraction and is based on Theory of Planned Behaviour (Ajzen, 1991), to include customisable pathways to maximise personal relevance to the individual driver.

Online courses based on established behavioural change techniques have been used as part of the driver diversion approach of education rather than pure penalty for some time, particularly in relation
to "low level" offences such as seatbelt offences. Online courses are also widely used on a global basis among fleet operators wishing to deliver a standardised message to improve safety across their fleets. The courses can be designed/adjusted to utilise relevant identified Behavioural Change Techniques such as to educate drivers of the dangers and potential outcomes of mobile phone use when driving, and influence their behaviour using established Behavioural Change Techniques, and to adjust attitudes so that using a mobile phone whilst driving becomes socially unacceptable. Improvements in self-reported attitudes, beliefs and behavioural intentions have been found for an online seatbelt course (af Wahlberg, 2011).

A study of young drivers who had committed driving offences and were allocated corresponding e-learning indicated a significantly reduced number of self-reported offences, penalty points and crashes after taking the e-learning compared with other groups who were given fines or classroom-based interventions (af Wahlberg, 2011).

Fleet Based Online Interventions

Many fleet-based companies now provide online education for fleet drivers as part of their fleet risk management programme. For example the module available via DriverMetrics\textsuperscript{1} takes about 20 mins to complete. The driver is shown the dangers of using a mobile phone while driving. The module includes two scenarios demonstrating the dangers of talking and texting whilst driving. The driver is presented with interactive video clips that demonstrate how difficult it is to listen to a phone message and concentrate on the road at the same time. Many DriverMetrics case studies are available showing that fleet operators have seen reductions in crash rates as an outcome of their fleet management programmes. However, it is not possible to understand the impact of the mobile phone module alone as this is completed alongside other modules and assessments. Other online modules are available via the IAM but no evaluation has been conducted.

Another recent innovation is the ability to monitor driving and mobile phone use by providing feedback via an app after the journey. The app could include a number of behavioural change techniques designed to reduce the frequency and duration of mobile phone use whilst driving. More

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\textsuperscript{1} The author of this report is a Director for DriverMetrics
recently an insurance company in Ireland (AIG) have set up a driver behaviour unit with telematics provider The Floow to provide telephone coaching interventions for drivers using their mobile phone whilst driving. In-house analyses shows the significant impact of this type of educational intervention on driver behaviour.

**Educational campaigns**

In terms of educational interventions, most countries have relied upon media campaigns and giving advice and guidance. Public communication campaigns can be effective if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015). On average campaign effects result in a 9% reduction in road casualties accidents with significant variations regarding the topic of the campaign and additional enforcements (Delhomme et al, 2009; Elvik et al, 2009). Guttman (2016) explains, "Communication campaigns have been credited with having an important role in promoting road safety practices; for example, by explaining reasons for speed limits or by influencing social norms regarding drinking and driving. However, they have been found to be effective mainly when they are part of multi-faceted interventions and when they utilize explicit theoretical frameworks and a social marketing approach."

There have been several media campaigns to address mobile phone use whilst driving in the UK. For example, a new phase of an ongoing campaign was launched in Brighton, in an attempt to tackle the number of road casualties caused by distraction. Launched to coincide with Road Safety Week, ‘What Did I Miss?’ was developed by Brighton and Hove City Council and sought to highlight the dangers of distraction to all road users. The new campaign features a point of view film which brings together the journey of a cyclist, pedestrian and van driver. They are all distracted - and get away with it - but come together at the end, this time with consequences. There is little evidence that any of these campaigns have been evaluated.

**Campaign to Motivate Behavioural Change**

Historically, campaigns have been extremely effective in targeting certain risky on-road behaviours, such as drink driving, but there is no single type of message content strategy which is best overall, as it depends on the specific campaign objectives, audiences, and topic-relevant theory and research (Delhomme et al, 2009). Current campaigns tend to be based on social marketing principles and behaviour change theory (Rodriguez and Anderson-Wilk, 2002). However, many are not based on research or established behaviour change theory (Phillips et al., 2011). Designers may favour their own beliefs about what influences driver behaviour (Hoekstra and Wegman, 2011) and prioritise attracting attention when competing with other media messages (US National Highway Traffic Safety Administration, 2014), resulting in campaigns based on a creative or attention grabbing approach rather than a theory-driven approach (Delhomme et al, 2009). Four main types of persuasive appeals/message content strategies are well-established in road safety campaigns –

- Appealing to reason
- Appeals to negative emotions
- Appeals to positive emotions and social values
- Threat of enforcement.

Each of these have strengths and limitations, but many effective campaigns combine multiple strategies. See Guttman (2016) for a full analysis.

Gauld et al (2017) evaluated three Australian campaigns aimed at reducing smartphone social media use among young drivers - "Good Driver", "Animated Smartphone” and “Voice Your Opinion". They
reported that overall, the messages targeting monitoring/reading were found to be more persuasive than those targeting responding. The behaviour of monitoring/reading was reported to be more prevalent with 74% of participants reporting monitoring/reading on a daily basis compared to 41% of participants who reported responding. This higher prevalence is supported in previous studies (Atchley et al, 2011; Shi et al, 2016). These results support the suggestion that monitoring/reading and responding may be distinct behaviours and, therefore, may require different message content when attempting to persuade young drivers to stop engaging with social interactive technology.

6.7 Enforcement Interventions

Mobile Phone Bans and Enforcement Levels

Most governments around the world (except Japan) allow drivers to talk on a hands-free device while driving. This is despite the fact that extensive research has found that using a hands-free device is no less hazardous than using a hand-held mobile phone while driving as presented earlier in this section.

The most common response to the dangers of driving whilst using a mobile phone has been to ban its use and enforce the laws to reduce its prevalence. Official figures show that the number of fixed penalty notices issued by police in England and Wales for the offence has fallen from 123,100 in 2011 to just 16,900 in 2015. The total fell by 43% in 2014-15 in the last recorded year which suggests that the police are not keeping up with increasing trends in this behaviour. 


In a Swedish study, Kircher, Patten, and Ahlstrom (2011) concluded that bans on phone use while driving tend to produce compliance in the first year but that phone use frequency returns to baseline levels after that. The review of EU states by Janitzek et al (2010) also found that the severity of penalties had no effect on self-reported phone use rates while driving, and that self-reported use rates were also similar in countries with and without phone ban legislation. However, self-report methods can be unreliable and these findings may reflect poor levels of enforcement. Kircher, Patten, and Ahlstrom (2011) concluded that bans on phone use while driving tend to produce compliance in the first year but that phone use frequency returns to baseline levels after that. In the UK, mobile phone use penalty rates have decreased dramatically but research shows that drivers are increasing their phone use behind the wheel rather than reducing it (RAC, 2016).

Community Spotters

As mobile phone conviction rates have decreased so dramatically in the UK while self-reported phone use behind the wheel has increased (RAC, 2016), it can be concluded that there are insufficient police resources to target mobile phone offending effectively. The use of community road safety action groups to target mobile phone offending in the same way as speeding would increase the number of motorists reached with warnings and/or remedial action. This would reach a greater number of motorists using mobile phones behind the wheel and provide advice and/or interventions to reduce the likelihood of further offending.

Community speedwatch programmes have been found to produce significantly lower speeds once established (e.g. Blume et al., 2000) so it is reasonable to assume that a community-based mobile phone programme would have a similar effect on mobile phone offending rates. Volunteers from the community have extensively been used to support traditional police work in different regions including the US, China, Taiwan, Russia and Israel, as well as the UK, and there are published case
studies reporting their success (Bartels, 2013). Evaluations of community speeding programmes have shown them to be effective (e.g. Blume et al., 2000).

Camera Systems and Enforcement

There are several ways in which better enforcement levels are being investigated with the use of camera technologies. For example, in the UK a Police HGV-based camera system is being trialled. Highways England are using CCTV in traffic officer’s vehicles to detect drivers using their mobile phone and refer such incidents. In Western Australia, a world-first fixed camera system is being used to better detect and prosecute mobile phone use.

With declining traffic police numbers and increasing demands on those that remain, systems that collect offence data autonomously could fill the enforcement gap that exists and which is fuelling non-compliance. This could extend to using camera data collected by the public using dashcam technology. This could increase reporting and enforcement of mobile phone offences, and overcome the perception that drivers are unlikely to be caught.

The public are co-producers of safety, along with the police (Wesley et al., 2008). New Zealand and Canada allow drivers to report bad driving behaviours, such as crossing the centre line and tailgating, via phone and mail. Park et al. (2017) report that in the US, the National Sheriffs Association that organises neighbourhood watch groups introduced a mobile app called the ICE BlackBox that supports video recording, location tracking, and secure reporting to the police. Also, the American Civil Liberties Union (ACLU) developed Mobile Justice, an app launched in Michigan in June 2015 as well as in 17 states and Washington, D.C. that allows citizens to capture videos and send them to the state officers. In India and Korea, citizens can use the mobile apps to report traffic violations captured on video by their smartphones and dashcams, and then the police use the video evidence to issue traffic tickets to the violators.

Lewis and Lewis (2012) analysed two online community policing communities: (1) the CLEARpath website of the Chicago police designed for public involvement and information sharing and (2) an informal web forum organised by local residents to have problem-solving conversations. They found that the residents used the informal web forum more frequently than the official site, so the prevalence of video footage appearing on Facebook may not be indicative of expected levels of official reporting. The South African Police Service used a Facebook group to support neighbourhood watch and build relationships (Hattingh, 2015). In the US, social media has been used by the police for announcements about crime and traffic, requesting information about urgent issues, and building relationships (Huang et al., 2016). In a UK study of the use of twitter by police, Denef et al. (2011) found that the language style used by the police had a significant impact on online community involvement: informal and personalised styles elicit better user involvement than formal depersonalized styles. Violi et al. (2011) used Batson et al.’s (2002) motive framework and showed that the key motives for participating in online neighbourhood watch communities are egoism (for my safety), altruism (for others’ safety), collectivism (for our community safety), and principism (for social justice).

6.8 Conclusions

Educational interventions to reduce mobile phone use tend to be limited to campaigns and few evaluations have been conducted to assess their effectiveness. Most governments around the world allow drivers to talk on a hands-free device while driving even though extensive research has found
that using a hands-free device is no less hazardous than using a hand-held mobile phone. Better enforcement via technology is likely to improve compliance on the SRN.

**Recommendations**

- Observational studies may provide data on mobile phone use whilst driving to investigate the effectiveness of an intervention
- The distracting effect of mobile phone alerts for younger, less experienced drivers suggests that interventions to support mobile phone blocking whilst driving is recommended.
- Alternative means of interacting with a mobile phone whilst driving may minimise distraction such as voice control, gestures, and HUDs in-vehicle.
- Online mobile phone modules are widely used by fleet companies and there is some evidence of effectiveness when considering case study data. One study has shown the beneficial impact of online courses for offender drivers
- A campaign to target mobile phone use, based on psychological principles to motivate behavioural change is recommended
- Given levels of enforcement are not as high as they could be, it is recommended that Highways England investigate a widespread use of camera technologies including linking up with the Police HGV-based camera system, CCTV in traffic officer’s vehicles and recording and reporting apps.
- An engineering, educational and enforcement approach combined is recommended.

**6.9 Mobile Phone Intervention Matrix**

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address mobile phone use whilst driving and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘hug’.
<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>Put it away campaign (Herts Road Safety Partnership)²</td>
<td>Use of ‘community spotters’⁵ Use of CCTV in Highways England vehicles (see MM)</td>
<td>6 points and £200 penalty for mobile phone offences from 2017⁵</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Highways England HGV cab trial¹⁹ Western Australia world-first cameras to catch drivers using their mobile phones²²</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td>UK THINK campaign on mobile phones² DfT running mobile phone campaigns for start of the new fixed penalty points and fines. (Feb 2017)² RoSPA fact sheet⁷ BRAKE advice on avoiding distractions⁶ Aviva virtual reality experience²⁵</td>
<td>NSW Get your hand off it campaign³</td>
<td>A Sirious Safety Message – advert that interfaces with mobile phone¹⁷</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Project Pictogram safe norm development¹² SafeDrive app²⁴</td>
<td>Voice control apps (commands, text to speech, etc.)¹⁶</td>
<td>Driver monitoring app feedback¹¹ App to block phone use while driving¹⁰</td>
</tr>
<tr>
<td><strong>Educate</strong></td>
<td>South Africa Arrive Alive social media campaigning⁸ AIG Ireland DDIP programme²³</td>
<td>DriverMetrics mobile phone online module⁹ Fleet risk management strategies on mobile phone use¹⁸</td>
<td>What’s Driving Us classroom course¹⁴</td>
</tr>
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## An Intervention Framework for Safer Driver Behaviour: Using a Mobile Phone Whilst Driving

<table>
<thead>
<tr>
<th>Hug</th>
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<td></td>
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<td>Hampshire Driver Diversion Distraction course for offenders[^4]</td>
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<td>What did I miss[^19]</td>
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<tr>
<td><strong>Support</strong></td>
<td>Behavioural pledges, e.g. the BRAKE pledge[^15]</td>
<td>Variable message signs 'Leave Your Phone Alone'[^5]</td>
<td>Vehicle technology to alert drivers detected as distracted[^13]</td>
</tr>
</tbody>
</table>

1. **Hertfordshire Road Safety Partnership “Put It Away” campaign**  

2. **THINK campaign on mobile phones**  
   [http://think.direct.gov.uk/mobile-phones.html](http://think.direct.gov.uk/mobile-phones.html)

3. **New South Wales “Get Your Hand Off It” campaign**  

4. **Hampshire Driver Diversion scheme for distracted driving offenders**  

5. **UK NPCC national mobile phone campaign**  

6. **BRAKE road safety advice**  

7. **RoSPA distracted driving factsheet**  

8. **Arrive Alive (South Africa)**
9. **DriverMetrics Mobile Phone module**

During this online module which takes about 20 mins to complete, the driver is shown the dangers of using a mobile phone while driving. The module includes two scenarios demonstrating the dangers of talking and texting whilst driving. The driver is presented with interactive video clips that demonstrate how difficult it is to listen to a phone message and concentrate on the road at the same time.

10. **Apps to restrict or block phone use while driving**

   e.g. [http://www.automotive-fleet.com/article/story/2011/08/6-mobile-applications-to-prevent-distracted-driving-accidents.aspx](http://www.automotive-fleet.com/article/story/2011/08/6-mobile-applications-to-prevent-distracted-driving-accidents.aspx) (fleet drivers), [http://lifesaver-app.com/](http://lifesaver-app.com/) (young drivers), evidence in support (e.g. Creaser, et al., 2015). There is technology available that can block mobile phones while driving. Ponte et al (2016) investigated two different technologies: one required software to be installed on mobile phones, while the other technology used software in addition to external Bluetooth hardware that paired with the phones. A sample of 104 study participants who regularly drove a corporate fleet vehicle were recruited. Each participant experienced one of the two technologies, and their opinions on the technology and phone use while driving were assessed using pre- and post-trial questionnaires. A majority of participants reported that phone blocking was not reliable but a majority nonetheless considered the technology they trialled to be an effective way of preventing phone use while driving. The reliability and usability of the products need to improve to reach higher ratings of user acceptance and approval.

11. **Driver tracking apps including phone use monitoring.**

   Some are freely available – e.g. DirectLine’s Shotgun (in the hope young drivers will ask for a quote when their insurance is up for renewa). Shotgun also offers rewards such as amazon and Starbucks vouchers for safe driving. Many apps and OBD-II plug in ports are insurance based and there are lots available on the market. Aegis TeenSafer app (Ageis Mobility, 2015) can be monitored by parents in the US to check on their children’s speed and it disables text and phone capabilities whilst driving. A portal is also available for children and parents to get feedback online as well as when using the app. Notifications and emails are sent to parents when their children have a red flag event. [https://www.youtube.com/watch?v=qzBsy3pWV0y3pWV0y3pWV0andlist=UUrKLsNyxxgs3I3q7v0Ox5yw&index=3](https://www.youtube.com/watch?v=qzBsy3pWV0y3pWV0y3pWV0andlist=UUrKLsNyxxgs3I3q7v0Ox5yw&index=3). A similar approach is used for fleet drivers called FleetSafer for mobile phone use [https://www.youtube.com/watch?v=_GJFuXuCyQandindex=4andlist=UUrKLsNyxxgs3I3q7V0Os5yw](https://www.youtube.com/watch?v=_GJFuXuCyQandindex=4andlist=UUrKLsNyxxgs3I3q7V0Os5yw).


12. **Project Pictogram**


13. **Vehicle technology to alert drivers detected as distracted**


14. **NDORS “What’s driving us” course**

   [https://ndors.org.uk/courses/](https://ndors.org.uk/courses/)

15. **The BRAKE pledge**


16. **Text-to-speech and voice control apps**
An Intervention Framework for Safer Driver Behaviour: Using a Mobile Phone Whilst Driving

Text'nDrive, ReadItToMe and DriveSafely, supporting evidence e.g. Albert, et al (2016)

17. A Serious Safety Message


18. Driving for Better Business

http://www.drivingforbetterbusiness.com/ NETS https://trafficsafety.org/ among many others

19. Highways England HGV cab trial

In collaboration with the Police. Use of an HGV to observe mobile phone use. Over the last 16 months, out of 3,600 vehicles pulled over, over half were using a mobile phone.

20. What did I miss?

A new phase of an ongoing campaign has been launched in Brighton, in an attempt to tackle the number of road casualties caused by distraction. Launched to coincide with Road Safety Week, 'What Did I Miss?' was developed by Brighton and Hove City Council and seeks to highlight the dangers of distraction to all road users. The new campaign is the latest element of the council’s ‘Share the Roads’ campaign, which has sought to raise awareness of the dangers of distraction for the last five years. What Did I Miss? features a point of view film (featured) which brings together the journey of a cyclist, pedestrian and van driver. They are all distracted - and get away with it - but come together at the end, this time with consequences. Figures show 42% of the road casualties in Brighton and Hove are down to people failing to look properly or being distracted. The council says all road users contribute to this statistic, adding that mobile phones and headphones play a significant role. What Did I Miss? targets males aged 18 to 35 years who are significantly overrepresented in local casualty data, which also shows that people driving for work are involved in 30% of collisions -- with van drivers making up an increasing number of these. Brighton and Hove City Council adds that although ‘cycling is much better for you than not cycling’, the increase in the number of people cycling in the city has been accompanied by an increase in collisions and casualties, with more than 80% occurring near junctions. - See more at: http://www.roadsafetygb.org.uk/news/5437.html#sthash.rQZlm5jK.dpuf

21. S-Drive App

In-vehicle technology to nudge desirable behaviour might include the Samsung app in Australia called S-Drive that verbalizes speeding behaviour to nudge the driver to reduce their speed (https://www.youtube.com/watch?v=U9TldyYNYUY) S-Drive Australian Samsung app translate text to voice and detects touch also telling drivers not to touch the phone whilst their driving https://www.youtube.com/watch?v=U9TldyYNYUY.

22. Western Australia Government world-first cameras to catch drivers using their mobile phones

Western Australia government is considering installing cameras that could catch drivers using their mobile phones in an effort to tackle WA’s "deadly addiction". The world-first technology was touted as an option for Western Australia after Road Safety Commissioner Kim Papalia observed a demonstration on the fixed and mobile-cameras. Three different models are available, one is a roadside fixed camera, another is a mobile roadside camera, so you set it up at different location, the third option is really interesting - it’s a roving camera in a mobile platform," Highways England said. In one in three crashes, distraction an issue in WA and just over 20%of fatalities - particularly in regional WA - involved people not wearing their seat belts - this technology also picks up that risk. Mr Papalia said the technology could be used to complement traffic enforcement motorcycles, which already patrol roads to ensure drivers are not using their mobile phones while driving. http://www.brisbanetimes.com.au/wa-news/wa-considers-installing-cameras-to-catch-drivers-on-their-mobile-phones-20170119-gtuzec.html

23. AIG Ireland

High risk mobile phone use drivers as measured via gyroscope in their mobile phone selected for motivational interviewing by their insurance company
24. Safe drive App

A Dutch-based company has developed an app which incentivises drivers with rewards for not using their mobile phone while at the wheel. SafeDrive, which has nearly 100,000 users globally, uses a ‘complex and proprietary algorithm’ to give points to the driver - as long as they aren’t using their device when the vehicle is travelling faster than 6mph. Once a driver exceeds 6mph, the app launches a ‘Release’ button on the screen, effectively locking the phone. Pressing the release button while driving wipes out the points earned during that journey. The points can be exchanged for discounted products and services that companies are offering in the ‘SafeDrive Marketplace’. The offers in the Marketplace vary from country to country. By awarding drivers points, SafeDrive hopes the app can act as an incentive to drive responsibly and in turn, improve road safety. See more at: http://www.roadssafetygb.org.uk/news/5582.html#sthash.bVsnjnWq.dpuf

25. Aviva virtual reality experience

The Wasps stars, were put through a Virtual Reality experience by Aviva while sitting behind the wheel of a stationary car to highlight the potential consequences of interacting with your mobile phone while driving. Unaware of what was about to happen, the players were exposed to three near-misses all caused by a distracting smartphone that was receiving messaging while they travelled down a dark country road. The scenarios included a darting deer, a fallen tree and a broken-down motorist, with the culmination being a traumatic high-speed crash. The film highlights the fact that if you are driving at 45mph and look at your phone for five seconds you will have travelled the length of an average rugby pitch. Along with Wasps, Premiership Rugby and the other 11 clubs are all proud to support Aviva’s #DriveSafer campaign and help raise awareness of dangerous driving caused by distractions. Peter Markey, Brand and Marketing Communications Director for Aviva said, “We’re on a mission to make Britain’s roads as safe as possible and we’re proud that Premiership Rugby and all 12 Aviva Premiership Rugby clubs are helping us to make people wake up to the dangers and take that extra care when they are behind the wheel. The Aviva Drive app is free to download and safer drivers save an average of £170 off their Aviva car insurance.


26. Police Gun to detect Mobile Phone use

The technology works by detecting the radio frequencies that emit from a vehicle when someone inside is using a phone designed by ComSonics. A text message, phone call and data transfer emit different frequencies that can be distinguished by the device.
7.0 Close Following Behaviour

Research reveals that many drivers attempt to follow with time headways significantly lower than two seconds and close following contributes to a high percentage of road traffic accidents (mainly rear-end collisions). A time headway is defined as the time interval between successive vehicles (from a reference point of the first vehicle to the same reference point of the second vehicle) as they pass a point along the lane. The behaviour of following the vehicle in front with short headways is commonly referred to as close-following or tailgating. This behaviour is considered to be risky and some countries including the UK have penalties for drivers who close-follow. Various studies have been conducted to investigate the relationship between close-following and safety (rear-end collisions in particular), although Brackstone and McDonald (2007) expressed concern about the statements such as 'drivers drive too closely' and 'constant time headways', arguing that these rules are based largely on little quantitative substantiation.

7.1 The Impact of Close Following

Close following is a dangerous behaviour and contributes to a high percentage of the road traffic accidents (mainly rear-end collisions). Muttart and Fisher (2016) analysed rear end crashes and considered that they fall into one of two categories based upon the distance to the lead vehicle and the following vehicle at the onset of recognised closing. Rear-end crashes includes where the lead vehicle suddenly slows and is hit in the rear by the following vehicle and where the lead vehicle is stopped or moving slowly and struck in the rear by the vehicle behind. The latter scenario is the most common one and associated with inattention (Brown, et al., 2001).

In China close following contributes to nearly 16% of all road traffic accidents (Duan, et al., 2013). Michael et al. (2000) reported that in the USA tailgating contributed to nearly 1900 fatalities and over 650,000 injuries in 1996. In 2013, close following was reported as a contributory factor in five fatal collisions and 110 seriously injured (Highways Agency, 2014a). Close following is a contributory factor in 7% of collisions according to Road Casualties Great Britain: 2014 Annual Report (DfT, 2015).

About 29% of personal injury accidents on the SRN are a result of close following (either wholly or partially) (Gorrell, Nicholls and Winnett, 2010). In 2013, close following was reported as a contributory factor in 5 fatal collisions and 110 seriously injured on the SRN (Highways Agency, 2014a). This behaviour also affects the level of satisfaction and safety felt by SRN users. It was the third most frequently reported poor driving behaviour (18% of drivers who contributed to the NRUSS in 2014) making them feel unsafe and frightened or frustrated and annoyed (Highways England, 2015). According to the road safety charity BRAKE, 44% of drivers are concerned about close-following most times that they drive on motorways; however, nearly 60% of drivers admit to leaving less than the recommended two-second gap between themselves and the vehicle in front. Business drivers may be especially at risk given their high annual mileages and their increased risk of being involved in road traffic collisions.

Essentially, crashes happen when safety margins reduce to zero. This does not happen very frequently—the average road user will never be involved in a serious traffic accident, or even sustain a minor traffic injury. Tailgating, or close following, is a widespread concern on UK roads. It makes drivers feel intimidated, aggravates congestion. In China it contributes to nearly 16% of all road traffic accidents (Duan, et al., 2013). According to Michael et al. (2000), tailgating contributed to 1835 fatalities and 653,000 injuries in 1996 in the USA alone. Evans and Wasielewski (1982) showed that in
a particular study sample, nearly half of those who drove with a time headway of less than one second had been involved in an accident sometime in the past and almost two-thirds had at least one offense on their record, whereas the corresponding figures for those with a time gap of one second or more were considerably smaller. Michael et al. (2000) reported that 27.2% of all crashes happened in Tennessee in one year were rear-end collisions and following too closely was the contributing factor in nearly a third of these cases.

Close following behaviour also affects the level of satisfaction and safety felt by SRN users. It was the third most frequently reported poor driving behaviour (18% of drivers who contributed to the National road users satisfaction survey (NRUSS) in 2014 making them feel unsafe and frightened or frustrated and annoyed (Highways England, 2015).

There is some evidence that commercial vehicles may be at increased risk of crashes due to close following. AXA Business Insurance commissioned Road Safety Analysis to analyse the circumstances of collisions involving van drivers. The majority of the research was based on the Stats19 database which holds data on all reported personal injury road collisions. The analysis looked at injuries in Britain between 2008 and 2012 involving a van and compared the circumstances to those of other vehicles. The key findings were that van drivers were more likely than other motorists to be involved in collisions on motorways or dual carriage ways and less likely on urban roads. Van drivers were less likely to be involved in collision at junctions (not including slip roads) but over represented in collisions in London, the north east, and the west midlands. The analyses showed that vans are more likely than other vehicle to be involved in collisions on weekdays and more likely to collide when reversing. The analysis of the contributory factors to road collisions involving vans found that close following, fatigue, and observational and manoeuvre errors were more prevalent in van drivers.

7.2 A Brief Empirical Review of Close Following

In traffic engineering, vehicular headway studies are carried out by measuring the gap between successive vehicles. There are two types of headways: time headways and distance headways. Researchers used various empirical methods in headway-related studies. In addition to the video recording-based techniques and manual analysis of traffic flow (e.g. Gunay 2008) driving simulators were widely used to investigate driving behaviour and reaction times (e.g. Hoffman and Mortimer, 1994, van Winsum and Brouwer, 1997). Smart car technology and instrumented or probe vehicles have enabled researchers to study car-following behaviour. Similarly, global positioning systems were facilitated in car-following studies to analyse headways, speed, acceleration and deceleration characteristics of vehicles but these applications were limited by the small number of vehicles fitted with these in-vehicle units compared with the total number of vehicles in the whole traffic population in a study area.

A recent study conducted at roadworks in Manchester found that a high percentage of drivers violating the “two-second rule” and were following too closely. The percentage of drivers’ tailgating increases after crossing the roadworks site (38%) compared with before approaching the site (24%) (Yousif, et al., 2014). Tailgating is often difficult to remediate because drivers are poor at estimating their own headway. Interestingly, while many driving skills improve with experience, drivers also reduce their safety margin. It has been demonstrated that headway decreases with increased driving experience, possibly because drivers learn that they can follow at a short headway yet avoid negative consequences (Duncan, et al., 1991).

Though a zero-safety margin equals an accident, actual safety margins in everyday traffic vary from “ample” to “very narrow”. Feedback on whether a user has kept a sufficient safety margin or not
usually only comes from a relatively limited number of “near-miss” episodes. For over 99% of their time in traffic users receive no feedback on whether their perception of situational risk is accurate, and whether their safety margin is adequate. Rajalin et al. (1997) stated that close-following leads to high accident rates, and on the basis of the interviews with drivers, they discovered that close-following becomes a ‘habit’. Drivers may maintain short headway times as they may believe that a sudden deceleration by a lead vehicle occurs rarely or as their past experiences may reinforce that driving at a short headway is fairly safe (Evans, 2004). There might also be an intentional component here, with drivers choosing shorter headways to keep others from cutting in front of their vehicles.

Whilst there is little evidence of educational interventions being effective in changing close following behaviour, a related study in which fleet-based organisations participated in ‘How’s my driving’ schemes could be cited as having the potential for tackling close following behaviour. In a study of 78 fleet companies a 53% reduction in accidents was reported (Strahilevitz, 2006). More work is needed to update this research which is now ten years old. Research involving working with stakeholders would be required to compare matched fleet-based companies that use the scheme with those that do not and compare crash rates.

**Current Research on Close Following**

An unpublished review of psychological influences on close following behaviour carried out at TRL in 2011 summarised the possible mechanisms that result in close following:

- Errors in estimating the distance to the car in front (drivers tend to overestimate this distance)
- Errors in judgement of speed required to maintain a following distance
- Differences in risk perception (i.e. the ability to comprehend the risk posed by close following)
- Differences in risk acceptance/threshold
- Social pressures – pressure to keep up with traffic flow
- Attitudes towards close following
- Aggressive driving

Drivers may tailgate because they feel under time pressure, because they want to reach their destination fast, due to fast flow of traffic, or due to emotional reasons such as anger or seeking thrill (Dorn and Matthews, 1992; Dorn and Matthews, 1995; Dorn, 2005).

Currently, a Transport Research Laboratory (TRL) pilot is currently underway funded by the Road Safety Trust requesting participation from employers with young, male drivers who undertake regular driving in light goods vehicles or cars during work, with significant mileage on motorways and major roads to take part in the study.

The selected drivers will undertake the following activities over an eight-week period:

- A 90-minute, interactive workshop exploring close following behaviour – the triggers, consequences, and potential coping mechanisms.
- Receive supporting communications packs and texts designed to remind of and prompt the desired behaviour, as well as record progress.
- A 50-minute teleconference at the end of the trial, reviewing how drivers found it and exploring progress in their own close following behaviour.

The analyses evaluating the effectiveness of this intervention will be available in 2018.
7.3 Close Following Engineering Interventions

Vehicle Engineering

Shinar and Schechtman (2002) found that drivers fail to estimate following distance accurately, and that adopting time as a measure is more prone to errors than adopting measures of length (metres or car lengths). The authors showed in a field study that providing in-vehicle feedback to drivers on immediate time headway (i.e. the elapsed time between a lead vehicle passing a certain point, and the following vehicle passing the same point) increased their following distance. Technology to provide feedback to drivers based on headways can potentially help reduce crashes.

A vehicle ahead that slows suddenly presents a number of cues to the following vehicle including brake lights, an immediate change to the following distance and even pitching cues as the lead vehicle brakes. Novice drivers tend to be over-represented in these types of crashes (Singh, 2003). Chang et al (2008) report that the average perception-response time is almost one second and this is sufficient time to respond if the driver is following two seconds behind assuming that the following vehicle is applying the brakes with the same amount of force. Significant associations between age and time headways have been reported (Taieb-Maimon and Shinar, 2001). Long glances away from the forward view increase the risk of crashing during close following (Horrey and Wickens, 2007) and it is known that young drivers in particular are prone to distraction.

Adaptive Cruise Control

Adaptive cruise control (ACC) was first introduced in passenger cars in 1995. ACC supports the driver in selecting (and then automatically maintaining) an appropriate speed and distance to the vehicle in front depending on his/her preferences and the current traffic situation. DeWinter et al (2014) investigated the effects of ACC on drivers’ workload and situation awareness through a meta-analysis and narrative review of simulator and on-road studies. Based on a total of 32 studies, the unweighted mean self-reported workload was 43.5% for manual driving and 38.6% for ACC driving suggesting there is less expended effort required when driving using ACC. Based on 12 studies, the number of tasks completed on an in-vehicle display relative to manual driving (100%) was 112% for ACC suggesting to a lesser extent that ACC drivers may complete tasks that are unrelated to driving. ACC showed an improvement in situation awareness compared to manual driving if drivers are motivated or instructed to detect objects in the environment. However, if drivers are engaged in non-driving tasks, situation awareness deteriorates for ACC compared to manual driving.

The European project euroFOT developed the first large scale Field Operational Test, with a focus on Intelligent Vehicles equipped with Advanced Driver Assistance Systems (ADAS) and used by ordinary drivers in real traffic to evaluate different on-board functions with regard to traffic safety, efficiency and the environment. Participants either owned their test vehicles, leased them during the experiment or took part as professional drivers employed by freight companies and data was collected when both ACC and a forward collision warning (FCW) system was in operation whilst driving. The FCW provides an alert to assist drivers in taking the necessary action to help avoid or reduce the severity of crashes involving the equipped vehicle striking the rear of another vehicle. It provides a warning to the driver in case the evaluation of trajectories and relative speed of the subject vehicle and the obstacle show a high probability of a collision. This function is intended to decrease drivers reaction time in case of potential rear-end accidents. It was found that ACC led to an 80% reduction in critical events.
Further results showed that for both cars and trucks the time-headway increased significantly when drivers were following a lead vehicle while using ACC+FCW. Plus, the relative frequency of harsh braking events and incidents decreased. Car drivers were three times more likely to engage in visual secondary tasks during normal driving (e.g. reading maps, looking at passengers or objects in the car) when using ACC+FCW but this difference was not found during incidents. The results imply that drivers seem to be capable of managing secondary tasks such that they focus on the road ahead when the traffic situation requires doing so. There were also positive (indirect) effects on traffic efficiency.

Projecting the safety indicators of widely deployed ACC+FCW to EU-27, it was concluded that ACC+FCW that both passenger cars and trucks would see a positive effect on the overall number of crashes. In trucks, this conclusion could only be made for motorways. It was estimated that ACC+FCW cars could potentially affect up to 2.2-5.7% of the injury accidents on motorways, while ACC+FCW trucks could potentially affect up to 0.2-0.6% of these accidents but these estimates should be used with caution. Due to the potential reduction of accidents the annual incidental delay calculated in lost vehicle hours could be lowered by up to three million hours on an EU-27 level.

Birrell et al. (2014) reported significant increase in mean headway in a real-world on-road driving trials implementing short headways warnings. There was no difference in lane keeping parameters between a control group and the experimental group, suggesting that the drivers were not distracted when using the lane keeping warning system. In Canada, Merrikhpour et al (2014) conducted a field trial with 37 participants with a system installed in participants’ own vehicles providing real-time in-vehicle feedback based on speed limit compliance and safe headway maintenance. Participants also accumulated reward points and could view related information on a secured website. The trial consisted of three phases: baseline (two weeks), intervention with the system (twelve weeks), and post-intervention without the system (two weeks). The results revealed two driving styles: more speed and headway compliant (Cluster A), less speed and headway compliant (Cluster B). Overall, the intervention closed the gap between the two groups. For headway compliance, Cluster A did not have any changes throughout the trial, whereas for Cluster B, the headway compliance rate increased with the intervention and then decreased slightly in the post-intervention phase, which was still better than the baseline. It appears that the group of drivers who were less speed and headway compliant during the baseline benefited more from it.

Although promising results were found for the feedback-reward system, the observed benefits could be due to either feedback, or reward, or the unique combination of both. Future research should isolate these relative contributions.

**Automatic Emergency Braking**

Automatic Emergency Braking (AEB) systems address the issue of failure to look properly (and/or act upon this information) by offering urgent warnings and autonomous braking action if a collision is
deemed imminent/unavoidable—when the calculated Time-to-collision (TTC) is typically less than two seconds. In order to avoid “false-positive” events (unwarranted emergency braking), AEB systems only respond to hazards that are detected with a high level of certainty. AEB will autonomously brake the car in those rare situations where human reaction time is not fast enough to avoid a crash. If a driver is only confronted with an AEB-stop once every year, there is little learning taking place. If a driver gets feedback on his distance-keeping behaviour throughout every drive, and this frequent feedback nudges him to keep a longer distance there will be more learning; keeping greater distance (either self-regulated or through more frequent use of ACC) is more likely to become a habit.

Static Road Signs

Studies have considered static signs advising against tailgating, and have found some positive behavioural changes in response to the signs (e.g. Michael, Leeming and Dwyer, 2000). Michael et al (2000) implemented a method to collect headway data in an urban setting for over 25,000 drivers. Two hand-held roadside signs admonishing drivers not to tailgate in which one referenced ‘crashes' had a significantly positive impact on drivers’ headway. Drivers followed with an average headway of 2.11 s when the sign was absent compared to an average headway of 2.29 s when the sign was present. When the sign was absent, 49.4% of the drivers were in compliance with the 2-second rule compared to 57.5% when the sign was present. The percentage of drivers who followed with a headway of less than 1 s decreased from 7.3 when the sign was absent to 3.0 when the sign was present. Additionally, there was an increase of 10.6 ft in vehicle separation from baseline to intervention.

In 2006, the Minnesota Departments of Transportation and Public Safety partnered with other stakeholders to pilot a Tailgating Treatment Program. The Minnesota project was viewed as a tool to educate motorists on how to identify and maintain a minimum safe following distance, and ultimately to reduce rear end crashes. A section of State Highway was used to paint 94 elliptical dots, spaced 225 feet apart, along a two-mile segment of the rural, single-lane, 55 mile-per-hour roadway. The study corridor had an estimated average travel rate of 16,000 vehicles per day, no dedicated left turn lanes, minimal grade differences, and no congestion issues. In addition to the dots, a series of four different signs directing motorists to maintain at least two dots between them and the vehicle ahead were placed along the corridor. To maintain consistency with information currently provided through driver training and other safe driving programs, the project used the three-second minimum safe following distance strategy. The project did not include an enhanced enforcement component. This provided an opportunity to evaluate the engineering and public information components in modifying driver behaviour independent of an enhanced enforcement deterrent. The public was informed of the project through the distribution of informational handouts. The project received television, radio and print coverage throughout the state, as well as national coverage by the New York Times and other publications outside Minnesota. Evaluation Criteria: Vehicle headway data was collected for 48 hours prior to and after installation of the pavement marking dots and signs. Traffic counting tubes were set one-mile prior to the beginning of the marking location, at the mid-point of the marking location, and one-mile after the marking location, in both east and west bound lanes. The raw data was filtered to exclude vehicles following at seven seconds or more, vehicles traveling under 45 mph, and vehicles with more than two axles. The combination of all data collection points showed an increased average gap from 2.35 to 2.52 seconds, or 14.1 feet. The greatest average increase occurred at the mid-point location, where the average gap increased from 2.36 to 2.62 seconds or 22.9ft. The average gap increased from 2.49 to 2.64 seconds, or 12.9ft at the points placed one-mile after the marking locations.
This evidence suggests that there could be an advantage of the use of signage on the SRN however, further research is required.

Variable Messaging Signs

A variable message sign, often abbreviated VMS and in the UK known as a matrix sign - is an electronic traffic sign often used on roadways to give SRN users information about special events. Such signs warn of traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific highway segment. They may also ask vehicles to take alternative routes, limit travel speed, warn of duration and location of the incidents or just inform of the traffic conditions. Variable message signs (VMS) are increasingly being used to provide drivers with up-to-date dynamic information to inform drivers as well as influence driver behaviour. Truck-mounted VMSes are sometimes dispatched to warn traffic of incidents such as accidents in areas where permanent VMSes are not available or near enough as a preventive measure for reducing secondary accidents. Trailer-mounted variable-message signs are used to alter traffic patterns near work zones, and for traffic management for special events, natural disasters, and other temporary traffic patterns. The messages displayed on the sign can be programmed locally on the unit’s control panel, or units equipped with a cellular modem can be programmed remotely via computer or phone.

Previous studies have reported the influence of adverse driving condition information displayed on VMS and found some messages resulted in reduced driving speeds for relatively short distances after the display, but they were dependent on the content of the display, its conspicuity and the ‘novelty value’ of new message types (Luoma et al. 2000). Bai et al. (2010) suggests that the use of text-based message signs alongside traditional road signs could be the most effective combination of signage to reduce driver speed through road work zones. Variable message signs have been shown to be effective in increasing headway and reducing traffic speed, for example in Finland a VMS showing a minimum headway sign decreased the proportion of short headways (Rämä, 2001).

Schroeder and Demetsky (2010) investigated the effects of message signs on driver behaviour using analysis of traffic volumes and driver speed on a section of interstate highway in Virginia, USA. They found a trend towards increased rates of diversion when the legend displayed indicated the number of lanes closed (TWO LEFT LANES CLOSED) rather than a more general message (LEFT LANES CLOSED) or one with no direction information (INCIDENT AHEAD). Messages suggesting alternative routes were more effective for diverting traffic. They also looked at specific wording of legends on driver behaviour and found that wording such as MAJOR ACCIDENT produced greater rates of diversion than ACCIDENT and that the use of abbreviations such as ALT rather than ALTERNATIVE appeared to be less understood by drivers.

This influence of level of detail on driver behaviour is reinforced by Bonsall and Palmer (1999) who found that there were differences between causes of delays in the compliance with route diversion suggestions. Where the cause was ‘ROADWORKS’ rather than ‘ACCIDENT’, compliance reduced considerably. Driving behaviour may be influenced by the behaviour of other drivers however. Pedic and Ezrakhovich (1999) found that VMS information was effective in reducing speed violations, but only where the majority of other drivers complied with the speed limit too.

Sharples et al (2016) makes a number of recommendations regarding sign design based on their study:-

- There is a value in repetition - repetition of signs up to three times does not seem to adversely affect trust or annoy drivers excessively
Give instructions if a change in behaviour is required—e.g. ‘Keep Left’ it is better to explicitly instruct this action  
Include detail where space allows on the VMS as it improves trust  
Provide instructions and advice that seems sensible  
Be specific and meaningful e.g. explaining the dis-benefits of close following.

Future sign content and presentation research need to take account of these developments if they are to be used to address close following behaviour.

One possibility is to include a ‘watching eyes’ intervention on signage. MeLeady et al (2017) found that the mere presence of a sign about air quality has limited impact on a driver’s willingness to turn off their engine at a railway crossing to reduce pollution. However, the presence of “watching eyes” had a positive effect when presented in conjunction with an explicit behavioural standard (instruction). However, the most effective mechanism for encouraging drivers to turn off their ignitions was to induce private self-focus (i.e., self-focus that does not evoke reputational concern). The private self-focus condition had a larger effect than the public self-focus (watching eyes) conditions. These findings reinforce the importance of engaging the self in behaviour change, but beyond this suggest that when behaviour is not easily publicly observable, it may be most effective to stimulate private rather than public self-focus. Watching eyes are regarded as an implicit reputational cue, activating automatic, subconscious processing. The private self-focus instructions, however, prompted a conscious reflection (“think of yourself”) to encourage drivers to switch off their engines. It may be that while the watching eyes intervention implicitly triggers self-awareness, the private self-focus instructions trigger more conscious self-referential processing of the behavioural instructions. Watching eyes could be used on the SRN with a message to improve close following.

7.4 Close Following Educational Interventions

Hazard Perception Training

Several studies have found a link between poor hazard perception skills and crash involvement, so it is reasonable to assume that improving hazard perception skills is likely to lead to improved road safety. Furthermore, there is evidence of behavioural change as an outcome of hazard perception training, mainly focused around changes in visual search strategies that seem to endure for at least a week post-intervention. Previous research has also demonstrated the transfer of computer-based hazard perception training to on-road measures (Isler et al., 2011; Pradhan et al., 2009) and provides some grounds for optimism.

Most rear-end collisions do not involve close following but about 70% are due to the lead vehicle being stopped or slowing (Knipling, et al., 1993; Sorock, et al., 1996). Rear end collisions are more likely to happen when there is greater variability in traffic speed (Taylor, et al., 2000). Therefore the driver needs to be better at recognising that the vehicle ahead has stopped or slowed. One of the problems in this scenario is that the lead vehicles brake lights may not be on and this would serve as a major cue for the following vehicle to slow down. Detecting that the vehicle ahead has stopped or slowed requires a wide and frequent visual scan of the forward view. Novice drivers may be particularly prone to close following when using a mobile phone whilst driving (Lamble, et al., 1999). This suggests that hazard perception training might be a useful educational intervention to improve the ability of young drivers to scan the forward view for evidence that the vehicles ahead may be slowing.

Where and when to look can be trained using filmed traffic clips and simulators to improve hazard perception skills (Deery, 1999; Isler, et al., 2009; McKenna, et al., 2006; Pradhan, et al., 2009; Wetton,
et al., 2010; Horswill, et al., 2013). For example, Chapman et al. (2002) showed a significant increase in the variance of horizontal search after training compared with a control group and this effect persisted for several months. Petzoldt et al (2013) used PC-based hazard perception training materials. The results confirmed that hazard perception training had a positive effect on participants’ glance behaviour. Participants in the experimental group were faster in fixating on the hazard indicator, and faster in completing a critical glance sequence than a control group.

A study to investigate the benefit of hazard perception training on the development of hazard perception skills was conducted on 78 experienced drivers who had held an open driving licence for a minimum of 10 years and were recruited via their company (Horswill et al., 2013). Experienced drivers were randomly assigned to either a hazard perception trained group (n = 36) or a placebo control group (n = 42). A laptop with a LCD screen was used for all computer-based tests and training tasks. A Hazard perception test (HPT) was used to evaluate the benefit of the hazard perception training. The results showed that experienced drivers’ hazard perception test performance was improved with 20 min of video-based hazard perception training. Those experienced drivers who received the hazard perception training intervention responded significantly faster to hazards than those who received the placebo intervention, both immediately following the intervention and after a delay of at least one week. There was no evidence that the training effect decayed during the delay.

Hazard perception training can be streamed on the web meaning that hundreds of thousands of drivers can access the training at the same time. Most importantly, automatic feedback on the trainee’s responses to the sequences is provided in a constructive way with the facility to replay a sequence for improved learning. Training to encourage visual search for a looming vehicle ahead could be especially useful. Future research could focus on the development of hazard perception clips to present close follow scenarios that aim to develop hazard perception skills. Filming can take place in different weather and light conditions including in ice, in the rain and at night, given the increased risk associated with driving under difficult conditions (Konstantopoulos et al., 2010).

DriveiQ Software

DriveiQ is a not-for-profit community interest company, funded by corporate sponsorship so that it is free at the point of use for young people. Drive iQ software is currently available in 1500 schools and colleges across the UK, with more than half the schools making time for its use within the curriculum. The Drive iQ interactive online modules cover thirty core topics including a hazard perception module called Eye scanning. Some of these modules can be completed before starting to learn to drive such as anticipating danger, risk assessment emotional response, eye scanning and impulse control. Other modules can be taken alongside practical driving lessons and following driving test passes, covering matters such as motorway driving. DriveiQ video sequences that have three rearward mirror views synchronized with the forward action. Part of a car’s interior is also visible in the foreground so that normal instruments (particularly the speedometer) are displayed in the field of view on screen. Clips pause at a pre-determined position which is unknown to the trainee. A question is then presented either on the events that have just transpired or on how the scenario will develop. Immediate feedback is provided to responses to cement learning, along with the option to replay the clip to revisit what the trainee got wrong or right. An evaluation study of DriveiQ in New Zealand showed that the training materials led to novice drivers attaining a level of hazard perception that was equal to experienced drivers, compared with a control group of novice drivers (Isler et al., 2009).

It is also important to state that there are currently no studies showing that hazard perception training can reduce collisions for any age group. Hazard perception training has not been proven for its
potential for reducing crash risk mainly because there are practical difficulties associated with such an investigation. It would require a large sample of novice drivers to complete online training sessions and then be followed for a period of time to collect data on crash involvement rates compared with a control group. The Department for Transport is currently undertaking a major trial to evaluate hazard perception training.

The TailGuardian

TailGuardian is an interactive-deterrent system for its ability to reduce close following behaviour. Tail Guardian is a vehicle activated sign that presents a message to drivers when their headway is below a certain threshold. The TailGuardian combines advice and an interactive-deterrent system to encourage drivers to consider the suitability of their following distance. In an unpublished TRL report, a range of interventions to reduce close following have been identified by Palmer et al; the TailGuardian device was recommended for trialling, and the devices were subsequently rolled out to national fleet operators. The TailGuardian combines advice and interactive-deterrent elements to encourage drivers to ensure they are driving with an appropriate headway.

The TailGuardian system uses specially designed 'intelligent' signs that can be quickly and easily applied to the rear of vehicles. When following a vehicle displaying such signs, a warning will reveal itself to other drivers who are following too closely. The concept works by using filtering algorithms to enhance parts of the sign at the perception threshold which do not attract attention beyond a specific distance. By calibrating the images differently, each warning sign ‘appear’ at a correctly set safety distance, whilst remaining apparently invisible outside that distance. The medium of delivery - as an inexpensive, adhesive sign.

Trials were conducted to evaluate the effectiveness of the sign and involved the distribution of 4,470 signs delivered to fleet operators for deployment on their vehicles. This was far less than anticipated and insufficient incident data were collected to allow an analysis of its effectiveness. In a subsequent study, Delmonte et al (2014) investigated the effectiveness of the TailGuardian on drivers’ self-reported close following intentions using a self-completion survey. Surveys were completed by drivers at two service stations on the M25 and 227 drivers participated. The study found that TailGuardian exposure and awareness was found to be low relative to that of other signs and vehicle stickers of those, participant recognised the decal as a close following deterrent, but did not understand its precise meaning. However, drivers reported that they would increase their following distance after seeing the TailGuardian. The study also reported that those reporting greater tendencies to close follow were more likely to hold negative attitudes towards the behaviour, and reported that they would increase their following distance to a lesser extent than those with a low tendency to close follow. This study shows that providing information to drivers about an intervention appears to be important in ensuring a positive impact on driver behaviour.

TailGuardian report another study on their website conducted by a national bus company suggesting a reduction in collisions but this report could not be sourced in the literature or online. The trail apparently involved 150 buses and showed a 60% decrease in rear end shunts on buses fitted with TailGuardian.

Multiple StakeHolder Campaigns

Amongst academics there is a consensus that public communication campaigns can be effective, if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015; Atkin and Rice, 2012).
Several meta-analyses have found that on average campaign effects result in a 9% reduction of road traffic accidents with significant variations regarding the topic of the campaign, additional enforcements (e.g., new laws or increased police controls), campaign duration, and communication channels (Delhomme, et al., 2009; Elvik, et al., 2009).

To reduce close following behaviour the general consensus is that target groups should be selected to address clear goals and tailored messages designed to influence knowledge, attitudes, and behaviour.

Highways England segmentation analyses of SRN users has revealed distinct categories according to dimensions of confidence and frequency of SRN use: Respectful; Speedy; Superior; Nervous and Steady.

Figure 7 - Segmentation Analyses of SRN Users
### An Intervention Framework for Safer Driver Behaviour: Close Following Behaviour

<table>
<thead>
<tr>
<th>Segment Name</th>
<th>Defined by</th>
<th>Dominant demographic</th>
<th>Journeys</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERIOR 13%</td>
<td>HIGH FREQUENCY</td>
<td>Affluent mature working males</td>
<td>AM peak</td>
<td>Tuned into road quality/design. Keep traffic moving, prevent incidents or poor drivers. Build their trust/belief in Highways England abilities.</td>
</tr>
<tr>
<td>Experienced, confident drivers, intolerant of others</td>
<td>HIGH CONFIDENCE 40+ years MED/HIGH MILES LONG EXPERIENCE</td>
<td>Post/Older families</td>
<td>Repetitive, familiar journeys</td>
<td></td>
</tr>
<tr>
<td>SPEEDY 9%</td>
<td>HIGH FREQUENCY</td>
<td>Young working males</td>
<td>AM peak</td>
<td>Want Highways England to improve the road network so they can use them to their maximum capacity. Always trying to get there quicker, taking risks in the process.</td>
</tr>
<tr>
<td>Overly confident fast drivers, risk takers</td>
<td>VERY HIGH CONFIDENCE U40 years HIGH MILES MED EXPERIENCE</td>
<td>Pre/Young families</td>
<td>Repetitive, familiar journeys Mobile app users</td>
<td></td>
</tr>
<tr>
<td>STEADY 25%</td>
<td>HIGH FREQUENCY</td>
<td>U45 years</td>
<td>Daytime off peak</td>
<td>Willing to slow down to be safe. On the road frequently. Keen for Highways England to control traffic levels to reduce stress, particularly when there are road incidents.</td>
</tr>
<tr>
<td>Careful drivers, who do not enjoy the experience</td>
<td>LOW/MED CONFIDENCE MED MILES MED EXPERIENCE DISLIKE MOTORWAYS</td>
<td>Working females ABC1</td>
<td>Similar/familiar routes</td>
<td></td>
</tr>
</tbody>
</table>
## An Intervention Framework for Safer Driver Behaviour: Close Following Behaviour

<table>
<thead>
<tr>
<th>Segment Name</th>
<th>Defined by</th>
<th>Dominant demographic</th>
<th>Journeys</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NERVOUS 31%</td>
<td>LOW FREQUENCY</td>
<td>Mature females</td>
<td>Off peak, less familiar journeys</td>
<td>Lack confidence and require support. Want Highways England to ensure predictable traffic flow. Better planning and communication is critical for this group.</td>
</tr>
<tr>
<td>Less frequent, less confident drivers</td>
<td>LOW/MED CONFIDENCE</td>
<td>Post/Older families</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW MILES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONG EXPERIENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESPECTFUL 22%</td>
<td>LOW FREQUENCY</td>
<td>Mature Males</td>
<td>No set time, familiar journeys</td>
<td>Careful, patient and tolerant of others. Want Highways England to invest to make the network modern, with efficient accident/incident management and proper information to rival sat nav.</td>
</tr>
<tr>
<td>Confident, prudent drivers</td>
<td>HIGH CONFIDENCE</td>
<td>C1/C2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW MILES</td>
<td></td>
<td>Older couples, still working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONG EXPERIENCE</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Table 7 - Segmentation Analyses of SRN Users
Based on these segments, particular messages can be tailored to influence those SRN users that are more likely to close follow or be affected negatively by close following behaviour from other road users. The segments requiring specific interventions from a close following perspective are Superior, Speedy and Nervous and the rationale is provided below.

**The ‘Superior’ User** - need to feel in control of their journey but are not great at journey planning as they are often in a hurry. They pride themselves on being ‘better drivers than other people’ and report that they don’t take risks on the road. They are intolerant of other drivers and of Highway England inefficiency complaining about slow, middle lane, lack of driver experience, and a slow response by Highways England to incidents and accidents. For them, efficiency is paramount – they are busy, want to get to places quickly and will mindfully speed (80 mph on motorway). This kind of user may adopt very narrow safety margins and close follow perhaps to intimidate other road users to get out of their way.

**The ‘Speedy’ User** – tend to be young 20-something males who have just passed their test who like to drive fast beyond the speed limit and often hit 100 mph on the motorways. They report not always paying attention to the road signage and sometimes ignore Red X, VMS until the last moment. They are risk takers if it means they will get to their destination quicker. They lack tolerance of roadworks that slow them down but seem oblivious to other drivers unless they are driving slowly. Becoming irritated by slower drivers on the SRN could lead to close following by this particular user type.

**The ‘Nervous’ User** - Although happy driving on minor roads, they do not enjoy motorway driving and lack confidence and avoid SRN where possible. They fear of large and fast vehicles means they are only comfortable in the middle lane where they can minimize manoeuvres. Pain moments far outweigh pleasurable moments and they only feel really comfortable when the roads are empty and journeys are completely predictable. Although they always comply with the road rules but lack of frequency of usage can lead to lower comprehension of VMS, red X etc. They want Highways England to ensure traffic flow is predictable as possible, restrict HGV usage and ensure roads are well lit. Better planning sites and communication is critical for this audience. They are likely to drive too slowly and may use the wrong lanes at time. This means that they can be intimidated by someone close following and commit errors leading to crashes.

### 7.5 Close Following Enforcement Interventions

Other than financial penalties, penalty points and disqualification ancillary orders are the main means of deterring and punishing motoring offenders and are aimed to have an effect on offenders’ future driving behaviour. Several major international reviews show that the introduction of points systems positively modifies driver behaviour until the realisation of a low detection risk. Research has shown that there is a ‘fear of penalty points’ and is at its greatest when speeding drivers are at risk of disqualification at next prosecution. Compliance with traffic laws is therefore greater when drivers have 9 points rather than fewer (Broughton 2008, Corbett et al 2008). An effective visible enforcement must be in place to back up the threat of points. Cameras are one means of providing this although some elements of dangerous and careless driving will not be captured by camera and can only be controlled via a dedicated and visible traffic patrol vehicles.

A comprehensive meta-analysis of the effects of a penalty point system on road traffic accidents and the duration of these effects was conducted by Castillo-Manzano and Castro Nuno (2012). The findings show that the strong initial positive impact (15 to 20% reductions in accidents, fatalities and injuries) seems to wear off in under eighteen months with a strong initial shock. The findings suggest improved behaviour with a mean reduction of 30% in traffic violations as well as a mean reduction of over 50%
in hospitalizations and A&E admissions. The major effect seems to last under 18 months. This limited effectiveness is related to the absence of complementary enforcement to back up these measures. The following section present the evidence relating to the Highways England own Compliance Monitoring Tool as a technology aimed at enforcing safer driver behaviour by providing a continual presence.

**Compliance Monitoring Tool**

Gunay (2008) was the first to theoretically investigate the stochastic nature of two vehicles being in a 'macroscopic' car-following state based on a possible ANPR system application. The detectability of drivers' time headway preferences will lead to a number of useful practical applications to be considered by Highways England. For example, if Highways England can identify those vehicles that have a tendency to keep short headways in most of the captures, then the drivers of these vehicles can be contacted and warned for safer roads. More recently Gunay (2012) used a set of ANPR data collected in the Republic of Ireland found that the ratio of standard deviation to the mean of the time headways (when vehicle identities are taken into consideration) was smaller than that of the headways obtained from the overall population without any number plate identities and suggested more research was required.

Use of camera-based systems to catch tailgating drivers using a configurable system taking into account headway, vehicle average speed, evidence of sustained behaviour over distance has been investigated (see (Narroway, 2014)). The Compliance Monitoring Tool (CMT) is a Highways England tool potentially capable of detecting close following on the SRN supported by temporary ANPR equipment to capture offences. The CMP is a system that utilises cameras operated and owned by Highways England and by other organisations and Agencies and ANPR cameras for crime prevention purposes, the DVLA and Vehicle and Operator Services Agency (VOSA). Since November 2016 thousands of letters, accompanied by educational information leaflets and online feedback requests, have been sent to drivers misusing the hard shoulder or contravening a Red X signal on sections of the M6. Where repeat non-compliance has been identified the police are undertaking additional investigations. An initial trial in 2013/14 issued 700 letters to repeat hard shoulder offenders (i.e. those using the closed hard shoulder more than once during the monitoring period). Only 4% of those drivers were identified as re-offending during the subsequent monitoring period of September 2013 to April 2014.

A warning letter system in partnership with the police and Driver and Vehicle Licensing Agency (DVLA) could be introduced for close following. The CMT can be used to measure a baseline of close following before sending out warning letters and used to monitor compliance after the intervention. However, a clear definition of what constitutes close following is required in collaboration with the police so that incidents can be reliably detected. Prior to any automated signal enforcement triggering warning letters for close following, a customer awareness campaign should be rolled out. Highways England has a warning letter trial in progress for close following with results expected in the summer of 2017. The aim is to issue a nominal amount of letters for a limited number of trial detection sites. A leaflet is also included along with information about logging into a portal in which feedback can be gathered about the offence to build up Highways England understanding.

### 7.6 Conclusions

The literature review found that there are relatively few interventions (compared to other unsafe driver behaviours such as speeding) that have attempted to combat the problem of close following.
Interventions to tackle close following tend to be in-vehicle in nature and studies suggest they have the potential to reduce crash involvement by increasing safety margins but there is insufficient evidence of their impact on KSIs to date. In particular, there is insufficient reference to methods that target behavioural norms and motivations as an approach to reduce close following behaviour. There

Recommendations

- In-vehicle nudging interventions such as ACC and forward collision warnings could be promoted by Highways England for an increased usage on the SRN.
- Variable message signs appear to have a positive impact on driver behaviour and could be utilised more effectively for reducing close following behaviour on the SRN.
- There is some evidence that TailGuardian could be an effective method of tackling close following behaviour, but more work is needed to pilot its impact.
- Hazard perception training may be an effective method of improving visual search strategies to reduce rear-end collisions on the SRN.
- A multi-stakeholder campaign to address close following is recommended taking into account different target segments of the driving population (see section 5.5)
- Recent enforcement initiatives by Highways England via the CMT hold promise for detecting close following and nudging drivers towards greater compliance via warning letters.

7.7 Close Following Intervention Matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address close following and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘hug’.
<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>Variable message signs “Keep your distance” (UK) or minimum advised headway (Finland)</td>
<td>Real life dash cam footage of tailgating incidents</td>
<td>Fixed penalty notices for careless driving including tailgating</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td>Warm, non-shock adverts against tailgating TailGuardian Advice websites and forums offering tips and explanations Highways England compliance monitoring tool warning letter trial in progress till summer 2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Headway Evaluation System Motorway distance chevrons painted on the road surface Telematics feedback which may indicate limited headway Dash cams that record own behaviour as well as the behaviour of others Minnesota distance dots</td>
<td>Tail Guardian</td>
<td>Camera-based systems to detect tailgating</td>
</tr>
<tr>
<td><strong>Educate</strong></td>
<td>Educational video on how to gauge following distance using two second rule</td>
<td>Behavioural advice using third-party perspective to increase buy-in</td>
<td>Driver Awareness Course participation for offenders</td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>The Van Excellence Code</td>
<td>Driver monitoring and feedback on headway Fleet driver feedback on headway</td>
<td></td>
</tr>
</tbody>
</table>

*Table 8 – Close following behaviour intervention matrix*
1. Warm, non-shock adverts against tailgating

Positive non-threatening advertising against close following behaviour, e.g. Association of Personal Injury Lawyers Safety Watch campaign video “A lesson in social graces – tailgating” https://www.youtube.com/watch?v=A0B0n7Tk6GY, and Facebook “Back Off” campaign https://www.facebook.com/APILBackOH/.

August 19, 2015 was Injury Prevention Day and the Association of Personal Injury Lawyers (APIL) raised awareness of the dangers of ‘tailgating’ using the above video.

2. Fixed penalty notices for careless driving including tailgating


In Germany tailgating is punishable with a fine of up to €400. In case of gross negligence one or more penalty points are given and the driver’s license may additionally be immediately suspended for up to three months (“Abstand und Abstandsvergehen” [Distance and Distance Offense] (in German). 2015.)

3. Behavioural advice using third-party perspective to increase buy-in

Advice from insurers, road safety organisations, or well-established information sources, using perspective of the third party on dealing with tailgating, may increase awareness of the problem in culprits e.g. https://www.confused.com/on-the-road/safety/too-close-for-comfort-how-to-deal-with-tailgaters, http://www.wikihow.com/Handle-Tailgaters-on-the-Road

4. Motorway distance chevrons painted on the road surface

Chevrons painted on the road surface to indicate correct distance between vehicles travelling at the posted speed limit, used extensively in the UK and recently in the Middle East, found in the UK to reduce crashes by 56% (Helliar-Symons and Butler, 1995) https://tri.co.uk/reports/PR118, http://www.thenational.ae/uae/transport/chevron-road-markings-could-reduce-tailgating-in-the-uae-experts-say

5. Variable message signs “Keep your distance” (UK) or minimum advised headway (Finland)

Variable message signs have been shown to be effective in increasing headway and reducing traffic speed, for example in Finland a VMS showing a minimum headway sign decreased the proportion of short headways (Rämä, 2001).

6. Tail guardian

Interactive-deterrent systems – vehicle activated signs which present a safety warning message when headway is detected as below acceptable threshold (see Gorell, et al., 2003) but algorithms need validation. Tail Guardian signs are in use with: Stagecoach (750 coaches), Arriva (1200 buses), The Highways Agency (7000 vehicles), Driving Schools (1300 vehicles) and thousands of other smaller organisations and individual car owners. http://www.tailguardian.com/ see (Delmonte, et al., 2014).

7. Advice websites and forums offering tips and explanations


8. Camera-based systems to detect tailgating

Use of camera-based systems to catch tailgating drivers using a configurable system taking into account headway, vehicle average speed, evidence of sustained behaviour over distance (see (Narroway, 2014)). Gunay (2012) investigates whether more meaningful interpretation of time headways could be achieved when vehicle identities are taken into account as opposed to the conventional headway studies with no vehicle identification. The idea of spotting those vehicles that are in close car-following mode, through ANPR technology in the Republic of Ireland found that the distribution of headways with respect to time was more skewed to the right compared with the overall distribution of all data that had no particular reference to the vehicle identities. The ratio of standard deviation to the mean of the time headways (when vehicle identities are taken into consideration) was smaller than that of the headways obtained from the overall...
population without any number plate identities. More research is required to explore the issue further from both points of view of academic studies and enforcement bodies. Highways England due to monitor close following on the M3 and issue warning letters.

9. **Driver Awareness Course participation for offenders**


10. **Telematics feedback which may indicate limited headway**

High levels of speed change (celeration) are indicative of a few core risky behaviours, one of which is close following (see af Wåhlberg, 2008).

11. **Educational video on how to gauge following distance using two second rule**

A US study used an educational video to help drivers understand how to gauge their following distance and adjust it accordingly, and found that vehicle headway was significantly increased by 0.84 seconds (Wang and Song, 2011).

12. **Real life dash cam footage of tailgating incidents**

Whilst “shock tactics” have been found to be generally ineffective, there is an increase in the availability of real-life on-road video examples of the potential consequences of tailgating, e.g. a US truck driver’s video of a tailgating incident in Arizona which was spectacular but did not result in any injuries [http://www.azcentral.com/story/news/local/arizona/2016/08/05/video-shows-dangers-of-tailgating/88316936/](http://www.azcentral.com/story/news/local/arizona/2016/08/05/video-shows-dangers-of-tailgating/88316936/).

13. **Driver monitoring and feedback on headway**

In vehicle monitoring systems which utilise headway monitoring as a key component of data collection and feedback to the driver in real time provide useful support for positive behaviours in relation to following distances. In a large-scale field test of intelligent vehicle systems called EuroFOT found that Adaptive Cruise Control (ACC) led to an 80% reduction in critical events for ACC. A model of driver response to rear-end crash scenarios can identify more appropriate and timely information to be displayed to the driver e.g. Foot-LITE system. (see Birrell, et al (2012)).

14. **Fleet driver feedback on headway**

Rear-end crashes are one of the major crash types involving heavy trucks and are more likely than other crash types to result in fatalities. Data from a ten-month naturalistic driving study were used. Participants were 18 professional heavy-truck drivers who received warnings during the last eight months of the study (treatment period) but not during the first two months (baseline period). Time headway and driver’s brake reaction time were extracted and compared with condition variables, including one between-subjects variable (driver shift) and five within-subjects variables (treatment condition, roadway types, traffic density, wiper state, and trailer configuration). The presence of warnings resulted in a 0.28s increase of mean time headway with dense on-road traffic and a 0.20s increase with wipers on. Drivers also responded to the forward conflicts significantly faster (by 0.26s, a 15% enhancement) in the treatment condition compared with responses in the baseline condition. The installation of such in-vehicle crash warning systems can help heavy-truck drivers keep longer headway distances in challenging situations and respond quicker to potential traffic conflicts (Bao, et al., 2012).

15. **Headway Evaluation System**

Novice drivers were compared with fully licensed drivers as they applied existing headway interventions in a driving simulator with an automated, reward-based approach to encourage longer headways. Drivers are poor at estimating their own headway and even when applying the 2 second rule intervention, fully licensed drivers overestimate their headway. The authors used positive feedback to encourage longer headways using an in-vehicle display called a headway evaluation system. The system yielded headways that were greater than those achieved with the 2 second rule and that were more conducive to drivers recognizing and evading potential rear-end collisions (Ramkhalawansingh and Trick, 2015).

16. **Police Close Following Enforcement in Dubai**
Police in Dubai launched an anti-tailgating campaign to warn motorists of the risks of following dangerously close to cars ahead - a major cause of rear-end collisions. The Abu Dhabi Police said that the call for impatient drivers to leave substantial space between vehicles would prevent deadly accidents and expensive wrecks. As part of the campaign, police patrolled the capital in undercover taxis, lorries and unmarked sedans. Motorists caught bullying other cars by driving too closely behind were fined and received four black demerit points from their licences.

17. Minnesota Distance Dots.

In 2006, the Minnesota Departments of Transportation and Public Safety partnered with the Wright County Highway Department and the Safe Communities Coalition of Wright County to pilot a Tailgating Treatment Program. The Minnesota project was viewed as a tool to educate motorists on how to identify and maintain a minimum safe following distance, and ultimately to reduce rear end crashes. A section of State Highway 55 in Wright County was used to paint 94 elliptical dots, spaced 225 feet apart, along a two-mile segment of the rural, single-lane, 55 mile-per-hour roadway. The dots were painted within a section of Highway 55 that was previously designated a “Toward Zero Deaths” corridor. The study corridor had an estimated average travel rate of 16,000 vehicles per day, no dedicated left turn lanes, minimal grade differences, and no congestion issues. In addition to the dots, a series of four different signs directing motorists to maintain at least two dots between them and the vehicle ahead were placed along the corridor. Following Distance: To maintain consistency with information currently provided through driver training and other safe driving programs, the project used the three-second minimum safe following distance strategy. Law Enforcement Activity: The project did not include an enhanced enforcement component. This provided an opportunity to evaluate the engineering and public information components in modifying driver behaviour independent of an enhanced enforcement deterrent. 

Public Information Campaign: The public was informed of the project through the distribution of informational handouts. The project received television, radio and print coverage throughout the state, as well as national coverage by the New York Times and other publications outside Minnesota. Evaluation Criteria: Vehicle headway data was collected for 48 hours prior to and after installation of the pavement marking dots and signs. Traffic counting tubes were set one-mile prior to the beginning of the marking location, at the mid-point of the marking location, and one-mile after the marking location, in both east and west bound lanes. The raw data was filtered to exclude vehicles following at seven seconds or more, vehicles traveling under 45 mph, and vehicles with more than two axles. Outcome: The combination of all data collection points showed an increased average gap from 2.35 to 2.52 seconds, or 14.1 feet. The greatest average increase occurred at the mid-point location, where the average gap increased from 2.36 to 2.62 seconds or 22.9ft. The average gap increased from 2.49 to 2.64 seconds, or 12.9ft at the points placed one-mile after the marking locations.

18. Connecticut Tailgating Enforcement Campaign

Stop Tailgating, You’re Too Close - Connecticut State Police targeted tailgating motorists on highways in an effort to reduce accidents and what they call "aggressive driving habits." The campaign called "Stop Tailgating, You’re Too Close" ran throughout March on limited-access highways. Statistics show 31% of the accidents are the results of drives following too close. The majority of those crashes happened between 1pm and 5pm. Drivers between the ages of 16 and 35 were said to account for 40% of reckless driving accidents State wide last year. State police said many offenders are distracted, possibly by texting or a hand-held device. The first offense is $150, second offense $300 and the third offense is $500.

19. The Van Excellence Code
Van Excellence is a scheme designed by some of the best van operators in the UK; facilitated and managed by FTA to recognise excellence and improve operational standards. At its heart is the Van Excellence Code which is a Code of Practice outlining ‘what good looks like’ in van operations. With The Code established, the accreditation scheme has been developed to allow operators to ensure their standards of operation meet the requirements as laid out in the Code. [http://www.vanexcellence.co.uk/about/what-is-van-excellence.html](http://www.vanexcellence.co.uk/about/what-is-van-excellence.html)

**20. Highways England Compliance monitoring tool warning letter trial**

Highways England has a warning letter trial in progress with results expected in the summer of 2017 with the aim of issuing a nominal amount of letters but there are a limited number of trial detection sites. The Compliance Monitoring Tool (CMT) will detect close following and enable letters to be sent to warn drivers about the offence. A leaflet is also included along with a portal in which feedback can be gathered about the offence to build up Highways England understanding. The CMT is expected to be effective when considering the success of a recent Red X compliance intervention using the same methodology in which there has been a 97% reduced recidivism on follow up for the vehicle using ANPR. 15-20% of the offenders gave feedback online. The cost is about 50 pence per letter.
8.0 Driver Fatigue

Driver fatigue can be defined as a general psychophysiological state which diminishes the ability to perform the driving task (Thiffault and Bergeron, 2003) Driver fatigue makes drivers less aware of what is happening on the road and impairs the ability to respond quickly and safely if a dangerous situation arises. It is very difficult for drivers to accurately assess their own level of fatigue. The ability to self-assess becomes increasingly impaired as become more fatigued, however self-confidence to do so remains high.

8.1 The Impact of Driver Fatigue

Driver fatigue is one of the main contributory factors in crashes in the UK. According to the Department for Transport (DfT) in 2015, nearly 4% of road fatalities and 2% of all road causalities were caused by driver fatigue. These figures, however, are very approximate and may be under-estimated, as it is difficult to be tested for ‘tiredness’ on the roadside as with alcohol and drug roadside testing. It is thought that some fatigue-related crashes may be categorised as ‘inattention’ or ‘distraction’ related. The typical profile of a fatigue-related road traffic accident involves drivers running into the back of another vehicle and running off the road. In most of the cases, drivers fail to brake before crashing so accidents can happen at high speed and this dramatically increases the risk of fatal outcome or serious injury. Even if fatigued drivers do not fall asleep, they still pose a danger due to the deterioration in driving performance.

NHTSA in 2016 found that driving while drowsy can lead to a 4-6 times higher crash, or near-crash risk relative to alert drivers. While fatigue is not considered as one of the ‘Fatal Four’, it still has a significant impact on the numbers of KSIs, especially on the SRN. In 2013 50% of fatal accidents in which fatigue was a contributory factor occurred on the SRN (Highways Agency, 2014a).

Fleet-based companies in the UK are obliged to control and maintain the health and safety of all employees, while they are performing the duties. Under the (Management of Health and Safety at Work Regulations, 1999) employers must set reasonable work schedules that do not require drivers to exceed recommended working limits and drivers’ hours in order to manage driver fatigue.

8.2 Highways England: Addressing Driver Fatigue

The design of the road can significantly affect the severity of crashes due to driver fatigue. Recent infrastructure interventions by Highways England consisted of developing a system to rate road safety standards based on the International Road Assessment Programme (iRAP) standards and upgrading of roads. This helps to focus on those roads with lower ratings as well as building in safety measure such as barriers as part of its general road improvement and development programmes. Gardner (1995) proposed that drowsy driving can be reduced by design efforts in highway engineering by building roads with shorter tangents, rhythmic alignments and appealing vistas at irregular but short distances. Highways England also refers to the installation of artificial “eye-openers” such as art exhibits along the road, an initiative has already been used in France.

A ring-fenced road safety fund is used as part of the Road Investment Strategy 2015 to 2020. SMART motorways are a technology-driven approach to increase capacity and relieve congestion while maintaining safety. The hard shoulder is used for traffic, either permanently or at peak times. This creates an extra lane to provide additional capacity. Technology is used to monitor congestion levels and
change the speed limit when needed to smooth the traffic flow. The main advantages of SMART motorways are:

- changing the speed limit to smooth traffic flow — this reduces frustrating stop-start driving and improves journey times
- activate warning signs to alert drivers to traffic jams and hazards up ahead
- close lanes — e.g. to allow emergency vehicles through.

The use of SMART motorways may help to reduce driver fatigue then but no research could be sourced to confirm whether this is the case.

8.3 Driver Fatigue: A Brief Theoretical and Empirical Review

In the last couple of decades, researchers have focused on identifying the main indicators and determinants of fatigue to improve driver safety. Methodological approaches for assessing the progression of fatigue are extremely varied. In general, the most commonly associated factors with drivers’ fatigue are monotony of road environment (Thiffault and Bergeron, 2003) and sleep deprivation and disorders (Wesensten, et al., 2001). Most of the recent studies have tried to explore fatigue by examining the factors which influence the basic preparation state of the organism when performing the driving task. Hartley (1998) suggested that long hours, time of day and sleep-related problems are the main factors of driver fatigue and they should be the main targets in corrective measures aiming to prevent fatigue-related road accidents. Long hours driving

Factors Influencing Driver Fatigue

Time-on-task is one of the most common factors that produce fatigue and leads to driving performance deterioration. Many studies have shown the correlation between time-on-task and fatigue progression using various subjective and objective methodologies. The results of a study conducted by Kecklund and Åkerstedt (2004) suggested that subjective sleepiness level and electroencephalogram (EEG) spectral power (alpha and theta waves) increase significantly with driving time. Otmani (2005) also observed that frequency of right edge-line crossings significantly increase as driving time increases. However, degradation of driving performance can occur during the very early stages of a driving tasks, and according to Summala and Mikkola (1994), nearly 60% of fatal sleep-related accidents in Finland occurred within the first hour of driving. Another commonly related to fatigue factor is the 24h physiological circadian rhythm, or time-of-the day effect. (Pack, et al., 1995) reported that a significant proportion of sleep-related accidents occur during the early morning (2:00-6:00) and afternoon (14:00-16:00) due to the circadian and homeostatic influences, that reduces alertness in human activity.

Driver fatigue can be subcategorised into sleep-related (SR) and task-related (TR). SR fatigue is usually caused by circadian rhythms, sleep deprivation and sleep restriction (Boivin, 2000). It is also influenced by homeostatic factors, such as the duration of wakefulness and sleep deprivation. Performance becomes worse the longer a person remains awake, hence sleep restriction will result in increased sleepiness and a decline in performance (May and Baldwin, 2009). TR fatigue is the outcome of the actual driving and driving environment. Several scholars (e.g. Hancock and Verwey, 1997) suggest that driver fatigue can be produced by active or passive TR fatigue. Active fatigue is the most common form of TR fatigue and it is related to mental overload (high demand) driving conditions and passive fatigue with underload conditions. Passive fatigue usually occurs when the driving task is predictable and drivers can rely on existing mental schemas which results in mental underload and a reduction in effort exerted on the task (Gimeno, et al., 2006).
Sleep/wake patterns follow the body’s natural circadian rhythm or internal clock, which drives humans to sleep during the night and be awake during the day. The circadian rhythm also produces an alertness dip in the early afternoon during which people tend to be sleepier (Monk, 1991). Performance decrement are evident during the troughs in the circadian rhythm.

Sleep deprivation, as it was showed in the study by Lenne, Triggs, and Redman (1998) results in greater lane variability and the sleep drivers tend to drive closer to the centreline of their lane as well as have greater speed deviations. Sleep restricted drivers tend to exhibit significantly more inappropriate line crossings, have lower reaction time and higher sleepiness than rested drivers (Phillip, et al., 2005).

Medication can also have a serious effect on driving performance and can be a major cause of fatigue. Different kinds of medication have various effects on drivers. However, a different kind of medications that are aimed at effecting the central nervous system (e.g. sleep, psychotropic medication, morphine analgesia etc.) can impair driving ability the morning following bedtime administration and sometimes the impairment can be also significant in the afternoon (16 to 17h after administration) (Verster, et al., 2004).

Finally, several studies indicated the effect of age in driver fatigue, suggesting that young drivers (<30 years) also account for a significant proportion of fatigue-related crashes. Due to their minimal experience and dynamic driving styles, young drivers, particularly males, are at a higher risk for accidents than older and more experienced drivers (Summala and Mikkola, 1994; Thiffault and Bergeron, 2003).

Psychological Factors influencing Driver Fatigue

Driving requires sustained attention in complex dynamic tasks and detection of changes in the task environment to search for potential hazards. Perception of hazards may be affected by driver stress, especially for professional drivers who often have to adhere to strict schedules and timetables. Driver fatigue from psychological point of view, can be resulted from a continual interaction of intrinsic and extrinsic factors in which stress, negative mood, psychological states and motivation take an active part.

Driver stress vulnerability relates to cognitive processes of appraisal and coping. Demands can exceed perceived capability or resources and as a result, stress factors can impair the driving performance (especially in underload conditions). Driver stress including daily hassles, time-pressure, congested roads and long hours spent driving can increase driver fatigue (Dorn, 2005; Taylor and Dorn, 2006). The interventions based on these theories should be aimed at diminishing the effect of stress on drivers as well as include various preventive measures (e.g. increased physical activity).

Another approach to understand the influence of personal factors on fatigue is to take into consideration motivational factors to drive whilst fatigued as the studies showed that most of motorists are aware of the signs of fatigue, however, they admitted they would be likely to carry on driving whilst they were fatigued under certain circumstances.

In most of the cases motivation to drive whilst fatigued can be explained with reference to the Health Belief Model (Boer and Seydel, 1996) and the Protection Motivation Theory. Here the models explain that perceived risk of harm to the self as a precursor to self-protective (or safe) behaviour. Hence, driving when fatigued occurs when drivers believe that the risk of personal harm is very low. Therefore, interventions should focus on increasing the perception of risks associated with driver fatigue. Driver’s motivation to drive tired are influenced by their expectations about the consequences of their behaviour in terms of other people’s opinions. Thus, if a driver perceives a risk of social censure
for fatigued driving, then they could be expected to avoid this behaviour, as outlined by the theory of planned behaviour. The possible implication of this theory into the fatigue interventions is that the actual interventions should be aimed at influencing the driver’s motives.

8.4 Engineering Interventions to Reduce Driver Fatigue

Most of the studies concentrated on developing countermeasure technologies to detect and reduce fatigue and prevent crashes as outlined below (May and Baldwin, 2009)

1) Detection and warning technology
   i. Eye closures: the PERCLOS system calculates the amount of eyelid closure over the pupil based on video monitoring of the eyes. It measures this in 1–3 min intervals and derives an index of fatigue. The algorithm calculates the proportion of time within 1 min blocks that the eyelid covers 80% of the pupil. This system has been validated in on-road driving studies (Wierwille, et al., 1996) as well as with the PVT (Dinges, et al., 1998).
   ii. Head-nodding technology: as a driver starts falling asleep, his/her head starts to nod as muscles relax (Hartley et al., 2000). The No-NAP technology fits over the driver’s ear and monitors head position. When the head nods down, the driver receives a buzz in the ear to wake him or her up.
   iii. Deadman switch technology: deadman switches are designed for the user to continuously press a switch. When the switch is released, it is assumed that the user has become impaired and alarms sound. The release of the switch has been related to longer reaction times, and presence of stages 1 and 2 of sleep (Ogilvie, Wilkinson and Allison, 1989).

2) Crash prevention technology
   i. Roadway designs: rumble strips are a roadway design option for monitoring weaving and alerting drivers when they drive off the road. The advantage of rumble strips is that they are available for all drivers. The two types of rumble strips constructed today are milled and rolled rumble strips. Milled rumble strips are constructed on existing asphalt shoulders or new ones, and are concave circular depressions approximately 180 mm wide, 400 mm long and 13 mm deep. Milled rumble strips are preferred because they produce more noise and vibrations than the other types (Perrillo, 1998). Rolled rumble strips can only be installed in new or reconstructed shoulders while the asphalt is hot. They are constructed by creating rolls of excess asphalt above the flat surface of the shoulder and are narrower than the milled rumble strips and result in a shallower tire drop thus producing less noise and vibration than milled rumble strips (Perrillo, 1998). Centre line rumble strips have resulted in a reduction of crashes along rural two-lane roads.
   ii. Lane departure warning systems: lane drifting or departure technology receives information from a video camera that monitors the road ahead and graphs the boundaries of the lane. An alarm sounds when a driver veers out of the lane. SafeTRAC AssistWare Technology is such a device and warns drivers if they begin to drift out of their lane without using a signal. This device also calculates a continuous ‘score’ of performance, and if the score drops, SafeTRAC generates an alert recommending rest. In this way, SafeTRAC not only detects lane departures, but lane position variability or weaving such that performance can be evaluated.
   iii. Collision avoidance system (CAS) warnings: CAS warnings are currently integrated in the production of some vehicles and are intended to alert drivers of potential rear-end or side crashes. This type of technology is useful in vigilance conditions where the ability to detect these critical events is reduced. CAS warnings can measure time to collision or temporal headway.

3) Fatigue countermeasures
   i. Automation: automation refers to transferring control of a system or task (in this case, a component of driving such as speed control) from the operator to the vehicle. Hancock and
Verwey (1997) described two adaptive automation systems. The generic intelligent driver support system utilizes a computerized scheduling system which analyses the mental and visual workload of the driver, prioritizes information messages to send to the driver and decides how to present the information. If the driver is under high visual workload, the system may present messages verbally or by tactile sensation.

ii. The SAVE system integrates a monitoring unit, an automatic control device and a warning system. The monitoring unit detects fatigue, intoxication and unresponsive drivers. The automatic control device stops the car on the side of the road if the driver is not responding to warnings. The warning system informs the driver of his or her unsafe condition and also informs surrounding traffic and a traffic control centre. Active or adaptive cruise control is an advancement of cruise control which automatically adjusts the car’s speed in response to the speed of the vehicle ahead of the driver.

iii. The S.A.M.G-3, steering attention monitors normal corrective steering movements, defined by the micro-corrections that drivers must constantly maintain performance. An alarm sounds when normal steering movements cease. In a form of adaptive automation, there is an option to allow the system to turn off cruise control when steering wheel movements cease. Other steering monitors, such as the ZzzAlert Driver Fatigue Warning System and the TravAlert early warning system also monitor corrective steering movements and produce audible alerts if the driver stops steering, but they do not attempt to modify the driver’s task load or take over any driving systems (Hartley et al., 2000).

Of all of these technologies, the crash prevention devices may be the most feasible to implement in terms of incorporating them into vehicle construction or roadway design. Lane departure warnings and rumble strips are currently widely in use. Collision avoidance warning systems are also installed in some vehicles to assist in reducing rear-end and side crashes.

8.5 Driver Fatigue and Educational Interventions

There is very little evidence of effectiveness of information campaigns such as ‘THINK!’ and further work should focus on evaluating this approach to improving the prevalence of driver fatigue. Recent in-vehicle technological in-built features provide advice of time spent driving and ‘nudge’ the driver to take a break. This approach will only have an impact if drivers choose to respond to the nudge but compliance could have a stronger impact if incentivised. Although this approach would be difficult to implement on a national level in all vehicle types, there is scope for further investigation with the potential for engagement with vehicle manufacturers. Education coupled with in-vehicle technology may be an effective approach.

The Motorway Buddy App

Highways England (Commercial Vehicle Incident Prevention (CVIP) team) is supporting a Motorway buddy app which provides commercial drivers with up to date information about truck stops (with support from the Freight Transport Association and the Road Haulage Association). The app can be translated into many languages but Polish is the initial translation. The app aligns with smart parking solutions to show real time availability of truck stops for drivers. The app also allows drivers to pay for their stay and simplifies all transactions as shown below. The app is currently being used by 40,000 drivers.

- Provides a comprehensive daily check-list with defect reporting for drivers which can be completed from the driver’s handset, then sent to the haulage company web portal
- A load security function that enables pictures to be taken before departure that displays every available precaution was taken before setting off
The app gives the ability to capture three pictures of an incident for insurance purposes.

http://motorwaybuddy.com/

The CIVP Team are also developing a leaflet aimed at overseas commercial drivers arriving in the UK to distribute via ports and ferry companies and truck stops. There is the potential to integrate this with the motorway buddy app.

8.6 Driver Fatigue and Enforcement Interventions

Professional drivers of goods and passenger road vehicles must comply with the UK and EU Drivers’ Hours Rules (Department for Transport, 2014), maintain log books, record hours of work and rest and ensure medical assessments are up-to-date as required and some are provided with a tachograph. Rules for some commercial vehicle drivers are strict compared with others. In most cases, lorry and coach drivers are bound by EU driver hours’ regulations (Directive 2002/15/EC, 2002); these regulations are complex but include limiting time at the wheel to nine hours a day or 56 hours a week on routes where all or part of the journey is in more than one EU country. Drivers must legally take a break for at least 45 minutes after 4.5 hours of driving. They must have unbroken rest periods of 45 hours every week, which can be reduced to 24 hours every other week. Morrow and Crum (2004) suggested that in order to reduce the driver fatigue among the commercial drivers it is important to maintain the productive safety climate in the organisation and provide the supportive safety policies as companies that encourage drivers to avoid driving and sleep in accordance with the normal circadian rhythms show lowers reports of driving while fatigued.

However, other commercially-operated vehicles, notably vans (commercial vehicles weighing 7.5 tonnes or under) and minibuses with 10 to 17 seats operated for reasons that are not commercial (for example for community transport), are exempt from EU regulations. These vehicles are only bound by much less rigorous GB domestic hours rules (UK Government, 2017). These rules restrict a driving day to ten hours. However, they only stipulate a 30-minute break after 5.5 hours driving, or 45 minutes taken at times within an 8.5 hour driving shift.

A roadside test is being developed by Victorian researchers in Australia to identify tired drivers. So-called ‘smart glasses’, which track eye movements and measure the length of our blinks, might help police identify drowsy drivers and prevent fatigue-related crashes. The glasses sense eye movement and measure the length of a driver’s blinks to determine their level of fatigue. Ultimately, the test will allow police officers to test a driver’s fatigue levels in the same way as roadside drug and alcohol tests. The research is being led by Austin Health Associate Professor Mark Howard. Once development of the test is complete, it is hoped these measures will be implemented all around Australia.

8.7 Conclusions

Driver fatigue significantly increases the risk of a crash. A plethora of the countermeasures that have been put forward so far to fight against fatigue while driving. After focusing on in-vehicle detection and warning devices that have been put in place in recent years, the most recent studies and reports suggest using measures that would target road infrastructure, driver behaviour and employer awareness. Whilst campaigns are a popular way of influencing driver fatigue only one campaign has been evaluated at the level of self-report. Further studies should continue investigating possible measures to reduce/manage driver fatigue. There is a need to target driver’s motivations to continue to drive and not take a break and plan their journey in advance. Behavioural intervention should focus on the costs and benefits of behavioural change. A multi-faceted approach to tackling driver fatigue
has yet to be implemented and evaluated. Benchmarking data is required to monitor fatigued driving. However, this data may not be entirely reliable as it is difficult to record. It is possible that average speed cameras can record very long journeys and send warning letters to drivers not taking a break.

Recommendations

- Given that drivers tend to drive while fatigued interventions could highlight the potential costs (e.g. having a fatigue-related crash) to encourage self-evaluation competences.
- Several educational campaigns could be addressed to risky targets such as young drivers, professional drivers and shift workers.
- Using Smart motorways, travel information could be displayed and broadcasted on radio stations especially during the most dangerous hours.
- Motorway Service Areas (MSAs) could be made more attractive for taking a short nap.
- A separate campaign should target those people who have problems with sleep (e.g. sleeping apnoea) to increase their awareness.
- Driver training curriculums could include driver fatigue and its countermeasures.

8.8 Driver Fatigue Intervention matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address driver fatigue and categorized according to type of intervention and exchange mode. There are some gaps in the research showing relatively few interventions have been designed that can be categorised as ‘shove’.
<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
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</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td><strong>Service Stations 'Compromising' Driver Fatigue Campaign</strong></td>
<td><strong>“Pillow – You can’t fight sleep”</strong>&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Explain potential consequences&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Driver fatigue signs</td>
<td><strong>“Don’t fight fatigue”</strong>&lt;sup&gt;6&lt;/sup&gt;</td>
<td><strong>You Snooze You Lose - Don’t Drive Drowsy</strong>&lt;sup&gt;13&lt;/sup&gt;</td>
<td><strong>New Poster Campaign Warns of Driver Fatigue</strong>&lt;sup&gt;7&lt;/sup&gt;</td>
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<tr>
<td>THINK! driving tiredness campaign&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>“You Snooze You Lose - Don’t Drive Drowsy”</strong>&lt;sup&gt;13&lt;/sup&gt;</td>
<td><strong>The Nightcap campaign</strong>&lt;sup&gt;12&lt;/sup&gt;</td>
<td><strong>“Dead on their feet”</strong>&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td>“Think Don’t Drive Tired”&lt;sup&gt;3&lt;/sup&gt;</td>
<td><strong>“Think Don’t Drive Tired”</strong>&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td><strong>Fatigue: The Hidden Killer</strong>&lt;sup&gt;14&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td><strong>“Don’t fight fatigue”</strong>&lt;sup&gt;6&lt;/sup&gt;</td>
<td><strong>Don’t trust your tired self</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td><strong>“Driving Sleepy can Kill”</strong>&lt;sup&gt;18&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td><strong>Don’t trust your tired self</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td><strong>Fatigue awareness month campaign</strong>&lt;sup&gt;21&lt;/sup&gt;</td>
<td><strong>Careless driving convictions using speed cameras</strong>&lt;sup&gt;23&lt;/sup&gt;</td>
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<tr>
<td><strong>Educate</strong></td>
<td><strong>Take the Pledge Against Drowsy Driving Today</strong>&lt;sup&gt;11&lt;/sup&gt;</td>
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<tr>
<td>“STOP. REVIVE. SURVIVE.”&lt;sup&gt;7&lt;/sup&gt;</td>
<td><strong>Don’t trust your tired self</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Take the Pledge Against Drowsy Driving Today&lt;sup&gt;11&lt;/sup&gt;</td>
<td><strong>Fatigue awareness month campaign</strong>&lt;sup&gt;21&lt;/sup&gt;</td>
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<td>The Greek “Eyes on the Road” Campaign&lt;sup&gt;17&lt;/sup&gt;</td>
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<td>France: INSV poll on “coping with sleepiness at the wheel”&lt;sup&gt;20&lt;/sup&gt;</td>
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<td><strong>Support</strong></td>
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Table 9 – Driver fatigue intervention matrix
1. **THINK! driving tiredness campaign**

In March 2008 the THINK! driver tiredness campaign was launched as part of wider driving for work communications. The campaign has been developed for fleet driver as a key target audience from the time they plan their journey to when they are on the road. A key element of the tiredness campaign was radio advertising, which enabled to target people while they were in their cars. This was supported by advertising in motorway service areas, a partnership marketing campaign and online advertising.

The campaign aimed to:

- encourage drivers to take a 15 minute break every two hours of driving
- increase awareness of the dangers of driving while tired
- increase awareness of the signs of driver sleepiness

The target audience is made up of:

- company car drivers aged under 30
- company car drivers aged between 30 and 44
- heavy goods vehicle/large goods vehicle drivers
- passengers
- leisure drivers

Key messages

- Tiredness kills. Take a 15-minute break every two hours
- Tiredness kills. Make time for a break
- Plan your journey to include a 15-minute break every two hours of driving

2. **Don't trust your tired self**

Don't trust your tired self TV campaign on the Transport for NSW YouTube [channel](http://www.youtube.com/watch?v=we3aNazTODs) giving some tips to help avoid driving tired, and share driver’s results with other people at testyourtiredself.com.au. The campaign also consisted of public education of fatigue, leaflets, Trip Time calculator.

3. **"Think Don't Drive Tired"**

Signs on motorways urged drivers to "Think Don't Drive Tired". The government campaign launched featured television and radio advertising, posters and leaflets.

4. **“Pillow – You can’t fight sleep”**

The latest Transport Accident Commission (TAC) campaign taps into the science of sleep in a bid to stop drivers falling asleep at the wheel. The campaign appeared on television, radio, print, outdoor and online. Using the slogan ‘you can’t fight sleep’, the TV spot features a woman peacefully laying her head down on a pillow in slow motion as she falls asleep. As her head hits the pillow, it becomes apparent the pillow is actually an airbag inflating in a crash.

5. **“Dead on their feet”**

The new campaign, launched on April 10th 2016, targeted people who regularly drive home when their body is programmed to be asleep. They occasionally feel much more tired than normal, but choose to struggle their way through the drive because it’s only a short one – they think they can push through the tiredness. The campaign encouraged the audience to take a quick nap before they drive home on the days when they feel more tired than normal - a quick pre-drive nap needs to become a no-brainer. Media placement is through regular and time-targeted off-peak channels along with TV, On-demand, radio, digital, online and social channels, as well as industry specific placements. PR packs have also been produced for shift-worker organisations.


6. **“Don't fight fatigue”**

Cummins and Partners South Australia’s latest campaign for the Motor Accident Commission of South Australia (MAC) reminded drivers: don't fight fatigue. Cummins and Partners used 3-D printing technology to achieve a more realistic effect aimed at highlighting the blow drivers feel when fatigue hits. The fatigue outdoor campaign ran throughout regional South Australia and was supported with digital activity to give drivers tips on how to avoid fatigue.

7. **“STOP. REVIVE. SURVIVE.”**
An Intervention Framework for Safer Driver Behaviour: Driver Fatigue Interventions

A number of initiatives have been implemented with the aim of increasing awareness about the impact of driving while fatigued. The Department of Transport and Urban Planning will remind motorists, through these initiatives, to take regular rest breaks on long journeys. The television campaign, focusing on micro sleeps, will highlight the need for rest breaks. Furthermore, the Road Safety Advisory Council recommended promoting rest areas with signage, information brochures and maps to counteract the effects of fatigue on South Australian roads.

The objectives of the campaign were to:

- Inform drivers about the increased crash risk associated with driving while fatigued.
- Encourage drivers to stop and provide information about where and why they should stop.
- Provide factual information about micro sleeps and how far you may travel during a micro sleep while driving.
- Educate drivers to recognize the early warning signs of fatigue. Explain the high-risk times (10pm – 6am) for driver fatigue. Reduce road trauma in country regions and in young drivers.

The Driver fatigue campaign comprised a television commercial and billboard advertisement, which was supported by a statewide rest area map and fatigue road signage. The commercial also increased driver awareness of the early warning signs and encourage drivers to “STOP. REVIVE. SURVIVE.” This was communicated through the display of a car, which has crashed into a tree, depicted in a dream-like design. The State-wide Rest Area Map also provided information about driver fatigue and details the locations of all the state’s rest areas.

8. Service Stations 'Compromising' Driver Fatigue Campaign

The campaign aimed to reduce the number of accidents caused by driver fatigue is being damaged by the lack of motorway services available to tired motorists, it has been claimed. The Take a Break initiative is suffering because the facilities on offer are usually expensive or of poor quality, according to road safety champion GEM Motoring Assist. It is also difficult to relax in such locations due to "garish" shops, arcade games and ugly restaurants, according to the GEM chief executive. A lack of quality sleep could see drivers lose concentration on the road and in turn risk their car insurance policies. In addition, many service stations now fine drivers who are parked over a certain length of time, in some cases as little as three hours. So, when a motorist feels the need to stop and perhaps have a rest or even a nap if they stay for too long they could face a penalty.

9. Wake up for a work day

Working in partnership with an energy supplement provider, Brake, the road safety charity, has launched a campaign to raise awareness of the dangers of driving while tired. Brake says that a commercial vehicle is involved in four of every ten road crashes in which fatigue is a factor. To combat this, Brake and Quick Energy are encouraging organisations to hold a 'Wake Up For Work Day'. Ideas they are putting forward to raise awareness include wearing pyjamas to work, having an extra long coffee break or a work-at-home 'duvet day'. The free campaign resource pack includes a poster and leaflet covering issues relating to driver fatigue –

http://www.roadsafetygb.org.uk/news/2204.html#sthash.n1wIjAM8.dpuf

10. Drowsy Drivers Die

Though the U-Wake tool requires the driver to acknowledge he or she might have a problem, to bridge the stigma of wearing a headband while driving, and the U-Wake video strangely shows a guy driving a Porsche Cayenne, which hardly screams "We need the development funds," the wearable monitoring device could/should/might/hopefully will become a staple of industries where night driving and long-range driving is part and parcel of the job. The device operates by monitoring brain activity and when there are critical measures that determine that you're too tired to drive, it not only sets off an alarm, but contacts your phone, and can be set up to call the phones of loved ones, management (?) and other key figures in your friend zone, so that they, too, can scream into your ear, or calmly guide you to a motel/hotel/Holiday Inn.
11. Take the Pledge Against Drowsy Driving Today!

The Pledge Against Drowsy Driving is a National Sleep Foundation initiative that seeks to raise public awareness about drowsy driving, its effect on drivers and how it can be avoided. With the support of the members, communities and Congress, they are aimed at decreasing the instance of drowsy driving and improve the safety of those on the road. http://drowsydriving.org/

12. The Nightcap campaign

In an effort to reduce driver fatigue, the Nightcap campaign has written to the UK government and received confirmation from Ministers that tour companies used by schools have a legal duty of care to ensure passenger and driver safety and are duty bound to make sure that the accommodation they book for coach drivers will allow them to rest and sleep properly. http://www.youmecommunity.co.uk/nightcap.html

13. You Snooze You Lose - Don't Drive Drowsy

A Florida family turns their tragedy into a campaign to save lives. Driver fatigue leads to 1,550 fatalities and 71,000 crashes each year in the United States. While those numbers may seem like boring statistics, it is more than that to Ronshay Dugans' family. It is a sad reality.

In 2008, a driver fell asleep at the wheel of a cement truck in Tallahassee and slammed into the bus carrying 8-year-old Ronshay. While Ronshay’s death is a tragedy, her family wants to share it so that other families do not have to suffer a loss like the one they have. They worked with State Rep. Alan Williams to champion new legislation to create the Ronshay Dugans Act. The Act designates the first week of September as Drowsy Driving Prevention Week in Florida.

14. Fatigue: The Hidden Killer

Brochures were available in Australia by request from the Australian Transport Safety Bureau, and were also provided to hotels, motoring organisations and community road safety groups. Numerous state transport authorities have also developed brochures for safe country driving and related topics such as foods that may assist in maintaining alertness.

One Victorian television campaign focused on napping, stating that “a 15-minute nap could save your life!” to reinforce its powernap message. This campaign has also used billboards and full-page magazine and newspaper notices. Western Australia has also committed substantial efforts to television campaigns. One particular television commercial shown throughout Western Australia also used an emotive response. A driver is shown to be fighting sleep, repeating “I can make it”. After a crash, an ambulance officer is then seen telling a police officer that “the driver didn’t make it”. Three 15-second commercials have also been created, each providing a ‘solution’ to help combat fatigue. The first suggests a 15-minute nap, the second a stop for coffee, and the third suggests sharing the drive.

15. Fatigue Management Driver Assistance System

Fletcher, Petersson and Zelinsky (2005) offered implementation of a monotony detector using MPEG compression to measure the change of information content of the road scene over time into fatigue management driver assistance system.

16. The Belgian Pitstop Campaign

The Belgian “Pitstop” campaign targeted young drivers between 18 and 25 years of age through radio spots, an internet website, small posters, brochures and the distribution of gadgets. It ran during four weeks, its principle aim being to install the knowledge that there is only one effective solution: a 15 minute “powernap” to fight sleepiness at the wheel. The outcome evaluation of the campaign published the following year reports an increase in the knowledge that a powernap is the best solution against driver sleepiness, especially in the target audience but also in other age groups. Slight decreases were noted in the percentages of youngsters who believed that drinking coffee, opening a window, turning on the radio or talking to passengers are the best solutions against driver sleepiness. After the campaign, youngsters ranked the powernap as best solution to fight sleepiness, while they indicated “opening the windows” as the best solution prior to the campaign. The campaign was not able to challenge the belief that getting home as soon as possible is most important, which remained especially present in the 18-25 years old targeted audience. There was a slight increase in personal risk apprehension in the 18 to 25 years old targeted audience after the campaign; however, there was an increase in the percentage of youngsters who indicated to drive better than the others, even when sleepy.
17. The Greek “Eyes on the Road” Campaign

The “eyes on the road” campaign was the first sleepiness road safety campaign conducted in Greece. It chose professional drivers as the primary target group and non-professional drivers as the secondary target group. The campaign ran during two months, the main media channels being TV and radio spots, campaign leaflets and the internet. The aim here was to make drivers understand that sleepiness does affect them, whomever they are, and to make them start identifying the signs of sleepiness during their daily driving. Posters, radio and TV spots, used the slogan “Sleep, but not at the wheel”. Drivers were then nudged to rest before they drive, to stop at a safe resting area and take a powernap if they feel sleepy. On leaflets, reasons that cause sleepiness were clearly stated, but also the way sleepiness is detected and countermeasures to sleepiness.

18. Portuguese campaign “Driving Sleepy can Kill”

In 2011, the “Driving Sleepy can kill” campaign was the first sleepiness at the wheel campaign conducted in Portugal. The aim of this campaign was to increase awareness about the risks of driving sleepy and ways to prevent it. Especially dedicated to young drivers, it lasted for one week with several different approaches including a TV spot in partnership with a public television station, a radio spot in partnership with a public radio station and an educational brochure about Sleepiness at the Wheel which was handed out at gas stations along the main motorways. This campaign was presented in a media workshop presided by the Secretary of the Portuguese Ministry of internal affairs with the support of the National Road Safety authority (aNSr), Ministry of internal affairs, the Portuguese automobile club (acP) and others.

19. “Caution – microsleep”

In a campaign called “Caution – microsleep”, the German Road Safety Council draws the attention to this problem and gives advice for a safe ride. It clarifies some insider tips against overtiredness and informs how to early recognize overtiredness. Often, one main rule gets violated: before long rides, you should get enough sleep. In general, a break every two hours is recommended. In case you recognize the first signs of tiredness, like yawning, you should stop immediately. Instead of a short nap it is also possible to activate your circulatory system by some movement exercises. Knee bends, muscle relaxations, breathing exercises in the fresh air are helpful. On the other hand, fresh airs through an opened car window or loud music don’t help to fight overtiredness.

20. France: INSV poll on “coping with sleepiness at the wheel” 2011

Each year, the French institute of Sleep and Vigilance (iNSV) organizes a National Sleep Day to educate the public about the risks associated with lack of sleep or bad quality sleep. In 2011, the theme of this event was “sleepiness” and a national poll enquired on adult knowledge regarding sleepiness at the wheel. Across a representative sample of 1012 French adults, 3% reported they had fallen asleep at the wheel at least once in the past 12 months. 12% said they were forced to stop driving because of sleepiness at the wheel at least once in the last 12 months. interviewed on “what are the best means to cope with sleepiness at the wheel?” 49% of sources answered “to stop driving”, 27% “to stop driving and take a nap”, 22% “to listen to the radio or to music” only 8% responded “to keep on driving” and 6% “to open the window.”

21. Fatigue awareness month campaign

C.R. England, a Salt Lake City-based global transportation provider, and SleepPointe, a sleep apnea compliance solutions provider, have joined together to sponsor a Fatigue Awareness Month campaign intended to train truck drivers [http://www.crengland.com/truck-driving-jobs/overview] on fatigue awareness and proper fatigue management through a variety of activities. The Fatigue Awareness month campaign includes a number of activities designed to educate and train drivers, independent contractors, and employees through training, seminars, safety videos, raffles and other events.

22. Smart Glasses for detecting fatigue in Australia
A roadside test is being developed by Victorian researchers to identify tired drivers and keep them off the road. So-called smart glasses, which track eye movements and measure the length of our blinks, might help police identify drowsy drivers and prevent fatigue-related accidents. The glasses will sense eye movement and measure the length of a driver’s blinks to determine their level of fatigue. Ultimately, the test will allow police officers to test a driver’s fatigue levels in the same way as roadside drug and alcohol tests. The research is being led by Austin Health Associate Professor Mark Howard. Once development of the test is complete, it is hoped these measures will be implemented all around Australia.


23. Speed Cameras

Average speed cameras can be used to detect fatigue by linking them up across the UK to detect whether drivers take a break during a long journey.
9.0 Seat Belt Use on the SRN

Seat belts are designed to retain people in their seats during a crash, and so prevent or reduce injuries. They minimise contact between the occupant and vehicle interior and significantly reduce the risk of being ejected from the vehicle. In Great Britain, seat belt wearing rates are very high. Almost all (95%) car drivers and front seat passengers wear seat belts. In the rear of cars, 89% of passengers wear seat belts or use child car restraints. However, seat belt use is lower in other vehicles where only 69% of drivers and front seat passengers wear seat belts. In 2014, the DfT and Transport Scotland commissioned a survey in England and Scotland to monitor the use of seat belts by vehicle occupants. The surveys were conducted at 40 sites in England and 20 sites in Scotland, observing occupants of cars, vans, taxis etc. and drivers only in buses, minibuses, and coaches. The surveys took place in both morning (07:30 to 12:30) and afternoon sessions (13:30 to 18:30) with a half hour observation period every hour in each session. Overall, nearly 98.2% of car drivers were observed using seat belts in England and Scotland in total. The obtained statistical data showed a positive dynamic in seat belts use compared to the previous year’s suggesting that most of the drivers and front passengers (96.7%) and nearly 90.6% of all rear seat passengers were observed using seat belts or child restraints in England and Scotland. In general, several key facts on seat belt usage in England and Scotland can be highlighted:

- Male drivers have a lower seat belt wearing rate (93.7%) than female drivers (98.2%)
- Seat belt wearing rates were higher for drivers aged 17-29 and aged 60 and over (96.1% and 96.5%) with seat belt wearing rates for drivers aged 30-59 lower at 94.75%
- The difference between male and females was lower for car drivers with 98% of male car drivers and 98.5% of female car drivers observed wearing a seat belt in England and Scotland
- Wearing rates for car drivers in England and Scotland varied slightly throughout the day with a peak of 98.7% between 08:30 and 09:00
- Wearing rates for car front seat passengers were more variable with an apparent downward trend throughout the day. Car front seat passenger wearing rates were at their highest between 07:30 and 08:00 (98.4%) and at their lowest between 17:30 and 18:00 (94.9%)
- The wearing rate for child car rear seat passengers decreased in 2014 and was 91% compared to 2009 with 96%
- Seat belt use is lower in other vehicles, rather than cars, and only 69% of drivers and front seat passengers wear seat belts (e.g., Commercial Drivers).

9.1 The Impact of Not Wearing a Seatbelt

Car occupants represent 60% of all road casualties in Britain. In 2015, 111,678 people were killed or injured while travelling in cars; of these 76,402 (68%) were drivers suggesting that more lives could be saved every day if all drivers and passengers belted up every time they got in a car. As one of the ‘Fatal Four’, unrestrained car occupants have an increased risk of dying in a crash (2.5 times higher) (Raftery and Wundersitz, 2011) and being injured (Broughton and Walton, 2007).

The first results from an in-depth UK study on the effectiveness of seat belts were published in 1977 (Sabey, 1977). The data used was taken from an in-depth study of 1,126 accidents between 1974 and 1976. To calculate the effectiveness of seat belts, only information from front seat occupants was used. Of these 490 were wearing belts, 1,163 were not, and in 303 cases seat belt use was not known. Of the belted occupants, 42% were uninjured compared with 28% of the unbelted occupants. There was a 45% reduction in severe or life threatening injuries, which were sustained by 107 of the 1,163
unbelted occupants and 25 of the 490 belted occupants. The researchers also showed that seat belts prevented the occupant from being ejected from the vehicle, and that just under a quarter of those thrown from the vehicle were fatally injured.

A review of 19 USA articles on seat belt use conducted between 1960 and 1974 made a broad range of estimates of effectiveness of seat belts, ranging from 7.5% effective to 85.6% effective (Robertson, 1976). The variation was attributed to different methodologies, as opposed to any variation in the effectiveness of seat belts that may have overestimated or underestimated effectiveness. Many of the studies relied on self-reported seat belt use. In these studies, the observed belt use was lower than claimed following an accident. Hypothetical data was used to show that if the real effectiveness of seat belts was 40%, the observed effectiveness would be 53% if only 5% of uninjured occupants claimed that they used belts when they did not. Another source of error was that studies tended to only include crashes where an occupant was injured. This exclusion means that the effectiveness at preventing severe injuries would have been calculated at 22.1%, and the effectiveness at preventing all injuries at 23.3%.

Several studies have evaluated the effectiveness of seat belts more recently. In 2000, National Highway Traffic Safety Administration (NHTSA) refined their estimate on the effectiveness of seat belts based on data from 1986 to 1999 (Facts, 2000) with overall effectiveness calculated to be a 45% reduction in the number of fatalities in passenger cars and 60% reduction in fatalities in light trucks. Moreover, seat belts were most effective at preventing fatalities in a rollover accident, showing a best estimate of a 74% reduction in fatal injuries. 69% of the fatalities in rollover accidents were amongst occupants who were ejected from the vehicle. Seat belts were least effective in side impacts, with a 10% reduction in fatalities from impacts on the same side as the occupant and a 39% reduction in fatalities in far side impacts among belted occupants compared to unbelted occupants.

A meta-analysis of 29 studies of seat belt use was published in 2009 (Elvik, et al., 2009). It found that seat belts were effective at preventing injury, and were more effective at preventing more severe injuries. For drivers of cars and vans, the best estimate was that seat belts were 50% effective at preventing fatal injuries and 45% effective at preventing serious. Seat belts were found to be less effective at preventing injuries in the rear seats. The best estimate was that seat belts were 25% effective at preventing fatal injuries and 25% effective at preventing serious injuries.

9.2 Engineering Interventions and Seat Belt Use

Seat belt reminders (SBR) are an in-vehicle technology that alerts drivers if the seat belts in occupied seats are not being used. Most commonly, the reminder is a visual display or an audible alarm. Euro New Car Assessment Programme (EuroNCAP) award points if vehicles are fitted with a seat belt reminder and specifies several standards the reminder system must satisfy.

A study was conducted in seven European cities to see how seat belt reminder systems influenced seat belt use (Kullgren, et al., 2007). For all observations, the total wearing rate was 97.5% in cars fitted with SBR that met EuroNCAP standards, compared to 85.5% in models of cars without. The wearing rate in cars with a mild SBR was 93.2%. Other studies have looked at the association between seat belt reminders and driver fatality risk (Farmer and Wells, 2010). The fatality rate was 6% less in vehicles fitted with SBR, which was unlikely to be due to chance. When these results were adjusted to remove any differences in vehicle age between the two groups, it was found that the fatality rate was 2% less in vehicles fitted with SBR, although it was more likely that this was due to chance.
9.3 Seat Belt Use and Educational Interventions

The DfT’s Think! Annual survey carried out in November 2011 supported the ‘Three Strikes’ evaluation results with 10% fewer adults agreeing that not wearing a seat belt in the back of a car was dangerous, compared to not wearing a seat belt in the front of a car. Interviews with people who had been stopped by the police for not wearing seat belts found that non-wearing behaviour was excused often due to the perceived positive reasons for not wearing a seat belt. These reasons included inconvenience, physical discomfort, and ‘emotional discomfort’ such as the feeling of being trapped (Christmas, et al., 2008). Other explanations referred to feeling safer in the back of a car and participants were less inclined to wear a seat belt in these circumstances. Also, if a vehicle had airbags fitted, or if they were only going on a short journey, the respondents perceived that there was no real need to wear a seat belt (Christmas, et al., 2008).

The Think! ‘Three Strikes’ media campaign in 2008 focused on the physics of a crash. The campaign was aimed at increasing people’s perceptions of the risk of not wearing a seat belt in all driving situations. Although the campaign was well remembered there were mixed results for changes in attitude and behaviour from before to after the campaign. Although there were some positive changes, negative shifts in both attitudes and behaviour were reported. Although increasing the perceived risks of not wearing a seat belt may seem the natural choice for targeting inconsistent seat belt users, an alternative strategy would be to provide “pauses for thought” – giving people a reason to think about their own seat belt wearing behaviour. This could include the positives of wearing a seat belt as well as the negatives of not wearing one (Christmas, et al., 2008). One way of prompting habit-forming behaviour would be to remove perceived reasons not to wear a seat belt (e.g. discomfort) and to supply positive reasons to wear seat belts in situations where they are not already routinely worn.

9.4 Seat Belt Use and Enforcement Interventions

Compulsory wearing of seat belts by front seat occupants of cars and light vans was introduced in Great Britain on 31st January 1983. The Department of Transport commissioned a study to examine the statistical evidence on the effect of the seat belt law on road casualties (Durbin and Harvey, 1985) and a reduction in the number of drivers killed or seriously injured of between 20% to 26% was found. A similar calculation was conducted for the number of car drivers killed, and the best estimate showed that the law had reduced the number of driver deaths by 18% saving 241 driver’s lives in 1983 and 270 in 1984. Similar estimates were made for front seat passengers, where an estimated 147 lives were saved in 1983 and 181 in 1984.

The risk of punishment affects seat belt wearing behaviour is supported by Christmas et al (2008). They asked nearly 2,000 adults to select in which of 20 different situations they would most likely wear a seat belt. The situation in which people were most likely to wear a seat belt was if the front seat passenger put their seat belt on. The second situation most likely to make people wear a seat belt was if they were driving when there are police around. Mohamed, et al., (2011) also found that enforcement activities had the largest impact on rear seat belt wearing behaviour. They too advocated publicity focus on the visibility of enforcement activities.

Furthermore, a review of 33 research reports of the effectiveness of seat belt laws in the USA, identified 18 studies of enhanced enforcement programmes (periods of increased specific enforcement of seat belt laws combined with publicity). Enhanced enforcement programmes (enforcement plus publicity) are associated with an increase in seat belt use and a decrease in injuries
providing evidence that a heightened perceived risk of being ticketed increases seat belt wearing behaviour (Dinh-Zarr, et al., 2001). For example, there is some evidence of effectiveness on seat belt compliance from a meta-analysis of enhanced enforcement involving increasing the number of officers on patrol, increasing citations and the use of safety belt checkpoints (e.g. Dinh-Zarr, et al., 2001).

9.5 Conclusions

Seat belts are very effective in protecting vehicle occupants and significantly reducing their risk of being fatally or seriously injured in a crash. Seat belt laws increase seat belt use, and although seat belt wearing rates are high, not everyone wears a seat belt all of the time. Seat belt use in the rear of a vehicle is consistently lower than in the front. Seat belt wearing can be improved by increasing positive attitudes towards seat belt use, rather than relying on fear appeals. The benefits of wearing seat belts need to be promoted, and the perceived reasons for not wearing seat belts reduced.

Visible police enforcement appears to increase both perceived risk of legal penalty and actual seat belt use with enhanced enforcement programmes being found to increase seat belt wearing rates and reduce injuries. Multifaceted approaches to the problem of seatbelt use often comprise of education, communication, legislation and enforcement with some studies showing a positive influence (Hanfling, et al., 2000). With regards those people that do not wear a seatbelt, it is clear that they are an important group to reach for behavioural change purposes. However, seatbelt use is a habitual behaviour that requires underpinning with a high level of enforcement and campaigning. Putting on a seatbelt is a discrete behaviour or an ‘event’ that should be triggered when starting a journey.

Recommendations

- Further studies could be aimed at defying the key factors that influence a choice of car occupants not to wear seat belts.
- Increasing the sense of certainty with which non-compliance will be detected is likely to improve compliance so enforcement levels are crucial. The consistent enforcement of seat belt laws by the traffic police should be considered as the most effective method of raising and maintaining high levels of wearing rates among vehicle occupants.
- An effective intervention could be based on a combined approach using education and enforcement.
- Measures could also be applied to organise regular testing, assessing wear and damage of seat belts using pass and fail criteria, particularly for fleet-based companies with interventions aimed at encouraging commercial drivers to wear them.
- Some non-compliant behaviour may be due to a lack of knowledge and understanding, an informative campaign to address behavioural factors is recommended.

9.6 Seat Belt Use Intervention Matrix

The intervention matrix in Table 10 below represents the output of research to investigate what countermeasures have been implemented to address seat belt use and categorised according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘educate’ and ‘support’.
## An Intervention Framework for Safer Driver Behaviour: Seat Belt Use

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<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
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<td><strong>Control</strong></td>
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<td>Laser detection system</td>
<td>Fixed penalty notices for not wearing seat belts, East Midlands HGV seat belt campaign, The Road Safety Toolkit on seat belt use, Belt Up! All Wales Seat Belt Campaign</td>
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<td></td>
<td>Click it or Ticket</td>
<td>Reduced compensation for accidents, Vehicle inspection and seat belt maintenance</td>
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<td><strong>Inform</strong></td>
<td>America on move</td>
<td>Saved by the belt, Por Amor, Seat belt campaign targeting young people, Campaign for pregnant women</td>
<td>THINK! seat belt campaign, Embrace Life, Think Before You Drive, Seat belt campaign on Sakhalin Island, “Let’s fight for life” seat belt campaign</td>
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<td>Buckle Up America - Every Trip. Every Time</td>
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<td>Too Much Turkey Is No Excuse for Not Tightening Your Seat Belt</td>
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<td>Jordanian awareness-raising campaign</td>
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<td>Click, Tug and Snug driver safety campaign</td>
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<tr>
<td><strong>Design</strong></td>
<td>Booster seat use promotion</td>
<td>Art contest, Battle of the belt, Visual displays</td>
<td>Seat belt reminders</td>
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<tr>
<td><strong>Educate</strong></td>
<td>Educational leaflets</td>
<td>Education on seat belt use</td>
<td>Seat Belt Awareness Course</td>
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An Intervention Framework for Safer Driver Behaviour: Seat Belt Use

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<th>Support</th>
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<td>Discount schemes for infant restraints\textsuperscript{28}</td>
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Table 10 – Seat belt use intervention matrix

1. Seat belt Reminders (SBR)

SBR are an in-vehicle technology that alerts drivers if the seat belts in occupied seats are not being used. Most commonly, the reminder is a visual display or an audible alarm. EuroNCAP award vehicle models points if they are fitted with a seat belt reminder; this can help the vehicle to get a higher star rating. EuroNCAP also specify several standards that the reminder system must meet. As well as how they influence wearing rates, other studies have looked at the association between seat belt reminders and driver fatality risk (Farmer and Wells, 2010).

2. Seat Belt Awareness Course

Devon and Cornwall Police in partnership with the TTC Group have developed a Seat Belt Awareness Course to give the opportunity to complete an educational workshop as an alternative to paying a fine, if they have been caught driving without wearing a seat belt. The Seat Belt Awareness Course is a classroom-based (theory only) course that takes around 90 minutes to complete. The course content and delivery is designed to educate and explain why it is important to wear a seat belt.

3. THINK! seat belt campaign

The DfT has been promoting the use of seat belts since 1973, long before it became compulsory by law to use one. The latest campaign ‘Three strikes’ re-frames the issue and demonstrates that even at low speeds and on familiar journeys you are vulnerable to a fatal crash. ‘Three strikes’ aired for the first time in November 2008 with the latest burst in February 2010. This latest campaign used a mixture of TV, radio, cinema and outdoor advertising. This is done by showing the dramatic consequences of not wearing a seat belt. The TV advertisement demonstrates the ‘3 crashes in 1’ and the fatal injuries suffered, even at low speeds, this shows how the:

- unbelted driver’s vehicle hits another car
- the driver’s body hits the steering wheel and the windscreen
- the driver’s internal organs smash against his frame and rupture

4. No seat belt, no excuse

The Department of Environment (DOE) in Northern Ireland launched a new TV campaign which “dramatises the lethal and devastating consequences of not wearing a seat belt”. The campaign focuses on back seat passengers, following a new study which shows that while the overall rate for seat belt wearing in Northern Ireland is 98%, 5% of back seat passengers are not buckling up. DOE research also suggests there are lapses during which young people unbuckle for a short period to chat or share photos on mobile phones etc. The TV commercial, ‘No seat belt, no excuse’, shows how an unbelted passenger can become a ‘lethal missile’ inside a vehicle.

5. The First Kiss: Unbuckled Passengers Kill

The campaign was run by Western Cape Government, South Africa. Not wearing a seat belt is against the law. It is also extremely dangerous, not just for unbuckled passengers, but for other people in the vehicle. Unbuckled passengers become wrecking balls in a collision, and kill and severely injure others, even passengers who have buckled up.

6. Laser detection system

DORSET’S No Excuse campaigners are planning to unleash a new detection system to help them catch more drivers flouting the law. Their vans will be fitted with new lasers which will allow traffic officers to detect from a longer distance whether someone is using a mobile phone while driving or not wearing a seat belt. The system, which is already used to detect speeding motorists, is awaiting final approval but should be up and running in Dorset during the early part of this year. Bosses say the device will help boost detection with those who think they are above the law and spread the message to motorists that they have a responsibility to drive safely.

http://www.bournemouthecho.co.uk/news/9453973.No_Excuse_campaign__new_lasers_to_help_catch_motorists/

7. America on move


Created by ad agency Leo Burnett and professionals in filmmaking, costumes, and special effects, the fast-paced television commercials used humor and negative example to demonstrate the consequences of not wearing seat belts. Actors portrayed the kinetic misadventures of Vince, an experienced crash dummy, and Larry, a relative newcomer. The persistent, thought-provoking theme was that only dummies neglect to wear seat belts. The harsh consequences of this choice were played out in slapstick and mechanical ballet that could be funny and shocking at the same time.


American seat belt use awareness campaign Seat belts save lives every day. They can only save lives, however, if they’re used, and there are still many people in America who don’t buckle up. Wearing a seat belt can reduce the risk of a fatal injury by 45%. This is why the community need to know that wearing a seat belt can make the difference between life and death.

Use these marketing tools, which can be distributed to fit the local needs and objectives. These materials can help partner office with other States, communities, and organisations on this seat belt safety initiative. When not engaged in high-visibility enforcement (HVE) such as Click It or Ticket, the office can utilize these social norming messages and encourage the community to Buckle Up America. Every trip. Every time.

9. Too Much Turkey Is No Excuse for Not Tightening Your Seat Belt

The Broome County Traffic Safety Board and Local Law Enforcement Urge Drivers and Passengers to Buckle Up America. Every Trip. Every Time.

Broome County will be doing its part by using a combination of education and enforcement to spread the seat belt message. Drivers and passengers should be on the lookout as law enforcement agencies such as Binghamton, Johnson City and the New York State Police will be out in force sending the strong message to Click It or Ticket. These agencies will be actively looking for unbuckled drivers and passengers. Wearing a seat belt costs you nothing, but not wearing it could cost you a ticket or worse...your life.

The Broome County Traffic Safety Program has also been active this fall in educating young drivers and passengers about the importance of using a seat belt. The Keeping it Real Behind the Wheel program focuses on distracted driving, drowsy driving and safety belt use. Teen drivers learn not only the consequences of dangerous driving behaviors but also the failure to buckle up. Students at the Binghamton High School and the Drivers Education Class at Broome Community College have participated in this program. Both Union Endicott and Harpursville High Schools plan to have their health classes participate in the program this month.

10. Saved by the belt

The Missouri Department of Transportation - Office of Highway Safety’s Saved by the Belt program raises awareness about the importance of everyone buckling up and celebrates those individuals who were involved in a car crash and were Saved by the Belt.

11. Art contest
JEFFERSON CITY – The Missouri Coalition for Roadway Safety announced the “Make a Difference” art contest for Missouri students ages 14 to 19. Students created a poster to support the importance of wearing a seat belt. The poster must have a strong call to action and encourage peers to buckle up. Among prizes awarded, contest winners had their posters promoted in the March Teen Seat Belt statewide media campaign.

12. Embrace Life
A Social advertising that become a hit - Embrace Life – always wear your seat belt. The work from director Daniel Cox is part of a wider campaign from the Sussex Safer Roads Partnership (SSRP). Now it is viewed 13,293,485 times on YouTube.

13. Por Amor
From the autumn of 2003 until the summer of 2004, the FIA Foundation supported a nationwide campaign to promote seat belt wearing in Costa Rica in conjunction with the Costa Rican Ministry for Transport, the National Road Safety Council, the National Insurance Institute and the Costa Rican Automobile Club.

The campaign slogan “por amor use el cinturón” (for love use your seat belt) deliberately did not demand that Costa Ricans “obey an order”, something which had proved so disastrous in the past, but asked them to make the choice to wear a seat belt for the sake of family and friends.

This campaign was a pilot project based on the principles of ‘best practice’ developed in the FIA Foundation seat belt toolkit, which identifies the best methods to raise levels of seat belt use. The toolkit, prepared by international experts at the UK Transport Research Laboratory (TRL) is especially targeted at emerging countries that are confronted with an escalating number of road traffic accidents, injuries and fatalities as a result of increasing motorization.

14. Cross your heart, not your fingers
The Seat belt Campaign is a provincial wide campaign coordinated annually by the Ministry of Transportation (MTO). The purpose of the campaign is to raise public awareness in Ontario about the importance of seat belt use. In Ontario, the law states every occupant travelling in a motor vehicle is required to be buckled up properly and yet people continue not to wear their seat belts properly or not at all.

As part of the MTO annual Seat belt Campaign held from September 28th to October 7th, 2016, Mayor Bryan Paterson proclaimed the week of October 1st to 7th 2016 as Seat Belt Safety Awareness Week. The goal of the campaign was to increase the percentage of seat belt usage in Kingston and area and to raise awareness about the importance of wearing seat belts whenever you get into a motor vehicle, no matter what your age.

15. East Midlands HGV seat belt campaign
Officers from the East Midlands Operational Support Service (EMOpSS) caught more than forty drivers without seat belts during a four-day operation in the East Midlands. Police officers patrolled the motorway and A1 in Leicestershire, Lincolnshire, Nottinghamshire and Northamptonshire in an unmarked HGV ‘tractor unit’ as part of the ongoing Fatal 4 campaign, which targets drink driving, speeding, not wearing a seat belt and using a mobile phone at the wheel.

EMOpSS officers in unmarked and marked vehicles stayed in radio contact with the officers in the HGV and pulled over motorists who were seen from the height of the tractor unit committing one of the fatal four offences.

16. The Road Safety Toolkit on seat belt use
The Road Safety Toolkit is the result of collaboration between the International Road Assessment Programme (iRAP), the Global Transport Knowledge Partnership (gTKP) and the World Bank Global Road Safety Facility. ARRB Group provided expert advice during the Toolkit’s development.

The materials on The Road Safety Toolkit suggest the following countermeasures to not wearing seat belts:
17. Click it or Ticket
Click It or Ticket is a National Highway Traffic Safety Administration campaign aimed at increasing the use of seat belts among young people in the United States. The campaign relies heavily on targeted advertising aimed at teens and young adults.

The Click It or Ticket campaign has existed at state level for many years. In 1993, Governor Jim Hunt launched the campaign in North Carolina in conjunction with a "primary enforcement safety belt law", which allows law enforcement officers to issue a safety belt citation, without observing another offense. Since then, other states have adopted the campaign. In May 2002, the ten states with the most comprehensive campaigns saw an increase of 8.6 percentage points, from 68.5% to 77.1%, in safety belt usage over a four-week period (Solomon, et al., 2002). Recently, Congress approved $30 million in television and radio advertising at both the national and state levels.

18. Click it 4 life
Colonel Ronald K. Replogle, superintendent of the Missouri State Highway Patrol, encourages motorists to adopt an attitude of “safety first” whenever they are behind the wheel. This year, traffic crash fatalities are currently zero percent lower when compared to the same time period in 2013. In 2014, 63% of those killed were not wearing a seat belt in vehicles requiring restraints. Every fatality is someone’s friend, sister, brother, parent, or child. The sudden loss of a family member forever alters the lives of those who loved them.

The chance of being in a traffic crash in your lifetime is virtually 100%. In Missouri, one person is killed in a traffic crash every 11.1 hours. A Missouri driver’s chance of being killed in a traffic crash if not wearing a seat belt is 42 times greater than that of a driver who is buckled up. Using the lap/shoulder belts cuts your chances of being killed or seriously injured in a crash 45-50%.

19. Hundreds of motorists caught during seat belt campaign
More than 230 motorists were fined for not wearing their seat belt during a week-long police crackdown across the West Midlands. Officers handed out £100 fines and warned about the dangers of not belting up as part of an awareness campaign between 13th and 19th March.

20. Belt Up! All Wales Seat Belt Campaign
‘Belt up can save a life’, people will be warned as part of an All Wales campaign stressing the dangers of not wearing seat belts. From Monday, March 13th Dyfed Powys Police lead the All Wales Seat Belt Campaign, warning drivers they are risking their lives by not wearing belts, and cracking down on motorists and passengers who refuse to belt up. Not wearing a seat belt can be a fatal decision even on short, familiar journeys and at low speeds. As a driver, you are responsible for ensuring that passengers under the age of 14 are wearing a seat belt, or using the correct child restraint for their height and age. Motorists and passengers who choose to risk their lives by not wearing a seat belt could receive a £100 on-the-spot fine or be summonsed to court, where they could face fines of up to £500.

21. Battle of the belt
Each school is required to submit an Educational Campaign Outline detailing resources and activities used during the campaign online. Starting in January 2017, each school should implement an awareness campaign to increase the use of seat belts in their schools. This campaign may include the use of any of the resources listed in the campaign kit or resources and activities created and produced by the school. The activities do not have to be inside the school building and may include activities at school functions held elsewhere. The education campaign should begin after the first seat belt check and be ongoing until April 7th, 2017.

22. Battle of the belt
A systematic review of interventions to promote booster seat use by children aged four to eight years showed that combining financial incentives or distribution of free booster seats with education demonstrated marked beneficial outcomes for acquisition and use (Ehiri, et al., 2006).

23. In-car seat belt reminders increase wearing levels, Sweden
A study showed significant results on the effect of in-car seat belt reminders suggesting this in-vehicle technology increases seat belts wearing levels (Bylund and Björnstig, 2000).

24. Seat Belt reminders
Reduced compensation due to non-use of seat belts in the UK, the level of personal injury claims has reduced since the recognition by the courts of “contributory negligence” by the injured party’s failure to wear a seat belt. In Slatter (1977) it was shown that the claimant’s injuries would have been reduced by 25% had they been wearing a seat belt, and as such their compensation was reduced by 15%. Hitchens vs. Berkshire CC (2000) set a precedent by reducing the claimant’s compensation by 50% after it was found that they were not wearing a seat belt.

25. Increasing seat belt and restraint use by children, UK
In Manchester, UK, a campaign where police targeted schools to promote wearing of child restraints resulted in a rise of 20% in use of seat belts. A campaign in Ireland in primary schools raised seat belt awareness by a scheme that encouraged children in the first and second years of school to take the “seat belt sheriff pledge”, by which they promise to tell all car occupants to buckle up before driving. The campaign also included a road safety competition. Alongside formal education in schools, peer education is also often effective. One study, using children as educators of their peers, found that persuasive arguments given by older children can significantly influence the behaviour of younger children.

26. Educational approaches to increase knowledge of the benefits of seat belt wearing
A campaign in Ireland in primary schools raised seat belt awareness by a scheme that encouraged children in the first and second years of school to take the “seat belt sheriff pledge”, by which they promise to tell all car occupants to buckle up before driving. The campaign also included a road safety competition. Alongside formal education in schools, peer education is also often effective. One study, using children as educators of their peers, found that persuasive arguments given by older children can significantly influence the behaviour of younger children.

27. Educational leaflet, India
The information leaflets were distributed in India, concentrating on educating vehicle occupants of the importance of wearing a seat belt. While many leaflets highlight the law regarding wearing, it is just as important to explain why one should wear a seat belt. Here, the vehicle occupant is informed of the substantial forces involved in a 50km/h crash due to severe deceleration of the vehicle. It explains how a seat belt can minimize the injury sustained by a vehicle occupant if they are wearing a seat belt. It also uses pictures (top right) to demonstrate how to fit a seat belt. Vehicle occupants should push the lap part of the seat belt down onto their hips so that it does not ride onto the abdomen. They should then pull the diagonal section up to minimize slack. “The diagonal section must stretch from the anchorage point over the centre of the occupant’s shoulder avoiding contact with the neck.”

28. Education and discount schemes for infant restraints, Greece
A study of a maternity hospital-based infant restraint loan scheme in Greece found that 82% of parents who were provided with an infant restraint for six months for a small fee had purchased the next-level restraint by the time they returned the loaned one. However, another study in Greece showed that the target group did not always take up the scheme, particularly in disadvantaged areas where the need was greatest.

29. Private sector initiative, India
A leading multinational lubricant manufacturer in India adopted an integrated safety management system to reduce road risks and achieve its goal of eliminating fatalities and serious road crashes. The organization typically had more than 500 vehicles on the road at any one time and these were largely driven by third-party contractors. Over four years ago most of the trucks had wooden cabins and bench seats, which provided poor safety features and little occupant protection. These cabins were usually constructed by traditional coach builders and not by the original vehicle manufacturer. To improve vehicle safety, the organization worked with vehicle manufacturers to develop a safe cabin as original equipment. This included improvements in all-round visibility, adjustable fitted seat belts and adjustable seats for the driver and the driver’s assistant. In three years, the organization has voluntarily introduced the new seats and fitted seat belts
in over 2,000 trucks, and encourages transport contractors to purchase trucks with these cabin specifications as original equipment. To raise seat belt wearing levels, the organization has made seat belt wearing mandatory as part of the contract agreements. Spot checks are carried out by the organization and penalties are issued for non-compliance. Regulation and compliance monitoring have been supported by a major engagement programme with transporters and drivers to ensure that they understand the reasoning behind seat belt rules and how seat belts help save lives. The organization also recognizes and rewards transporters and drivers for practicing safe driving.

30. Think Before You drive campaign, Peru

The Touring and Automobile Club of Peru launched the Think Before You Drive campaign on 29th September 2006. Campaign staff in dummy outfits took to the streets with the traffic police to remind motorists that the new seat belt legislation was coming into force as of 1st October 2006. A press conference was held with the many partners of the campaign, including the Head of Traffic Police and the Health Minister, and both gave the good example of buckling up on the club’s seat belt slide. The club demonstrated that in Peru, 3,600 people die and 600,000 people are injured in road accidents each year. This leads to a great deal of suffering and at times financial distress among those who are left behind, but the country also suffers: the financial loss due to the accident toll is estimated at up to US$ 1 billion per year. The club assisted the traffic police during their road checks on seat belt use. On the first day of police enforcement 234 tickets were issued, 70% to motorists who for some reason had taken out the seat belts that their cars were normally equipped with. Of the fines, 30% went to taxi drivers, who were also given a ticket if their passengers were not wearing a seat belt. Most people waited until the last minute to have seat belts installed, which resulted in long queues at sales points and the doubling of prices within two weeks. As a result the Transport Ministry decided to delay phasing in installation of seat belts in the back for some types of transport, such as intercity buses, until November.

31. Seat belt campaign, Sakhalin Island, Russia

The Sakhalin Island seat belt campaign is supported by the Sakhalin State Inspectorate for Traffic Safety (GIBDD) and Sakhalin Road Safety Partnership. The campaign was undertaken annually and monitoring of seat belt wearing rates was undertaken regularly through observational studies and through data collected by the traffic police during driver checks and at the crash scene. Components of the project include education and awareness raising, enforcement and effectiveness assessment. Before starting the development of this campaign, a detailed public opinion survey was undertaken on Sakhalin Island to identify the reasons that local residents chose not to wear a seat belt. This was recognized as being of key importance in designing a campaign that would be effective in addressing incorrect assumptions and inaccurate beliefs, allowing the project team to tailor the initial campaign ideas and messages accordingly. Before the campaign launch, all campaign materials were thoroughly tested in a number of externally managed focus groups. This ensured that the materials and messages that had been developed would be effective in reaching their target audiences (and where they were not, the project team was able to make changes). The campaign was implemented in two phases. First, an awareness campaign was launched with high-profile media coverage of key messages emphasizing why seat belts should be worn and correcting false assumptions about seat belts held by members of the public. Second, and most critically, an enforcement campaign was launched to reinforce the fact that the use of seat belts was the law, and failure to use a seat belt would be punishable by a fine. The project team identified that, although it was Russian law that seat belts should be worn, seat belt enforcement was not regarded as a high priority of the GIBDD due to lack of enforcement officers. The head of the local GIBDD agreed to ensure that enforcement of seat belt usage on Sakhalin Island would be intensified during the enforcement phase of the campaign. Research conducted before and after the 2005 campaign showed an increase in wearing rates in urban areas from 3.8% to 13.9% and on rural roads from 26.8% to 51.8%. 2006 seat belt campaign in an effort to bolster wearing rates a second campaign was launched in mid-2006. The project team evaluated lessons learned from the first campaign and chose to focus more effort on:

- ensuring consistent enforcement throughout the entire campaign period;
- creating stable positive opinions of the advantages of buckling up;
- reaching more people by using a larger range of mass media;
- implementing the campaign during the summer period, when crash rates are usually highest in the Sakhalin Oblast.

The geography of the 2006 campaign was expanded by conducting campaign launches in smaller communities. Video materials and radio clips were updated to reflect the summer season and higher level of enforcement. The campaign started with active communications in local media and lasted from May until the middle of November. Additional research was undertaken during and after the campaign to measure the effectiveness of the project and to study the opinion of the population with respect to the approach taken in conducting the campaign. The public opinion survey showed that 86.7% of the population had seen campaign materials, and that the most effective means of communicating were television, radio and billboards.

32. Jordanian awareness-raising campaign
A Jordanian awareness-raising campaign chose to cover the whole country through television, radio, newspapers, mosques and churches. This was particularly effective, increasing wearing rates by 47%. Television advertising can prove costly; however, in Jordan both television and some radio stations are government owned and airtime was not included in the costs of the campaign. Three one-hour televised meetings were held, discussing the benefits of seat belts, plus 50 30-second adverts. The most popular radio station was chosen to deliver road safety messages through programmes of general interest.

33. Seat belt campaign targeting young people who are rear seat passengers, Poland

The first national seat belt campaign in Poland started in the middle of September 2005. On the basis of research results showing that seat belt wearing rates were lowest amongst young people sitting in rear seats the target group chosen was young people (18 to 24 years of age) and the message was addressed mainly to those sitting in the rear seat. Research showed that the main reasons why people did not buckle up were:

- they thought they could control the traffic situation and they believed that they were in control of the risk;
- they lacked the habit of wearing seat belts. The campaign objectives were to increase the wearing of seat belts and to make wearing seat belts a social norm by:
  - building awareness that road crashes are a real and unpredictable hazard and that non-use of a seat belt can cause death and serious injury;
  - refuting false beliefs and myths related to seat-belts;
  - creating the habit of wearing a seat-belt in the rear.

Evaluation results showed that 93% of the targeted audience, i.e. young people 18–24 years of age, was reached. The declared utilization rate of seat belts in the back seat increased from 34% to 66%, while the observational study showed an overall growth in seat-belt use from 38% to 50% in the back, and from 74% to 84% in the front. A 10% decrease in fatalities was recorded in the campaign time, which is traditionally the period with the highest crash fatality rate in the country.

34. “Let’s fight for life” seat-belt campaign, Argentina

Luchemos por la Vida (Let’s fight for life) was founded in 1990 with the aim of promoting seat-belt use in Argentina. Before starting the seat-belt campaign, a systematic observation of seat-belt use among drivers and front seat occupants in Buenos Aires was undertaken, and regular surveys have been carried out every year since. Observations were taken at different sites in the city, at both day and night times, on holidays and working days, and for different types of vehicles. At least 4,000 vehicles were surveyed each time. Only 0.2% of car occupants were observed to be wearing a seat-belt in November 1990. In March 1992, after a first and very simple campaign on radio and television, percentages went up to 3.1% for drivers and 2.2% for front seat passengers. In July 1992 seat-belt use became a legal requirement in both front and rear seats and usage rose to 32% without any enforcement. The impact of the legislation was short lived since the complete absence of enforcement. By July 1995 only 13% of drivers and 11% of front seat passengers were wearing seat belts. A new law and campaign raised rates again to 32% for drivers and 30% for front seat passengers in April 1996, but again without enforcement rates declined to well below 20%. Luchemos por la Vida launched a new campaign, “Let’s save 1,100 lives by using the seat-belt”, in May 1999. The campaign used intense television and radio coverage based on the objections, myths and false beliefs of the majority of the population regarding the use of seat-belts, and provided information on the consequences of not being buckled up in the case of an accident. There was also a campaign prompting people to write letters to the president, the governors and the city mayors stressing their responsibility for 1,100 deaths each year due to lack of control of seat-belt use. Advertising at the roadside and at tollbooths on highways was used, and the campaign was helped by a high-profile accident in which a former president nearly died after being ejected from his car.

35. Vehicle inspection and seat-belt maintenance

According to WHO (2013), it is important that the condition of seat-belts is checked regularly and that they are maintained in good working order. Countries that have mandatory vehicle inspection systems for vehicles in use should include checks of the seat-belts, retractor and anchorage points for corrosion, damage and excessive wear and tear that may reduce the capability of the whole system. To ensure effective checking it is important that the vehicle testing manual includes the testing procedures for seat belts and that the inspectors are trained to carry out these procedures.

36. Seat belt Committee of Ontario
An Intervention Framework for Safer Driver Behaviour: Seat Belt Use

Seat belt Committee of Ontario suggested a few steps to be taken in order to develop a successful seat belt campaign:

- **Visual displays:**
  Provide visual displays for students during enforcement periods (such as crashed car at high schools throughout the enforcement wave)

- **Message Boards/Marquees:**
  Display buckle up messaging on outside message boards/marquees on school campuses. Advertise the enforcement period

- **School Websites:**
  Post articles on high school, college and university website homepages to spread the message regarding the enforcement periods

- **Social Networking Opportunities:**
  Create MySpace and Facebook online social networking accounts to promote buckle up messages and build awareness about the upcoming enforcement periods

- **Local Business Partnerships:**
  Partner with local businesses to offer free products/coupons to teens for wearing their seat belts. You should also provide these coupons to law enforcement to give out. This would not simply be a "caught in the act" reward, but a well-promoted activity in advance to change seat belt habits. Business could also include buckle up messaging inside restaurants near high schools

- **Mall and/or Movie Theatre Displays:**
  Create a display that says “Make a fashion statement. Wear a seat belt.” Display could include life-size cutout of teen wearing seat belt and include buckle up messages

- **Student Interviews:**
  Coordinate stories with local media outlets, arranging for students to be interviewed about why they choose to buckle up. Include information in all stories about enforcement period

- **Run a seat belt count:**
  Tally seat belt use at a key location, watching for any vehicles appearing to carry more occupants than seat belts

- **Conduct a booster seat count:**
  Children in primary/junior years can observe and record the use of booster seats for children in other cars

- **Set up a Child Passenger Safety Info Line:**
  Set up a phone line to answer commonly asked questions about car seat installations

- **Hold a contest - buckle up challenges, slogans, or Public Service Announcements:**
  Students can challenge teachers or students from other schools to a contest on who can correctly buckle up a child in a booster seat. Partner with local police to act as judges. Students can come up with slogans for banners that can be displayed around the school. Students can compete to develop a Public Service Announcement (PSA), with the winning PSA distributed to local radio outlets and school events

- **Work with local radio stations to promote seat belt safety:**
  Use the Seat belt Committee of Ontario’s seat belt audio PSAs, for distribution to local or campus radio outlets, or for use at school announcements, events

- **Organize a poster contest:**
  Copies of the winning poster can be displayed at public or neighbourhood pools, community centres or public health units

- **Write an article for local media:**
  Regional Marketing Planner can provide a pre-written sample article from MTO for distribution to local print media

- **Join local events:**
  Festivals, special events or fairs provide a venue to create displays or distribute educational materials promoting seat belt use

- **Conduct a Seat belt Deputy Program:**
  Geared toward elementary school students. Students are encouraged to be responsible for ensuring that everyone in a vehicle is buckled up correctly

- **Create a live show or skit:**
  Partner with local police, fire fighters or public health professionals to create a show that demonstrates the proper use of child car seats. The show could be videotaped and used later by teachers
An Intervention Framework for Safer Driver Behaviour: Seat Belt Use

- **Hold a seat belt trivia game show:**
  Use background information on seat belts to create the questions and material for a game show. Acknowledge winners with a school announcement or prizes
- **Run an essay contest**
  Essay contests are ideal for elementary and high school students. The winning entry can be published in the local paper/school paper
- **Create and distribute a Child Car/Booster Seat Shopping Guide for parents.**

37. Click, Tug and Snug driver safety campaign

The campaign aimed to increase truck driver awareness of proper seat belt usage, with specific instructions on how to use the Komfort Latch and Sliding Komfort Latch to make the seat belt more comfortable. Through the use of a free training kit and radio advertising, LifeGuard Technologies is educating users on how to buckle up properly - vertically insert the latch into the buckle, listen for a click, tug on the seat belt latch, and snug it across the hips.

38. "Clunk Click Every Trip"

"Clunk Click Every Trip" is the slogan of a series of British public information films, commencing in January 1971 and starring the now disgraced entertainer Jimmy Savile. The BBC adapted Savile's slogan for the title of his Saturday night variety show beginning in 1973. The slogan was introduced during the previous campaign, fronted by Shaw Taylor and featuring the slogan "Your Seat belt Is Their Security". However, it was the onomatopoeia used by Taylor to describe the act of closing the door and fastening a seat belt that proved the most memorable aspect of that campaign, and so it was upgraded to act as the slogan when the films moved into colour.

The advertisements highlighted the dangers of traffic collisions and reminded drivers that the first thing they should do after closing the door ("Clunk") is fasten their seat belt ("Click"). These advertisements, which included graphic sequences of drivers being thrown through the windscreen and, in one Savile-hosted public service announcement, an image of a disfigured woman who survived such an accident, helped lay the groundwork for compulsory seat belt use in the front seat of a vehicle, which came into force on 31st January 1983 in the UK, although car manufacturers had been legally obliged to fit front seat belts since 1965.

39. New campaign encourages pregnant women to wear seat belts

A new campaign has been launched in Co Mayo to inform mothers-to-be of the dangers of driving without wearing a seat belt. The campaign follows a recent number incidents involving pregnant women who were admitted to Mayo General Hospital after been involved in road traffic accidents which “potentially life-treating for both mother and child”, say organisers.

40. "NEVER GIVE UP... UNTIL THEY BUCKLE UP"

There are countless campaigns to promote seat belt usage to drivers beginning at the age they begin driving. On the opposite spectrum, child safety seat promotional messages are plentiful in the news today. Unfortunately, there is an age group between these two spectrums, that of 8 - 14 year-olds, also known as “tweens”. This 8 - 14-year-old age group is a time that adolescents test limits and learn habits. It is our goal to make buckling up and using seat belts a habit for tweens so that by the time they begin driving, it will be second nature to wear their seat belts. This is the first movement of its kind, aiming to increase not only the overall consistency of tweens wearing a seat belt, but to educate on the proper use of seat belts as well. The key message targeting parents and caregivers with this campaign is that there should be zero negotiation when it comes to seat belt usage and to “never give up until they buckle up”.
10.0 Drink Driving

According to Home Office statistics in 2012 data on breath tests drawn from returns from police forces in England and Wales, and related only to roadside breath tests, during 2010 there were approximately 733,088 screening breath tests carried out by police officers (for involvement in an accident, a moving traffic offence, or suspicion of alcohol use). This was 10% lower than in 2009. In 2010, the proportion of breath tests that resulted in a positive reading (or were refused) was lowest in June (7%) and December (5%), coinciding with police enforcement campaigns.

The number of drivers breath tested by the police continues to fall and dropped by almost half from 70,796 in 2015 to 49,440 in 2016 according to the National Police Chief’s Council (NPCC) in 2016 whilst the number of convictions for driving with a blood alcohol level above the prescribed limit fell from 74,055 in 2004 to 37,853 in 2014. With cutbacks in policing it is a challenging environment to ensure drink driving is detected and punished. Left unpunished, drink driving will continue and may increase.

10.1 The Impact of Drink Driving

The risk of road traffic injury and collision increases rapidly with alcohol consumption. Drivers with a blood alcohol concentration (BAC) between 20mg alcohol per 100ml blood (20mg/100ml) and 50mg/100ml have at least a three times greater risk of dying in a crash. This risk increases to at least six times with a BAC between 50mg/100ml and 80mg/100ml, and to 11 times with a BAC between 80mg/100ml and 100mg/100ml. Apart from being potentially life-threatening, drink driving on the roads can often results in tailgating, speeding and sudden braking.

Drink driving is among the leading cause of crashes. According to the DfT, provisional estimates in 2015 showed the number of people estimated to have been killed in drink drive accidents was 139 (9% of all road accident fatalities) where at least one driver was over the drink drive limit. The total number of collisions and accidents where at least one driver was over the alcohol limit rose by 2% to 5,740 in 2015 compared to previous years. The total number of reported casualties in drink drive accidents was estimated to be 6,971 (5% of all road casualties) (DfT, 2012). However, it should be highlighted that these estimates are based only on those road accidents which were reported to the police and it has long been known that a considerable proportion of non-fatal casualties are not known to the police.

While the number of drink drive related fatalities in 2015 remains relatively unchanged from the previous four years, there appears to be a ‘statistically significant’ increase in the number of killed and seriously injured casualties. Provisional estimates for 2015 show that between 180 and 250 people were killed in collisions in Great Britain where at least one driver was over the drink drive limit, with a central estimate of 220 deaths. Published by the DfT on 2nd Feb 2017, the figure is slightly down on the final figures for 2014, when the upper estimate was 260, central estimate 240 and lower estimate 220. Around 13% of all road deaths in 2015 were drink drive related and a statistically significant rise in the number of people KSI was found. In 2015, there were 1,380 KSi, up from 1,310 in 2014. The DfT says there is still ‘considerable uncertainty’ about this figure, but if it proves to be correct when the final estimates are released in August 2017, it will be the first rise in drink drive KSi since 2010.

Drink Driving; Age and Gender

Young men account for almost two thirds of drink drivers in the UK and nearly 62% of drink drivers killed on the roads. Research from the National Institute for Health and Care Excellence (NICE) showed
A second drink doubles a driver’s chances of being involved in a fatality. According to data presented by the Global Road Safety Partnership, a consistent image of drink-drivers emerges across different studies from the different countries and this is supported by a UK literature review (Hopkins, et al., 2010).

The highest reported prevalence of driving after drinking in the past year is in the 30–59 age group. The highest reported prevalence of drink driving in the past year is in the 17–29 age group declining with age. Young car drivers (aged 17-24) have more drink drive accidents per 100 thousand licence holders and per billion miles driven than any other age group, and the rate declines with age. Women are less likely than men to be involved or injured in drink-drive accidents. Most convicted drink drivers are men, however the proportion of women convicted for drink drive offences is rising. Driving after drinking is more prevalent among social grade AB and lowest among social grade DE, while drink driving is lowest among social grade DE, but more similar across the other social grades.

The most common demographic characteristics of drink drivers are:

- Aged 18 to 24 years old
- From a low socio-economic grouping
- Single or divorced
- In a blue collar occupation
- With low education and limited literacy
- With low self-esteem.

Hopkins et al. (2010) distinguished between ‘driving after drinking’ (i.e. when consumed alcohol but thought to be under the drink drive limit) and ‘drink driving’ (i.e. when thought or proven to be over the limit). The findings showed that between one-fifth and two-fifths of drivers report driving within a few hours of drinking alcohol in the past 12 months with most reporting it to be a rare event: 48% said once or twice during the year. For a minority, driving after drinking is more common: 14% said once a month or more. Surveys showed that 5% of drivers report driving when they thought they were over the legal limit in the past 12 months. Most drink drivers report this to be a rare event with 72–73% saying it was once or twice during the year. More men than women drive after drinking, and more men than women are drink drivers.

10.2 A Brief Empirical and Theoretical Review of Drink Driving

Over the last 15 years, a number of scholars have explored a drink driving behaviour. From an educational perspective, it is important to understand the antecedents and etiology of drinking behaviour in general. There are several approaches usually taken to explain the origins of drinking behaviour in terms of biological determination (e.g. having a family history of drinking behaviour) and personal determination (e.g. having a particular psychopathology; (Hemphill, et al., 1994)) and social determination (e.g., perceived approval of friends; (Chawla, et al., 2009)). However, recent studies underline a variety of sources of the motivation to drink namely the Tension-Reduction Model (TRM), Personality Theory (PT), Interactional Theory (IT), Social Learning Theory (SLT), Theory of Planned Behaviour (TPB) and Recent Theoretical Models, which are The Stress Response Dampening (SRD) Model.

Tension-Reduction Model (TRM) - Some theorists emphasize the function of drinking as a “time-out” from responsibilities, sometimes even as a moral holiday. The TRM was originally proposed by Horton (1934) and referred to as Anxiety Reduction. This model suggests that people tend to drink when they need/want to reduce tension. The empirical support for the tension-reduction model of drinking is
ambiguous and complicated. The complexities include the drinker’s expectations about alcohol’s efficacy in reducing tension and other individual variations in responses to alcohol.

**Personality Theory (PT)** - Many studies have shown that some dimensions of personality have repeatedly appeared to underline problem drinking. For example, antisocial impulsivity is linked with greater risk of addictive behaviours due to sensitivities to incentive motivation and engagement of addictive behaviour when reward cues are detected; and rash impulsiveness— reflecting individual differences in the ability to modify the addictive behaviour due to negative consequences. People with mood disorders are at increased risk of excessive drinking and may play a crucial role in influencing motivated behaviours. Emotion-motivated reasoning has been shown to influence drinking behaviours via selecting outcomes that minimize negative affective states while maximizing positive affective states.

**Interactional theory (IT)** - The IT is founded on the process of human interactions in the society to form meaning for individuals and human beings can be understood in practical and interactive relations with their environment. Individuals are inseparable with the society they live in and each is created through social interactions understood in terms of the other. Drinking behaviour according to this perspective is as a result of a number of promoting events and situations in the society. Drinking has been largely glorified and ‘accepted’ as being a ‘cool’ (Matthews, et al., 2013). Due to the normalisation and glorification of binge drinking, the majority of teenagers may take to binge drinking as the ‘mark of maturity’ and as a fun activity mainly because of the cultural relevance binge drinking has been awarded by the society. First time binge drinkers do so mainly due to the positive experience that has been presented by those around them.

**Social learning theory (SLT)** - Social learning is the most common way that people learn. People have a powerful need for social interaction. Therefore, it becomes important to consider the compelling social nature of drinking. Social learning theory fits well with the expectations and environmental and social effects shown conclusively to play a role in drinking and alcoholism. Reciprocal determinism describes how problematic drinking, despite its negative consequences, affects the motivation to drink. This dynamic explains loss-of-control drinking and recovery involves coping skills and specific self-control skills to manage drinking.

**Theory of planned behaviour (TPB)** - According to the TPB, a certain set of motivational factors leads to intention to act in a certain way (Ajzen, 1991). Given the right opportunity, people will translate this intention into behaviour. The role of intention in this model is believed to be two-fold: attitudes, subjective norms and perceived behavioral control should predict intention, and intention, in turn, should predict behavior. Several studies focusing on college drinkers have established the prediction of behavior by intention (Armitage, et al., 2002; Conner, et al., 1999; O’Callaghan, et al., 1997). Attitudes about alcohol use appear to be important in predicting drinking quantity and frequency (Leigh, 1989). The subjective norm is a target person’s perception of others’ evaluations of the target person performing a behaviour (Ajzen, 1991). Perceived behavioural control, or the perceived ease or difficulty of performing a behavior, is believed to both indirectly (through its association with intentions) and directly influence behavior (Ajzen and Fishbein, 1988, Ajzen, 1991)). A number of studies showed a support of TPB in predicting the intentions to drink and drive, however, this theory fails to define what interventions should be done in order to reduce it.

**Stress response dampening (SRD) model** - The SRD model is based on findings that the physiological stress response, especially cardiovascular responding, is dampened by alcohol. It emphasizes that persons who show pre-alcoholic personality characteristics are particularly susceptible to SRD effects.
Generally speaking, stress response model is based on the notion that alcohol consumption reduces one's emotional and physiological response to stressors. Individuals hold an expectation that consuming alcohol reduces stress, which in turn motivates alcohol use (Cooper, et al., 1995; Goldman, et al., 1987). Drinkers reporting SRD as their dominant motive for use display increased risk for problematic alcohol use (Cooper, et al., 1995; Schroder and Perrine, 2007). Whilst this model provides evidence on the effect of alcohol on the human neurological system, it is practically difficult to employ as the stress individuals are attempting to reduce through the use of alcohol may be lifestyle or personality-related rather than driving-related.

10.3 Drink Driving and Engineering Interventions

The use of Mobile Evidential Breath Tests Instruments (MEBTI) would enable police officers to take evidential samples at the roadside and be more efficient for the police. Provision for use of such equipment was made in the Serious and Organised Crime Act 2005.

Ignition interlocks are primarily aimed at high BAC and recidivist drink drivers. The ignition interlock device is wired to the ignition system of the vehicle and requires a sample of breath that does not exceed a pre-set BAC level, usually 0.02%, before allowing the engine to start. The device may also require the driver to provide breath samples while the vehicle is in motion to minimise the likelihood of bystander intervention. All BAC readings are recorded and can be downloaded to monitor the drink driving behaviour of interlock participants. Installation of ignition interlocks may be court-ordered (also known as judicial interlock programs) or may be voluntarily installed (also known as administrative interlock programs) by the drink driver in exchange for benefits such as reduced licence disqualification/suspension periods. They are highly effective at preventing repeat offenses while installed. Mandating interlocks for all offenders, including first-time offenders, may have the greatest impact.

10.4 Drink Driving and Educational Interventions

Hopkins et al. (2010) reported that driving after drinking alcohol tends to be on local, short journeys where the road is well known and drivers feel ‘safe’. Over half of driving after drinking occasions are in the evenings, but they also happen in daytime, late at night and on the morning after drinking. Driving after drinking journeys are mainly made when drivers perceive that they are within the legal limit of alcohol consumption for driving. Journeys are made when drivers feel they are safe to drive. Habitual driving after drinking, and previous experience of driving after drinking without incident and without ‘getting caught’, also play a part in decisions to drive after drinking. The likelihood of getting caught whilst drink driving is perceived to be low.

One of the latest THINK! Drink drive campaigns targeted young men aged 25 to 34. A media campaign ran from 1st December 2015 to 3rd January 2016 in England and Wales. The campaign was aimed at targeting nearly 5.4 million British young men through the social networks (e.g. Facebook, Twitter, and Spotify) and while they plan their night out, whilst on a night out, or drinking at home. This included social media advertising and posters in pubs.

The core messages of the campaign were:
- You don’t have to feel drunk to be a drink driver
- A second drink could double your chances of being in a fatal collision — THINK!

The results showed that:
There were statistically significant shifts in the perceived safety of drinking one and two drinks before driving and unacceptability of driving after two drinks. There was a 6% increase in strong disagreement that it is safe to drive after one drink. Perceived prevalence and acceptability of driving after one drink remained stable.

An area that was less positive was with ‘risky drivers’ (those who claim to drink two or more drinks before driving). Whilst post-campaign, respondents were more likely to agree that two drinks could put you over the limit, but did not necessarily consider this to be more dangerous. It is unlikely that one campaign would be sufficient to change behaviour in and of itself, suggesting that a range of different interventions would need to be implemented to tackle entrenched and habitual attitudes and behaviour. Campaigns are most effective when supporting other impaired driving prevention strategies.

There is some evidence of educational interventions reported in a meta-analysis of short face-to-face alcohol education sessions finding a positive effect on adolescents and young drivers (Steinka-Fry, et al., 2015).

10.5 Drink Driving and Enforcement

Most of governmental actions were taken to reduce the level of alcohol-impaired driving and alcohol-related crashes has focused on developing appropriate laws and enforcement activities. One of the main measures that was taken by the government was to implement a range of penalties for drink driving so the drivers can be imprisoned, banned from driving and face a fine for driving impaired. The actual penalty which drivers may receive, depends on the offence and is this is unlimited. In most cases a conviction for drink driving leads also to a significant increase in car insurance costs, problems entering/traveling to several countries (e.g. USA) and a conviction being recorded on the driving license.

An analysis to assess the effectiveness of a number of laws and other community-based interventions in reducing drink driving and alcohol-related crash fatalities was conducted using a systematic review (Shults, et al., 2001). Seventy-Six studies were included in the review with ‘lower BAC laws for young and inexperienced drivers’ being selected as a priority policy intervention for review. Six studies were included to examine this policy intervention. The findings showed that all six studies analysed data from police incident reports of crashes on public roads. Median post-law follow-up time for the six studies was 22 months. All six studies reported a post-law reduction in crashes of between four and 24%, depending on the study outcome employed (e.g. fatal crashes, non-fatal injury crashes). There is therefore sufficient evidence that lower BAC laws are effective in reducing crashes among young or inexperienced drivers.

Alcohol screening and brief interventions take advantage of “teachable moments” to identify people at risk for alcohol problems and get them treatment as needed. This combined strategy, which can be delivered in health care, university, and other settings, helps change behavior and reduces alcohol-impaired crashes and injuries. Some employers have decided to adopt alcohol screening as part of their alcohol policy.

The Rehabilitation Scheme

Under the Drink Drive Rehabilitation Scheme (DDRS), Courts can offer a course to drivers who have been convicted of driving, or being in charge of, a motor vehicle with excess alcohol in their blood. Drivers may also be offered a course if they fail to provide a specimen that can be tested to assess your level of intoxication. Some drivers may be able to reduce their bans by taking a DDRS course if
they were banned from driving for 12 months or more. The main goal of the course is to prevent driver from drink driving again. The course has a face-to-face format, takes places over 16 hours (usually run on three days spread over three weeks) and involves other offenders. In 2012 alone around 45,000 drink drive offenders were referred to the DDRS courses by the Courts. With nearly 24,000 offenders accepting the offer and successfully completing a course, making the attendee eligible to have the period of time they were banned from driving reduced by up to a quarter, for example taking a 12-month driving ban down to nine months. The DDRS is designed to change behaviours to prevent the attendee reoffending, and to become a safer driver. Specifically, the DDRS aims to help offenders recognise the problems associated with drink driving and to take personal responsibility for, and to address their behaviour in relation to drinking and driving.

TTC is the UK’s largest provider of drink drive courses in the UK and appointed by the DfT, and the DOE as part of the Government’s DDRS. TTC has been providing drink drive courses for 22 years and has delivered over 100,000 courses to drink drive offenders throughout the UK. They deliver ‘Drink Drive Awareness Courses’ at 155 venues. Teter and Brown (2014) reviewed rehabilitation programmes that run largely for high BAC and recidivist drink drivers. Rehabilitation programmes emerged due to a need for less costly and more effective alternatives to imprisonment. They aim to separate drinking and driving by involving drink drivers in education programmes to improve knowledge and attitudes, and involving those identified with alcohol disorders in alcohol therapy programmes.

The screening of participants is an important aspect of rehabilitation programmes as it helps determine the most appropriate treatment for each drink driver. That is because drink drivers are not a homogenous group and may engage in drink driving for a number of reasons including a lack of education, lack of skills to separate drinking and driving, and due to the existence of alcohol-related disorders. The underlying causes of drink driving should be identified to inform the type of treatment that is more likely to be effective at addressing drink driving behaviour.

Rehabilitation programmes can incorporate a number of treatments. They can consist of either educative or health programs, skills-based programs, short-term and long-term treatment programs, social skills and assertion training, other forms of counselling or a combination of a number of treatments. Voas et al (2004) recommended vehicle sanctions and rehabilitation interventions in dealing with repeat offenders given that there is sufficient evidence that rehabilitation courses can be effective in reducing repeat offences. Education-based programmes assume that lack of knowledge about alcohol and the risks of drinking and driving results in poor decision-making. The main aim of such programmes is to encourage participants to recognise a drinking problem and consider alternatives to drinking and driving while over the legal BAC limit. Psychotherapy or counselling-based programmes are directed mostly to individuals with signs of alcohol dependence or addiction. They are generally focused on reducing alcohol consumption. However, these programmes may fail to address drinking and driving. Combined programmes that recognise that the problems are a combination of crash risk and alcohol misuse. Education sessions are often used to address knowledge about the risk of drink driving, while individual counselling tackles issues related to individual alcohol misuse.

10.6 Conclusions

In order to combat drink drive related crashes, it is essential to adopt a multifaceted approach combining legislation and enforcement, public education and social marketing. This would involve multiple and wide ranging types of stakeholders. Enforcement efforts could be aimed at promoting the perception among the drivers that they can be tested anywhere and at any time. Enforcement
activities could be based on a sound understanding of the problem, supportive legislation, adequate training and equipment, and a strategic direction.

Recommendations

- Disparate organisations are developing and implementing drink driving campaigns and Highways England could join forces to develop a more targeted and wide-reaching campaign.
- The effectiveness of drink driving campaigns could be improved by greater focus on the constructed message, location of the message and timing of the message.
- A series of consistent, timely and relevant communications to tackle drink driving could be agreed by stakeholders as part of the Compliance Framework approach. Benchmarking data from police forces on the prevalence of drink driving would be required in order to monitor the effect of any intervention.
- There appears to be some value in delivering face to face sessions but further work is required to investigate the educational structure and content of these types of intervention.
- Research on the effectiveness of drink drive rehabilitation schemes is established but there may be ways in which this educational intervention could be improved to include Behavioural change techniques for example.

10.7 Drink Driving Intervention Matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address drink driving and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘educate’ and ‘support’.
## An Intervention Framework for Safer Driver Behaviour: Drink Driving

|               | Hug                                                                 | Nudge                                                                      | Shove                                                                 | Smack                                      |
|---------------|----------------------------------------------------------------------|                                                                            |-----------------------------------------------------------------------|--------------------------------------------|
| **Control**   | Driving Under the Influence (DUI) Simulator Program<sup>12</sup>     |                                                                             | Ignition Interlocks<sup>22</sup>                                      | Drink driving penalties<sup>25</sup>       |
| **Inform**    | Don’t drive to drink. And you will never drink and drive<sup>9</sup>  | Friends Don't Let Friends Drive Drunk<sup>1</sup>                          | Reflections from the inside<sup>2</sup>                              |                                             |
|               |                                                                      | Free Uber Ride<sup>4</sup>                                                | La última y nos vamos<sup>10</sup>                                   |                                             |
|               |                                                                      | What’s your plan B?<sup>20</sup>                                          | University anti-drink driving campaign<sup>13</sup>                   |                                             |
| **Design**    | Responsibility Has Its Rewards: TEAM Coalition<sup>17</sup>          | Tie one on for safety<sup>16</sup>                                        |                                                                      |                                             |
|               | Alert Cab<sup>18</sup>                                               |                                                                            |                                                                      |                                             |
|               | Noc-Turnos ("Noc-Shift")<sup>19</sup>                               |                                                                            |                                                                      |                                             |
|               | SoberRide<sup>31</sup>                                               |                                                                            |                                                                      |                                             |
|               | Driver’s Corner Bacardi B-Live<sup>20</sup>                          |                                                                            |                                                                      |                                             |
|               | Be My DD<sup>20</sup>                                                |                                                                            |                                                                      |                                             |
| **Educate**   |                                                                      | Education-based programmes<sup>19</sup>                                   |                                                                      | Rehabilitation programmes<sup>22,23</sup> |

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<sup>1</sup> Pelli Frischmann

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An Intervention Framework for Safer Driver Behaviour: Drink Driving

<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
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<tbody>
<tr>
<td>Support</td>
<td>Give A Damn. Don’t Drive Drunk</td>
<td>Workplace alcohol prevention programme and activity (WAPPA)</td>
<td></td>
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Table 11 – Drink Driving Intervention Matrix

1. **Friends Don’t Let Friends Drive Drunk**

Since the launch of this campaign in 1983, more than 68% of Americans reported that they have tried to prevent someone from driving after drinking. In 1998, America experienced its lowest number of alcohol-related fatalities since the U.S. Department of Transportation began keeping records. Campaign taglines have included: “Drinking and Driving Can Kill a Friendship” and “Friends Don’t Let Friends Drive Drunk”.

2. **Reflections from the inside**

Anti-Drinking and Driving Campaign Run in a Los Angeles bar with convicted DUI offender. The bathroom was installed with mirrors with a live video stream to a convicted drunk driver in prison. The campaign reminds drinkers to think before they drive home. This powerful campaign was built to target men in a Los Angeles bar. No evaluation could be sourced.

3. **Drive Sober or Get Pulled Over**

The NHTSA kicked off its annual “Drive Sober or Get Pulled Over” campaign and announced funding for technology designed to prevent drunk driving. During the 2015 Christmas holiday period (from 6pm. on December 24th to 5:59am on December 28th), the Nation lost 34 lives per day in drunk driving crashes — a total of 120 deaths over 3.5 days. During the New Year’s holiday period (from 6pm. on December 31st to 5:59am on January 5th), 31 lives were lost per day in drunk driving crashes — a total of 139 deaths over 4.5 days. These two holidays combined accounted for 259 lives lost in drunk driving crashes, NHTSA statistics showed. The campaign was intended to reverse this trend. Through January 1st, campaign advertisements appeared nationwide and law enforcement agencies across the country were on patrol to protect the public from drunk drivers.

4. **Free Uber ride!**

Uber ran anti drink driving campaign by offering a first free ride to passengers that are heading home from the bars.

5. **Enhanced Audit of Driving Capacity - Provincial Response**

Police in Quebec launched their annual anti-impaired driving campaign. The province-wide operation was called VACCIN, an acronym for the French-language phrase “Enhanced Audit of Driving Capacity - Provincial Response.” Police set up multiple checkpoints and continued to man checkpoints throughout the province during the holiday party season. Police said their aim was to catch and deter people who were driving while drunk or otherwise impaired. Police also be handed out bumper stickers with an anti-drunk driving slogan. Drivers of trucks, taxis, and buses, while probably not on their way home from a party, also ran into specific checkpoints from the SAAQ’s roadside control team. That group offered specific advice on dealing with impaired drivers. Meanwhile the SAAQ launched several new TV, web ads in French, and English radio ads, to remind drivers not to drink and drive. No evaluation could be sourced.

6. **Give A Damn. Don’t Drive Drunk**

Big beer brand Budweiser and ride sharing company Lyft partnered to share a responsible drinking message and give away free rides during peak party hours. The campaign called “Give A Damn. Don’t Drive Drunk,” and together they gave away up to 80,000 rides during peak times in key states like New York, Florida, and Colorado. Budweiser shared a code each week on their social media accounts. Followers of Budweiser could then enter that code into their Lyft app and received a $10 credit on their ride sharing account. No evaluation could be sourced.

7. **Super Bowl ads**
For one of its Super Bowl ads, Budweiser asked A-list British actress Helen Mirren to deliver an anti-drunk driving message as follows: "If you drive drunk, you, simply put, are a short-sighted, utterly useless, oxygen-wasting, human form of pollution -- a Darwin-award deserving, selfish coward," Ms. Mirren says in the spot, as she stares into the camera from a restaurant booth with a cold Bud and a hamburger in front of her. Mirren, delivered the message with a mix of British charm and wit. In the ad, which is called "Simply Put," she introduces herself as "a notoriously frank and uncensored British lady." In her tirade, she tells viewers that "chances are you're a fun, solid, respectable human being. Don't be a pillock." That message could a) spawn a bunch of Google searches for the definition of pillock (a stupid person), or b) create some instant demand for Uber or a local cab company.

8. Think! Drink Drive Campaign

Over 30 years; education, publicity campaigns and police enforcement have contributed to a reduction in fatalities of 85% from 1,650 in 1979 (when detailed reporting began) to 240 in 2013. But that's still 240 too many and so it is vital that drink drive messages continue to be heard and that social unacceptability is reinforced. DfT research shows that half of drivers (51%) would not consider consuming any drinks before getting in the car. However, a significant minority of drivers are still prepared to have 'a couple' of drinks before driving. One in 10 people would consider having two or more drinks before they get behind the wheel. This increases to 1 in 5 among men aged 18 to 34. Our recent campaign targets males aged 17 to 34 with this mindset.

DfT research shows that some drivers believe that they are safe to drive after having a second drink. The THINK! Campaign aims to shake confidence in ability to drive after a second drink continuing their strategy of pinpointing the moment of decision to have a second drink, following the Crash (2004) and Moment of Doubt (2007) campaigns.

9. Don’t drive to drink. And you will never drink and drive

Singapore Road Safety Council, Traffic Police and STCars launched the STCars Anti-Drink Drive (ADD) Campaign 2014 on 11th December 2014 at Bang, Pan Pacific Hotel. The ADD campaign served to remind the motoring community of the dangers and traffic consequences of drink driving. In addition, the event also drew greater attention towards the roles that family members and friends can play towards eschewing drink driving behaviour.

Whilst Traffic Police continued with its tough enforcement stance against drink driving, the ADD campaign aimed to discourage the public from driving if they are consuming alcohol at festive parties. More importantly, the campaign also highlighted how the community as a whole can help to make the roads safer by disavowing unsafe road behaviour such as drink driving.

The highlights for the event were:

- Launch of new creative posters with slogans which highlight the campaign tagline;
- Flag-Off of taxis decked out with the campaign designs;
- Theme for the campaign – “Let the Party Go On”;
- Tour of static display;
- Presentation of tokens of appreciation to campaign sponsors

10. What’s your plan B?

The Plan B drink driving campaign began in August 2012 was about making positive choices to get home safely after a night out, highlighting that driving is not an option. With practical options to avoid drink driving, Plan B takes a humorous and positive approach designed to engage the community about making alternative arrangements to get home after a night out. The campaign emphasized that police mobile Random Breath Testing (RBT) operations can happen anytime, anywhere.

Although the Plan B campaign reaches all drivers, it is aimed at young male drivers aged 17 to 25 years, who are over represented in all alcohol-related crashes. The main message of the campaign is if you are drinking, don’t drive. You need to have a Plan B to get home.

Other campaign messages include:

- Plan ahead on how to get home after a night out
- Some Plan B’s are smarter than others
- What’s your Plan B?
- Drink and drive, and you will face the consequences
- RBT means you need a Plan B.
The Plan B campaign has a heavy emphasis on digital, cinema and television. Online users are directed to click through to find a range of Plan B options, including telephone numbers and taxi information.

The campaign is supported with advertising on buses and taxis, and in licensed venues, where people are making the critical decision about whether to drink and drive.

11. Workplace alcohol prevention programme and activity (WAPPA)

A workplace alcohol prevention programme and activity (WAPPA) has been instituted by the Karnartaka State Road Transport Corporation (KRSTC) in India as a major contribution to road safety improvement in the state. KRSTC is responsible for provision of bus-based services in the south of the State and for all interstate and intercity coach services. The project objectives include improved worker welfare, increased productivity, and accident prevention in the workplace. The programme includes prevention and treatment components. Education and training to combat drinking and driving are provided, and alcohol consumption is prohibited within the workplace – a policy that applies to all employees and managers, not just drivers. Another phase of the programme, involves the use of breath analysis machines in depots is planned for testing drivers prior to shifts. Treatment at the company’s expense is provided for first-time offenders against the policy, Second-time offenders are required to attend at their own cost, and third-time offenders are subject to severe disciplinary action, including possible dismissal. Strategies under the programme are grouped into three “zones” – red, amber and green. There is an individual employee focus in red zone activities, building towards more organization-wide strategies in the green zone. Corporate evaluations claim a reduction in crash rates of more than 20% between 1997 and 2000, with additional corporate productivity and profitability benefits.

12. Driving Under the Influence (DUI) Simulator Program


The Save a Life Australia (SALA) system is delivered Drink Driving Education to communities using the simulator. It’s an Australian first but has already been working successfully in the US. The DUI program allows drivers the chance to drive a car with a specified amount of alcohol programmed into the software, as if they had been consuming it themselves. The extensively researched software gives the driver a very clear indication of how alcohol affects the essential senses in the body. The simulator graphically replicates the feeling of driving after drinking alcohol. Vision is impaired (tunnel vision), reactions are delayed and steering becomes ultra-reactive. After experiencing and learning from the simulator program, drivers of all ages will have a real idea of how they would be able to control a car after drinking alcohol. No evaluation could be sourced.

13. University anti-drink driving campaign

Private university in Malaysia HELP University launched an anti-drink driving awareness campaign. It was strategically targeted at students as it was found that college students are responsible for 28% of all alcohol-related accidents in developed countries. Created by BBDO Singapore, the campaign was launched keeping in mind the peak drink driving season, which occurs around the festivities such as Chinese New Year. Filmed using hidden cameras, the campaign featured a whisky-drinking taxi driver, startling students on their way home after lectures. Their spontaneous reactions were then captured and replayed to reinforce how ridiculous the act of drink driving actually is. There was also an online element at the end of the video where students can take an anti-drink driving pledge on drinkdrivedontmix.org – a site which features the downloadable contact details of several local taxi companies. No evaluation could be sourced.

14. OPERATION LOOKOUT

An intervention campaign that consisted of several components:

- Year-round awareness campaign encouraging the public to phone 911 or *OPP when they see a suspected impaired driver
- Can act as an intervention to impaired drivers and as a deterrent to potential impaired drivers
- Communities organized network amongst police, public health, local business, EMS, government and other interested parties
- Program components included road signs/billboards, signs in restaurants/businesses, ad in newspaper, PSA
- Approaches were tailored to different communities – boating, atv, snowmobiling, French language.

15. The designated driver
“Designated driver” became a household phrase in the U.S. to such an extent that the term appeared in the 1991 Random House Webster’s College Dictionary. Public opinion polls documented the rapid, wide acceptance and strong popularity of the designated driver concept. When the campaign began in late 1988, annual alcohol-related traffic fatalities stood at 23,626. By 1994, fatalities had declined by 30%. A variety of factors were responsible for this striking progress, including intensive publicity, new laws, and strict enforcement.

The campaign’s message was narrowly focused, highly specific, and easily communicated. It did not attempt to take on the entirety of alcohol use and abuse in American society. The campaign’s message called for only a modest shift in behaviour. The message was not anti-alcohol. It said, “If you drink, take your turn as the Designated Driver.” Instead of a negative message (“Don’t drink and drive”), the campaign promoted a positive, empowering message (“The Designated Driver is the Life of the Party”). There was a broad social consensus about the need to address the problem of drunken driving, and there were no economic interests opposing the campaign; the alcoholic beverage industry gets a black eye from drunken driving, so they supported the effort. The campaign also had the strong, sustained support of a leading member of the Hollywood community—Grant Tinker, former chairman of NBC and a prominent TV producer. The campaign assembled an Advisory Board of key individuals in the Hollywood community, who were recruited with Grant Tinker’s leadership, to provide ready access to a broad array of directors, writers, producers, and actors who could help the campaign. The campaign also won formal endorsements from the boards of the Writers Guild and the Screen Actors Guild.

To capture and sustain the attention and interest of the creative community, the campaign employed a dozen different tactics to follow-up after face-to-face meetings. Without a steady drumbeat of messaging directed at Hollywood, the odds were low that supportive members of the creative community would remember to act on their stated intentions. No evaluation could be sourced.

16. Tie one on for safety
“Tie one on” is a slang term for drinking alcohol, but this campaign involved putting MADD red ribbons in vehicles to raise awareness of the need to always designate a non-drinking driver for the celebrations. MADD has been organizing Tie One On for Safety since 1986. The timing of the event was selected to draw awareness to the fact that DUI arrests and alcohol-related traffic accidents spike between Thanksgiving and New Year’s Day. Tie One On for Safety has been supported by a number of prominent figures throughout the years. In 1997, First Lady Hillary Clinton launched the annual campaign by tying a MADD ribbon to a drunk driving victim’s car that was displayed in front of the White House. Grammy Award winning singer Naomi Judd served as the campaign’s spokesperson in 1998, and actress Kelly Ripa joined the cause in 2001 after her pregnant sister received severe injuries in a crash caused by a drunk driver.

17. Responsibility Has Its Rewards: TEAM Coalition
An initiative that enters designated drivers in a sweepstakes to win prizes at sporting events. http://www.rhir.org/

18. Alert Cab

Designated drivers receive awards (e.g., fuel and drink vouchers, shirts, etc.) after passing sobriety tests. http://www.disfrutadeunconsumoresponsable.com/conducir/noc-turnos.aspx

20. Driver’s Corner Bacardi B-Live - Bacardi, Slovakia
A programme that offers the designated driver a breathalyser at the end of the night and, if the test is negative, the driver is reimbursed for all soft drinks purchased. http://www.drinksinitiatives.eu/details-dynamic.php?id=118

21. Be My DD
This mobile service sends a personal driver to your location who will drive you to your destination in your own car. The programme has forged national partnerships with leading liquor and wine companies like CIROC and Brown-Forman and offers a safe and reliable transportation alternative. http://www.bemydd.com/

22. Rehabilitation programs
Terer and Brown in their study suggested two targeted interventions to reduce drink driving such as rehabilitation programmes and ignition interlocks.
Largely targeted at high BAC and recidivist drink drivers, rehabilitation programs emerged due to a need for less costly and more effective alternatives to imprisonment. They aim to separate drinking and driving by involving drink drivers in education programs to improve knowledge and attitudes, and involving those identified with alcohol disorders in alcohol therapy programs.

Screening of participants is an important aspect of rehabilitation programs as it helps determine the most appropriate treatment for each drink driver. That is because drink drivers are not a homogenous group and may engage in drink driving for a number of reasons including lack of education, lack of skills to separate drinking and driving, and due to the existence of alcohol-related disorders. The underlying causes of drink driving should be identified to inform the type of treatment that is more likely to be effective at addressing drink driving behaviour.

Rehabilitation programs can incorporate a number of treatments. They can consist of either educative or health programs, skills-based programs, short-term and long-term treatment programs, social skills and assertion training, other forms of counselling or a combination of a number of treatments.

### 23. Rehabilitation course

In 2012 around 45,000 drink drive offenders were referred to DDRS courses by the UK Courts, with nearly 24,000 offenders accepting the offer and successfully completing a Drink Drive Course, making the attendee eligible to have the period of time they are banned from driving reduced by up to a quarter, for example taking a 12-month driving ban down to nine months. Under the DDRS, Courts can offer people a drink drive course if they have been convicted of driving, or being in charge of, a motor vehicle with excess alcohol in their blood. They may also be offered a course if they fail to provide a specimen that can be tested to assess your level of intoxication. The DDRS is designed to change behaviours to prevent the attendee reoffending, and to become a safer driver. Specifically, the DDRS aims to help offenders recognise the problems associated with drink driving and to take personal responsibility for, and to address their behaviour, in relation to drinking and driving.

### 24. Lower legal drink drive limit

[http://www.bbc.co.uk/news/uk-39155282](http://www.bbc.co.uk/news/uk-39155282)

The Scottish government reduced its legal limit for drivers to 50mg in December 2014. Northern Ireland will also soon drop its limit to the same level, and even lower for professional and learner drivers. Lowering the limit in England and Wales could save up to 170 lives in the first year, rising to more than 300 lives in the sixth year. A lower limit could also save £300m annually by reducing the number of 999 responses and hospital admissions, according to the Local Government association. No evaluation could be sourced for Scotland and Northern Ireland.

### 25. Drink driving penalties in the UK

- Being in charge of a vehicle while above the legal limit or unfit through drink a driver may get:
  - three months’ imprisonment
  - up to £2,500 fine
  - a possible driving ban.

  For driving or attempting to drive while above the legal limit or unfit through drink:
  - six-months’ imprisonment
  - an unlimited fine
  - a driving ban for at least one year (three years if convicted twice in ten years).

  For refusing to provide a specimen of breath, blood or urine for analysis:
  - six-months’ imprisonment
  - an unlimited fine
  - a ban from driving for at least one year.

  For causing death by careless driving when under the influence of drink:
  - 14 years’ imprisonment
26. Alcohol testing for drivers at work

A company can use Home Office approved breathalysers such as the Draeger 6820 or 7510 to do evidential tests on their employees. These can be done pre-employment, randomly, for cause and unannounced with the right policy. By doing testing in house there is not only a bigger deterrent that can be added by more regular random tests being done, but also the ability to test immediately after an incident. Calibration is required every six months and costs £39 + postage. This and mouthpieces are the only ongoing costs and breathalysers often continue to work accurately for ten years or more.
11.0 Drug Driving

Drugs can severely affect drivers mentally and physically for hours or even days, influencing their ability to drive safely. The most common effects of drugs are:

- slower reaction times
- poor concentration
- sleepiness/fatigue
- confusion
- over-confidence leading to risk taking
- erratic behaviours
- hallucinations
- blurred vision/enlarged pupils
- aggression

Even though all of the illegal drugs undoubtedly cause deterioration in driving performance, they all have specific effects on human organism. The most commonly found drugs detected in UK drivers are:

- **Cannabis** slows reactions, affects concentration, and affects co-ordination.
- **MDMA (ecstasy)** increases heart beating, which can cause a surge of adrenaline and result in a driver feeling over-confident and taking risks.
- **Cocaine** can lead to over-confidence and can cause erratic behaviour. Cocaine also causes side effects after being used for quite long hours and drivers may feel like they have flu, feel sleepy and lack concentration.

11.1 The Impact of Drugs on Driving

According to the latest report by European Transport Safety Council (2017), nearly 13% of drivers in the UK self-declared driving under the influence of drugs at least once for the last 12 months that makes it a second place in Europe, with France leading (16%).

The statistics from 35 of the 43 forces reported by the DfT showed that 7,796 people were arrested between March 2015 and April 2016 in England and Wales for drug driving. According to the data obtained by the Glasgow Police, one in six (17%) of 1,396 randomly-tested Glasgow drivers in 2005 had taken at least one illegal drug, with the most common being MDMA, cannabis and cocaine.

Impaired driving was officially recorded as a contributory factor in 62 fatal road crashes and 259 crashes resulting in serious injuries in 2015 in Britain, but experts estimate the true figure could be much higher. A Transport Research Laboratory (TRL) study showed that at least one in six deceased drivers (18%) and 16% deceased motorcyclists were found to have illegal drugs in their bodies. About 6% of deceased drivers and motorcyclists had taken medicines that could have affected their driving. Compared to a similar study completed by TRL in the 1980s evidence of illegal drug use could only be detected in the 3% of deceased drivers.

11.2 Drug-driving behaviour: a theoretical and empirical review

Several studies have tried to evaluate the effects of drugs on psychomotor performance and driving ability due to their effect on the central nervous system (CNS; e.g., Drummer, et al., 1993; Friedel and Joo, 1994; Gier and O’Hanlon, 1986). The CNS mediates all of the perceptual, cognitive, and motor skills required for driving and as a result – driving performance deteriorates immensely. In the impairment of driving skills, the principal drugs of concern fall into the following categories: CNS
stimulants (e.g. peed, ecstasy, and cocaine); CNS depressants (e.g., benzodiazapines); narcotic analgesics (e.g., heroin); and cannabinoids (e.g., marijuana).

A large body of research has been done to understand the effects of different types of drugs on driving performance (e.g., Becker, et al., 1998; Friedel and Joo, 1994). Most of these studies provide convincing evidence that the main groups of commonly used drugs (as described above) have the potential to impair driving and thus increase the risk of crashing. Despite the fact that drugs effect individuals in a different way, it is still more than likely that it will have negative effects on driving performance and if they are used in a combination with other drugs – the effects can worsen.

In some of the studies the culture of drug use was considered in driving context. Aitken, Kerger, and Crofts (1998) described several circumstances, in which drug driving may occur. The results of qualitative and quantitative research suggest that heroin is commonly used in the car immediately after obtaining it; prior to driving home or elsewhere, some users deliberately drive under the influence of amphetamines, possibly because of the sensation it produces; smoking cannabis in a car is relatively common according to this study, particularly among younger users.

The most influential factors that can serve as predictors of drug driving are age and gender. Several studies (e.g. Drummer, et al., 2004; Hunter, et al., 2008) suggest that young drivers tend to be found under the influence of drugs more often than other age groups. Both Drummer et al (2004) and Hunter et al (2008) concluded that the average age of drivers found to have been driving while under the influence of drugs was around 25 years of age. A number of studies also found a significant difference between males and females, suggesting that males were more likely to be driving while under the influence of drugs more than females (Harré, et al., 1996; Hunter, et al., 2008). The results of the most recent surveys with regard to drug use in Europe also suggest that that illicit drug use had increased in the younger population over the last few years.

Age and gender are the strongest predictors of drug driving. Men, aged between 18 and 34 are more likely to drive under the influence of drugs. In the UK, 3,820 individuals were apprehended on suspicion of driving under the influence of drugs between 4th March 2014 and 31st May 2016 and 94% of these cases were male. Psychoactive drug use is the highest amongst young male drivers that is also reflected in the fact that amongst drivers involved in collisions, illicit drugs are mainly detected among young male drivers.

Psychosocial factors

Psychosocial factors are also considered to be as predictors of drug driving behaviour. Drug driving is thought to be strongly tied to drug use in a social and cultural nature (Davey, et al., 2001). There is also some evidence that social factors, such as encouragement from friends, have a strong influence upon drug driving behaviour. Similarly, perceptions regarding the likelihood of detection and apprehension for driving whilst under the influence of drugs are also expected to be related to the behaviour. Research suggests that general perceptions about the likelihood of being apprehended for drug driving are low (Davey and French, 2002; Lenton and Davidson, 1999).

Another factor which may contribute towards the higher incidence of drug driving amongst younger individuals is their propensity for sensation seeking, which is particularly pertinent amongst younger males. A review of literature by Jonah (1997) confirmed an association between sensation seeking and a number of risky on-road behaviours, including drink driving, speeding, and following too closely. Research has also identified that sensation seeking may have a strong association with drug use (Wagner and Anthony, 2002).
Theoretical Approach to Understand Drug Use

In general, there are a number of theories that could be used to explain drug behaviour, predominantly in the context of addiction. However, there are fewer theories that are aimed at explaining the drug driving behaviour – the most predictive among them are: deterrence theory, social-control theory, social learning theory, theory of planned behaviour, the health belief model, expectancy and social norms theories.

**Deterrence theory.** This theory postulates that the perception of certain, swift, and severe punishment discourages people from illegal behavior. The higher chances of being caught by the police and severity of punishment – the lower probability of law breaking (Taxman and Piquero, 1998). It is based on the assumption that that people tend to avoid pain and seek pleasure, and are free to control behaviour, knowledgeable regarding harmful behaviors, and deterred by fear of negative consequences. This theory suggests that driving under the influence of drugs can be diminished with the increased presence of the police on the roads and cases of being checked.

Even though this theory has been explored in numerous empirical investigations and theoretical reviews, it fails to explain recidivism of a drug driving behaviour after being caught (Nochajski and Stasiewicz, 2006). Despite this gap in empirical evidence demonstrating its practical utility, deterrence theory is the dominant ideology in law enforcement models to reduce drug driving. Classic deterrence theory, based largely on assumptions regarding human behavior rather than empirical observations, ignores potential variability in responses to threat or experience of punishment, and does not consider potentially important concepts, such as the moral components described in social-control approaches (Berger and Snortum, 1986). In most of the cases, this theory was tested using non-convicted offenders or predominantly college students (Freeman and Watson, 2006) and therefore can be critiqued.

**Social-control theory.** According to this theory, legal sanctions can be considered only as one of the mechanisms that can possibly influence drug driving behaviour. It postulates, that people can be judged based on the “informal sanctions”, such as social stigma associated with committing crime, perceived risk in committing the crime, and moral commitment to the law. In most of the cases, only “informal sanctions” can discourage criminal behaviour. “informal support” that can come from peers, family, criminal self-image. In contrast, criminal propensity and skills related to criminal behaviour, can encourage illegal behaviour. However, social-control theory, while incorporating many sources of potential social influence on illegal behavior, does not explicitly include punishment experience of peers and its potential effect on the person’s risk perception.

**Social learning theory.** According to this theory people learn from direct experience, and tend to learn by observing others (Bandura, 1977). The most powerful resource of social learning is the actual interactions with peers, family, and other communities.

Social interactions can have the greatest influence especially if they were formed while individuals were growing up. This includes parents and other family members. It might also include a neighbour or teacher. Hence, those behaviours that could be observed in the family members will be more likely to be perceived as acceptable or at least individuals will try out these behaviours themselves. Individuals have a strong need for social interaction. Hence, drug driving behaviour might quite often occur when it is accepted by the social surrounding of drivers and it is less likely that drivers would continue interaction with people who would judge drug driving or perceive it as illegal. Interventions based on this theory should promote positive role models or prosocial behaviours. Although this theory can explain how drug driving behaviour is formed, it provides a weak practical recommendation
on how this behaviour can be changed, apart from taking radical measures of changing perceptions on drug driving among the social groups.

**Theory of planned behaviour.** This theory suggests that a certain set of motivational factors leads to intention to act in a certain way (Ajzen, 1991). Lately, this intention will be transformed into behaviour. Knowing individuals’ attitudes, subjective norms, and perceived behavioral control can help to predict intention, and knowing intention, in turn, can help to predict behaviour.

Attitudes refer to people’s evaluation of their own behavior. Attitudes concerning drug driving could be used to predict drug driving, as it has been done previously in the studies using this theory to predict drink driving among college students (e.g., Stacy, et al., 1994). The subjective norm is a target person’s perception of others’ evaluations of the target person performing a behavior (Ajzen, 1991). This construct may be broken down into two components: perception of others’ evaluations (also referred to as normative beliefs) and the importance of the others’ opinions to the target person (representing motivation to comply with perceived norms). Hence, individuals are more likely to drug drive if others, whose opinions the individuals value, approve of the person performing the behaviour. Perceived behavioural control, or the perceived ease or difficulty of performing a behavior, is believed to both indirectly (through its association with intentions) and directly influence behavior (Ajzen and Fishbein, 1988; Ajzen, 1991). Perceived behavioural control can serve as the most predictive factor in drug driving as most of drivers believe their driving performance is under control and does not deteriorate after taking drugs.

**Expectancy theory.** According to this theory, drug driving is chosen over safer option (e.g. not to drive a vehicle while being under the influence of drugs) due to drivers’ expectations. When drivers expect the pros and cons of drug driving favourably outweigh the pros and cons of other safer options, they will choose the first one. These expectations about behaviours may develop by observing others. This can be through direct or indirect observation. Once these expectations develop, they are often resistant to change. This is true even in the face of new, more accurate information. This theory suggests that in order to prevent drivers from drug driving it is important to develop more accurate expectations of drug driving by encouraging more accurate evaluation of all the pros and cons.

**Social norms theory.** Social norms theory postulates that a drug driving behaviour is affected by an incorrect perception about how other people think and act about drug driving (Perkins and Berkowitz, 1986). The social norms are based on the assumptions that individuals incorrectly perceive that the attitudes or behaviours of others are different from their own, when in reality, they are similar. This phenomenon is known as pluralistic ignorance. It is largely because individuals assume the most memorable and salient, often extreme, behaviour is representative of the behavior of the majority. This may lead individuals to adjust their behavior to that of the presumed majority by adhering to the pseudo-norms created by observing such memorable behaviour. These exaggerated perceptions, or rather misperceptions, of peer behavior will continue to influence the habits of the majority, if they are unchallenged. This means that individuals may be more likely to enact problem behaviours and suppress healthier practices, making support for healthy behaviors much less visible at an aggregate level. This effect has been documented for alcohol, illegal drug use, smoking, other health behaviours, and attitudes, such as prejudice. Media campaigns based on this theoretical model attempt to dispel the misconception that many drivers drive under the influence of drugs and would also attempt to correct misconceptions and erroneous information.

**The health belief model.** The health belief model (HBM) is based on the idea that a lack of knowledge about the consequences of unhealthy behaviour may lead to drug driving (Lewis, et al., 2002). This
model is one of the most widely used conceptual frameworks for understanding health behavior. Developed in the early 1950s, the model has been used with great success for almost half a century to promote greater seat belt use, medical compliance, and health screening use, to name a few behaviors. The HBM is based on the understanding that individuals will take a health-related action (e.g. not to drive under drug influence) if they:

1. feels that a negative health condition (e.g. injuries due to vehicle collision) can be avoided;
2. have a positive expectation that by taking a recommended action, they will avoid a negative health condition;
3. believe that they can successfully take a recommended health action.

The HBM is a framework for motivating people to take positive health actions that uses the desire to avoid a negative health consequence as the prime motivation. Thus, providing factual information about the dangers of drugs should prevent or reduce abuse by creating negative attitudes toward drug use.

11.3 Drug Driving and Engineering Interventions

Different legislation and enforcement techniques determine the type of technology and equipment used to screen and test for drugs. The technology available also determines the types of legislation and substance thresholds used. Drug limits in blood can be set in many ways:

- Laboratory limit of detection/analytical cut-off: In this case the limit is not necessarily associated with the effects or impairment caused by a drug, (although this can coincidentally be the case for some drugs). Where zero tolerance per se laws have been implemented laboratory limits of detection are often applied.
- Risk thresholds/Lower effect limits: These levels are normally higher than the laboratory LOD and are at a level where there is evidence that there is an increased risk of impairment or the lowest concentration at which the effects of a drug are observed.
- Impairment limits: These limits are used where there is evidence of significant impairment at or above these limits.
- Supra-therapeutic limits: These limits are applied where medicines are prescribed and allow for the legitimate use of medicines by drivers. In the case where the driver is taking the medicines correctly they should be within the normal therapeutic range of the drug in blood and should not exceed the supra-therapeutic levels for these drugs.

11.4 Drug Driving and Educational Interventions

A new campaign video warned people who drive under the influence of drugs that a change in the law means it’s now easier to get caught. The new advertising campaign simulated the paranoia felt by many drug drivers. The levels for the illegal drugs, which include heroin, cocaine and cannabis, mean there will be zero tolerance for drivers caught with these substances in their system. The drivers were warned that the police will be using “drugalysers” to screen for cannabis and cocaine at the roadside and also be able to test for these and other drugs including ecstasy, LSD, ketamine and heroin at a police station, even if a driver passes the roadside check. No evaluation of this campaign could be sourced.

The Drug Aware Drug Driving Education Campaign has been developed in Australia to educate people about the harms of drinking alcohol and driving, and emphasizes the need to get serious about the harms of drug driving. The Western Australian-produced campaign does this by showing people that there is very little difference between drug driving and drink driving. The key messages of the campaign aim to:

- remind people that drug driving laws have changed as using drugs and driving can cause harm to themselves and others
• educate drivers about how drugs have varying effects on driving skills, judgement and risk-taking; which can impair a person's ability to drive safely
• educate drivers about the drug driving laws
• remind young people that you can get caught if you use drugs and drive
• advise young people where to go for more information about these issues.

The long-term goal of the campaign is to raise awareness of the dangers of driving while under the influence of drugs other than alcohol, and to ultimately modify driver behaviour to ensure a greater compliance with traffic laws and reduce drug-related road trauma. The campaign predominately features radio and online advertising targeted to reach anyone who might use drugs and drive, as well as outdoor advertising in identified high-risk entertainment venues and precincts.

Convicted drink drivers learned about the dangers of drug-driving as part of a new pilot course in 2017. The new course was trialled by 1,000 drink drive offenders and the results will form the basis for a consultation next year to make the new rehabilitation course available for drug drivers. The course was introduced after figures show a fifth of convicted drug drivers had previously been banned for drink driving.

No research to evaluate the effectiveness of educational approaches to reducing drug driving could be sourced.

11.5 Drug Driving and Enforcement Interventions

In the latest report by European Transport Safety Council published in 2017 a number of the most effective countermeasures to tackle drug driver were suggested:

Legislation. The most direct way of tackling drug driving is through legislation and its proper enforcement. It can be enhanced in three ways:

• Legal limits, also known as ‘per se’ laws: these establish a fixed substance limit, similar to BAC levels for drink driving. A driver detected with a substance reaching or exceeding the legal limit has broken the law.
• Zero tolerance laws: these set legal limits with a substance concentration set at the laboratory limit of detection (LOD), or the lowest limit of quantification (LLOQ). Any driver with a detectable amount of a relevant psychoactive substance is considered to have broken the law.
• Impairment legislation: in each case it must be proven that the skills of the driver were adversely affected by a specific psychoactive drug. Signs of impairment are usually observed and recorded by the police when they stop a driver. Most countries use a fixed testing protocol (Field Impairment Test), for police to follow.

Penalties. Penalties for driving under the influence of drugs vary and may be similar to punishments for drink driving. Under the new legislation in the UK, drug drivers face an unlimited fine, up to six months in prison and a minimum one-year driving ban. However, as it was suggested by Elvik (2016), the actual increase in penalties does not reduce road accidents as much as expected.

Enforcement. Legislation and penalties can only be effective when they are enforced. As the data in the report suggests, only 11% of drivers believe that on a typical journey, the probability of an illicit drugs test by the police is increased. Therefore, it is crucial that enforcement itself is carried out properly and visibly. Enforcement can be separated into two forms:

• Roadside screening. Drivers suspected of driving under the influence of drugs are stopped by police and, depending on the legislation in place, assessed and tested by police using impairment protocols and drug-testing equipment. If they test positive, a second sample may
be collected for evidential analysis or the individual may be taken to the police station in order to provide an evidential sample.

- Post-collision forensic testing. It helps to collect more detailed information collected on individuals involved in a collision including details of the various substances its participants have taken. This information can then be used as evidence and to help determine penalties and inform wider discussions.

A new drug drive law came into force in England and Wales on 2nd March 2015 with an introduction of a new easy-to-use roadside swab test. According to the new law it is illegal to drive with certain legal or illegal drugs above a certain level in the blood. Limits were set at very low levels for eight illegal drugs and at high levels for eight prescribed drugs which can be sometimes abused. New roadside drug testing kits were also introduced in Norfolk and Suffolk allowing officers to carry out roadside tests on drivers suspected of being under the influence of Cannabis or Cocaine. The kits work by testing a saliva swab.

Police in the UK also can use five field impairment tests:

- non-invasive eye examination
- balance exercises
- co-ordination exercises
- divided attention exercises.

Drivers who are convicted of drug driving usually get:

- a minimum one year driving ban
- an unlimited fine
- up to six-months in prison
- a criminal record
- DG10 driving licence endorsement
- if a drug driving caused death – a driver can be imprisoned up to 14 years.

A conviction for drug driving also includes a significant increase in car insurance costs and difficulties with traveling to some countries (e.g. USA).

The Road Safety Authority (RSA) in Ireland launched its fourth in a series of anti-drug driving awareness campaigns in 2014. The new campaign was launched in association with the police to raise awareness of Roadside Impairment Testing (RIT). Roadside Impairment Testing (RIT) provides the police additional powers to test drivers whom they suspect of driving under the influence of drugs. As part of the new test drivers were required to undergo five impairment tests; a Pupil Dilation Test, Modified Romberg Balance Test, Walk and Turn Test, One Leg Stand and lastly a Finger to Nose Test. To support the introduction of Road Side Impairment Testing the RSA have produced a new 30 second TV advert to raise awareness of the new powers. It also includes radio, online and cinema advertising.

No significant evidence relating to changing drug driving behaviour has been reported with regards drug driving campaigns. The ‘THINK!’ campaign is the main communication strategy between Government and road users and future campaigns could evaluate the impact of their campaigns on illegal drug driving in collaboration with enforcement.

11.6 Conclusions

A large body of research and statistical data suggest that drug driving has been a serious issue to deal particularly over the last ten years or so. Regardless of the previous interventions, drug driving has been growing all over the UK and concern about the impact on KSIs is also growing. Further research could develop countermeasures against drug driving including further improvements in roadside
testing availability to tackle drug driving, as well as providing the police forces with appropriate training programs to obtain skills of how to detect drug drivers and perform drug screening.

**Recommendations**

- A range of educational interventions could also be implemented such as providing education to high risks groups (e.g. young males)
- The risks of drug driving could be incorporating into the driving curriculum and professional driver training.
- See section 5.5 for the Australian programme called RRISK on building resilience to using illegal substances
- Collaboration between the police and health professionals could be developed to improve and integrate rehabilitation programmes.
- The rehabilitation programmes could be developed separately for drug addicts and non-addicted drivers with the legislation diverting offenders towards an appropriate intervention.
- New educational interventions looking beyond enforcement need to consider the benefit of behavioural interventions.
- Benchmarking data is required to monitor the prevalence of drug driving. However, police data may not be entirely reliable.

**11.7 Drug Driving Intervention Matrix**

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address drug driving and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as, ‘design’, ‘educate’ and ‘support’.
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<td>None For The Road\textsuperscript{17}</td>
<td>Drug detection systems\textsuperscript{30}, Summer Anti-Drink and Drug Driving Campaign in Suffolk\textsuperscript{2}</td>
<td>Christmas drink and drug driving campaign in Cleveland and Durham\textsuperscript{14}</td>
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<td>Don't let drugs take the driving seat\textsuperscript{24}</td>
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### An Intervention Framework for Safer Driver Behaviour: Drug Driving

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| New Zealand Transport Agency: Drug Driving\(^{23}\)  
Kiwi stoners targeted by Snapchat in drug-driving campaign\(^{25}\)  
The department partnered with Ministry of Sound to target a young audience on the dangers of driving after taking drugs\(^{27}\) | No One Drives Well On Drugs\(^{21}\) | Thoughts\(^{4}\)  
Paranoia\(^{7}\)  
Information resource on drug driving\(^{10}\)  
The Drug Aware Drug Driving Education Campaign\(^{15}\)  
It's time to stop drug driving\(^{16}\) | Think! Drug drive campaign\(^{1}\)  
The TAC drug driving campaigns\(^{8}\)  
West Mercia Police Drink/Drug Driving Campaign\(^{9}\)  
RSA Impairment test\(^{26}\) |

| Design | Educational workshops/sessions on the consequences of drug driving\(^{32}\)  
School based preventive education\(^{30}\) |

| Educate | |

| Support | |

1. **THINK! Drug driving campaigns**  
THINK! Drug driving campaigns have recently supported the introduction of the new law by informing adults of the law changes and challenging those who are more likely to take drugs and drive.

2. **Summer Anti-Drink and Drug Driving Campaign in Suffolk**
The campaign ran between June 10th and July 10th to coincide with UEFA Euro 2016. Essex Police worked with the families of two teenagers killed in a collision with a drink and drug driver to raise awareness of the devastation caused. The campaign reached in excess of 510,000 people on Facebook and 893,000 people on Twitter. The video that was made for this campaign was viewed in excess of 249,000 times across all platforms. Of the 197 arrested during the campaign, 168 were men and 29 were women. Forty (37 men and three women) were arrested on suspicion of drug driving and ten (eight men and two women) were arrested on suspicion of failing to provide a specimen of breath or blood for analysis. During last year’s summer campaign, a total of 102 drivers were arrested.

3. **Christmas Anti-Drink and Drug Driving Campaign**

The campaign Christmas Anti-Drink and Drug Driving Campaign was launched in partnership with the Safer Essex Roads Partnership (SERP). Essex Police takes a zero tolerance approach to drink and drug driving 365 days a year and they supported the National Police Chief Council’s campaign between December 1st, 2016 and January 1st, 2017. The campaign targeted perpetrators and the family and friends who know about their offending by highlighting ‘How it Feels’ to deal with the consequences of drink and drug driving. It aimed to push home messages about the far-reaching consequences through the eyes of road policing officers who witness them first-hand. To help spread those messages, two long-serving road policing officers voiced a radio advert which was aired on Heart FM throughout the festive period.

4. **Thoughts**

The campaign targeted drivers who use cannabis. It primarily focuses on guys in their early 30s who don’t think of themselves as ‘stoners’ but they smoke regularly with their mates to have a good time and then drive home. This campaign aimed to make the audience feel uncomfortable about driving under the influence of cannabis. After all, things may feel slower for them but things can happen very quickly on the road. Even with their coping mechanisms, such as driving more slowly, they’re not alone on the road and anything can happen.

5. **Op Attention - campaign to combat drink and drug driving**

To mark the start of the North Yorkshire Police and 95 Alive Christmas drink and drug driving campaign, the force made a film with the widow of a drink drive victim, Lorraine Allaway, to depict the devastating effects of drinking or taking drugs and getting behind the wheel of a car. Lorraine Allaway lost her husband Bob in a road traffic collision with a drunk driver in October 2015. In the film, she speaks bravely and openly about the experience of losing Bob, due to the actions of a drink driver and what life has been like since the death of her husband.

On Saturday 3rd October 2015 at 12pm, Bob was riding his motorbike along the A65 near Settle to join Lorraine at her terminally ill sister’s bedside, when Highways England was hit head on by a drunk driver. Bob very sadly died at the scene. A roadside breath test was conducted on the driver and Highways England returned a reading of 83ug per 100ml of breath – nearly two and a half times the legal limit (35ug/100ml). The driver, received a four year and eight-month prison sentence was served with a five year, eight-month ban from driving. North Yorkshire Police’s Major Collision Investigation Unit conducted an investigation into the collision and found that whilst under the influence of alcohol the driver, Andrew Crook, 48 from Swinnow in Leeds, had driven his vehicle across double solid white lines onto the wrong side of the road and collided head on with Bob.

6. **Summer campaign to target drink and drug driving**

As well as conducting alcohol breath tests, officers also used “drugalyser” devices at the roadside for the first time to test drivers for suspected drugs in England. As with drink driving offences, drug drivers can face a fine of up to £5,000, a prison sentence and a minimum one-year driving ban. During the Christmas Operation Tonic campaign motorists who were charged with a drink or drug driving offence were named and this approach will be continued as part of the summer campaign following the success of this additional deterrent.

7. **Paranoia**

A powerful new campaign video warned people who drive under the influence of drugs that a change in the law means it’s now easier to get caught. The new advertising campaign simulated the paranoia felt by many drug drivers. The levels for the illegal drugs, which include heroin, cocaine and cannabis, virtually mean there will be zero tolerance for drivers caught with these substances in their system. The drivers were warned that the police will be using "drugalyser" to screen for cannabis and cocaine at the roadside and also be able to test for these and other drugs including ecstasy, LSD, ketamine and heroin at a police station, even if a driver passes the roadside check.

8. **The TAC drug driving campaigns**
The campaigns were launched to support random roadside testing of illegal drugs in December 2004. Since then there have been several drug driving campaigns highlighting police enforcement and showing how drugs impair driving. In July 2006 the government extended the testing program indefinitely and introduced legislation which allowed for the testing of MDMA (ecstasy).

Swap (2009). "If you drive on drugs, you’re out of your mind"

Swap addressed the issue of driving while affected by THC, the active component of cannabis, and challenges the commonly held perception that it is OK to drive after using cannabis. This campaign clearly illustrated the effects this drug has in terms of the driver’s slowed reaction times, distorted perception of speed and distance, as well as reduced ability to concentrate and coordinate driving functions.

December 2006: Booze Buses are now Drug Buses

In the campaign scenario, a Booze Bus to randomly check drivers is spotted by a car full of young people driving down a main road at night. The music is on in the car and they are all in a good mood. One of the passengers notices the booze bus yet the driver is not concerned as Highways England has not been drinking. Highways England is pulled over, winds the window down and is given a drink driving test. However, the driver is told Highways England will be tested for drugs. All four in the car suddenly panic and the voiceover says ‘Now every booze bus will also be a drugs bus’. As this was the communication of a trial period for roadside random drug testing activity only press radio and outdoor were used.


The Cell brought to life the effect of taking ‘Party Drugs’ such as ecstasy and speed can have on a driver’s ability to drive. Some of the common effects include reduced peripheral vision, dizziness, blurred vision and loss of concentration. There can be a false sense of alertness which can lead to over confidence and the inability to make quick and good decisions. This campaign shows a young man in a police cell replaying the night’s events and the tragic result.


Throughout Christmas 2016 and New Year West Mercia operated the Christmas Don’t Drink Drive and Don’t Drug Drive Campaign. This Campaign ran throughout the festive period covering both Christmas and New Year. West Mercia was keen to point out that the use of drugs does not just apply to illegal substances. It can also include prescribed medication. Police worked alongside both their sister organisations, Ambulance and Fire, in the hope of educating and persuading motorists not to drink or drug drive. Local Policing teams throughout Shrewsbury visited licensed premises to distribute leaflets and posters highlighting the consequences of driving a motor vehicle whilst under the influence of alcohol or drugs. Police Officers including road policing teams were out and about in Shropshire to stop and interact with the public, and where necessary administer the tests. This to ensure the roads remain safe over the festive period for the law abiding public.

10. Information resource on drug driving

An internet resource that provides information on drug driving. It includes legislation, description of the negative effect of drugs on driving performance, the stories of people who got into an accident due to drug driving etc. http://www.drugdriving.com/effects.php

11. Christmas drink and drug driving campaign by Devon and Cornwall Police warns drivers of more testing

Devon and Cornwall Police warned drivers that they can still be charged and convicted for driving under the influence of drink or drugs this Christmas even if they are under the legal limit when tested. The force warned that any drivers involved in a collision or motorists whose driving leads police to suspect they are under the influence of alcohol will be breathalysed. If drug driving was suspected, drivers had to undergo a roadside sobriety test.

12. Anti-drug driving campaign hailed a success after 60 arrests made in North Wales

A campaign ran by North Wales Police has seen more drug drivers than ever before caught during the Christmas period. The campaign, which ran from December 1st 2016 until January 1st 2017, saw 60 drug drive arrests being made. During the same period North Wales Police carried out 9,448 breath tests of which 95 were positive, failed or refused. Officers used intelligence-led tactics and local knowledge of hotspots to detect people who were driving under the influence of drugs or alcohol over the festive period.

13. Christmas Drink/Drug Driving Campaign Launched in Wiltshire
Wiltshire Police alongside Wiltshire and Swindon Road Safety Partnership launched the annual Christmas Drink and Drug Driving Campaign on Tuesday 1st December 2015 to Sunday 3rd January 2016. Tests will take place at all times of the day and night to catch those who pose a huge risk to themselves and other road users. The campaign aimed to educate drivers about the dangers of drinking and taking drugs before getting behind the wheel and ran throughout the month from. It was launched in support of a national campaign by the National Police Chiefs’ Council (NPCC). All Wiltshire officers took part in this campaign, but specifically, members of the Tri Force Roads Policing Unit were conducting high profile roadside checks at various times. In addition to this, some of the checks were conducted in conjunction with Tri-force officers from Gloucestershire and Avon and Somerset. Police officers on Tri-Force were trained in Field Impairment Testing (FIT) techniques and were screening for drugs on the roadside. Wiltshire Police, Wiltshire Fire and Rescue, Wiltshire Council and Swindon Borough Council were holding Drink/ Drug Drive Roadshows around the county in order to highlight the dangers of drink/ drug driving. As part of the roadshow, a drink drive simulator was available to allow members of the public the opportunity to see how alcohol affects their ability to drive. [http://www.wiltshire.police.uk/news/2142-christmas-drink-drug-driving-campaign-launched-in-wiltshire](http://www.wiltshire.police.uk/news/2142-christmas-drink-drug-driving-campaign-launched-in-wiltshire)

14. 173 drivers have been arrested during a Christmas drink and drug driving campaign across Cleveland and Durham.

Throughout the annual initiative, which runs between December and the beginning of January 2017, almost 3,000 drivers were tested to see if they were intoxicated whilst behind the wheel. 116 of the arrests were in connection with driving whilst under the influence of alcohol and 57 of the arrests were in connection with drug driving. During this campaign, police teamed up with a local venue to offer free soft drinks to designated drivers. The Keys on Yarm High Street offered the soft drinks to customers using their pub during the week before Christmas.

15. The Drug Aware Drug Driving Education Campaign

The Drug Aware Drug Driving Education Campaign has been developed in Australia to educate people about the harms of drinking alcohol and driving, and emphasizes the need to get serious about the harms of drug driving. The Western Australian-produced campaign does this by showing people that there is very little difference between drug driving and drink driving.

The long term goal of the campaign is to raise awareness of the dangers of driving while under the influence of drugs other than alcohol, and to ultimately modify driver behaviour to ensure a greater compliance with traffic laws and reduce drug-related road trauma. The campaign predominately features radio and online advertising targeted to reach anyone who might use drugs and drive, as well as outdoor advertising in identified high-risk entertainment venues and precincts.

16. It’s time to stop drug driving

This campaign warned on the consequences of drug driving in South Australia by describing the police enforcement, penalties and current drug detection devices.

17. None For The Road

Merseyside Police launched its annual Christmas drink and drug driving campaign, urging motorists to have ‘None For The Road’. Officers from the Roads Policing Unit and colleagues across the force stepped up patrols throughout the month-long campaign, which ran until Sunday, 1st January 2017. They payed particular attention to areas across Merseyside in the evenings and early in the morning, to target those who were risking driving the morning after drinking or taking drugs the night before. The campaign was organised nationally and internationally, with the aim of reducing the number of road deaths and serious injuries on the roads of Merseyside and to raise the awareness of the dangers around driving while over the limit or impaired through drugs.

18. It’s not worth it

A police campaign aimed at preventing deaths caused by drink and drug driving in Hampshire.

It’s Not Worth The Risk, or Operation Holly, saw extra patrols throughout December to prevent motorists from driving after drinking or taking drugs. Hampshire Constabulary and Thames Valley Police worked together to deter and detect behaviour behind the wheel that puts lives in danger on our roads. Officers from both forces conducted operations at all times throughout the day and night across Hampshire and the Isle of Wight. Every driver involved in a collision was breathalysed by police, and officers made extra patrols based on intelligence about suspected offenders. The Roads Policing Unit is now also using Drug Analysers so officers can carry out roadside drug tests when there are reasonable grounds to suspect a motorist may have a trace amount of an illegal drug in their body. These policing tactics are designed to be a deterrent to any motorist thinking about driving while impaired by the effects of alcohol or drugs.

19. Festive drink drug drive campaign in Scotland
One year after the introduction of a vehicle forfeiture scheme for those convicted in Scotland of drink or drug driving for a second time, 357 repeat offenders have been caught and a total 105 vehicles seized or forfeited as of 16th November 2010 – an average of two a week across Scotland. The campaign took place at Lothian and Borders Police Headquarters, Fettes Avenue, Edinburgh on Monday 6th December with Chief Constable David Strang, Executive Vice President of ACPOS, Kenny MacAskill Cabinet Secretary for Justice and the Lord Advocate Elish Angiolini QC.

20. **Don’t Drink or Drug Drive**

Staffordshire Police and its partners committed to reducing deaths and injuries caused by drinking and driving. National drink and drug driving campaigns were run throughout the year to further target irresponsible and dangerous drivers in a bid to drive down fatal and serious road traffic collisions and protect other road users. In addition to testing drivers involved in road traffic collisions or those suspected of drink or drug driving, officers carried out operations where they generally stop motorists. These roadside stop checks were carried out at all times of the day or night.

21. **No One Drives Well On Drugs**

“Drugs and driving don’t mix”. This UK campaign focused on the harms associated with drug driving, including harm to yourself and others as well as the drug driving laws.

There were three key audiences for the campaign:

1. Young people aged 17 to 29 years, who are at risk of drug driving;
2. Young people aged 17 to 29 years, who occasionally or regularly drug drive; and
3. General community, aged 17 to 59 years, who may be exposed to random roadside drug testing operations and who may be at risk of impaired driving through both illicit and prescription/over the counter drug use.

Campaign objectives were: to increase knowledge that there are a range of health, social and legal consequences associated with drug driving by:

- Increasing knowledge that drugs can seriously impair driving ability putting you at more risk of having a motor crash that can result in a fatality or serious injury;
- Increasing knowledge that drugs can seriously impair driving ability putting others at risk of being affected by a motor crash that can result in a fatality or serious injury to family, friends and others on the road;
- Reminding the target audience that it is against the law for anyone to drive under the influence of drugs and if tested they can be caught, resulting in disqualification from driving, fines and/or imprisonment;
- Increasing the target audience’s knowledge of where to go to access information and support related to drug driving.

22. **Go cold turkey**

Surrey Police arrested 100 drivers during its 2016 festive campaign to put a stop to motorists getting behind the wheel whilst under the influence of drink or drugs. Their latest operation, which used the simple message ‘Go cold turkey and have none at all, ran from 1st December 2016 through to 1st January 2017. Officers from the Surrey and Sussex Roads Policing Unit carried out dedicated patrols on the roadside at various locations across the counties. They were tasked 24/7 with stopping motorists and interacting with them to take action against any breaking the law, whilst encouraging every driver to understand there is no ‘safe’ limit when driving. Half of those arrested (50 people) have already been charged with drink related offences and are due at, or have already been to court.

23. **New Zealand Transport Agency: Drug Driving**

Stoned drivers compensate by driving more carefully, but eventually their minds wander. No one buys that the government gets what it’s like to drive stoned, so the NZTA partnered with those who have more credibility on the subject. Each time the audience saw the ad, a different comedian was voicing the train of thought of each character, showing that whoever you are, it’s hard to stay focused when you’re stoned.

24. **DON’T LET DRUGS TAKE THE DRIVING SEAT**

The campaign that was aimed at increasing awareness on the consequences of drug driving. The UK police have been issued with more sophisticated equipment that enables them to test instantly whether a driver is under the influence of drugs, by testing saliva or sweat.
25. Kiwi stoners targeted by Snapchat in drug-driving campaign

Snapchat set up an account fronted by likeable Kiwis called 'TinnyVision' and generated interest in funny 'stoner snaps'. Thousands of people added TinnyVision as a friend on Snapchat, and over the course of a single day they received a series of video snaps, watching the stars of TinnyVision getting stoned and their reactions get slower. This is immediately followed by a snap that reads, 'Stoned drivers are slower to react'. Transport Agency spokesperson Andy Knackstedt says the innovative campaign was needed to reach the target audience.

26. RSA Impairment test

The Road Safety Authority (RSA) in Ireland launched its fourth in a series of anti-drug driving awareness campaigns on 27th November 2014. The new campaign was launch in association with the police as part of the Christmas and New Year Road Safety Campaign in co-operation with the Medical Bureau for Road Safety in UCD. The focus of the campaign was to raise awareness of Roadside Impairment Testing (RIT), which has been introduced by the Minister for Transport, Tourism and Sport, Mr Pascal Donohoe. Roadside Impairment Testing (RIT) provides the police additional powers to test drivers whom they suspect of driving under the influence of drugs (DUID). As part of the new test drivers will be required to undergo five impairment tests; a Pupil Dilation Test, Modified Romberg Balance Test, Walk and Turn Test, One Leg Stand and lastly a Finger to Nose Test. To support the introduction of Road Side Impairment Testing the RSA have produced a new 30 second TV advert to raise awareness of the new powers. It also includes radio, online and cinema advertising.

The roadside impairment testing:

- **Test 1:** Pupillary Examination – A Garda will ask a motorist to look straight ahead and keep their eyes open, and will measure the driver’s pupil for dilation.
- **Test 2:** Romberg Tests – A Garda will ask the driver to do a short counting exercise with their eyes closed, which measures balance and an awareness of body positioning.
- **Test 3:** Walk and Turn – A Garda will ask the driver to walk nine steps along a straight line and turn without counting aloud. This measures both balance and ability to focus.
- **Test 4:** One Leg Stand – A Garda will ask the driver to stand on one leg for approx. eight counts. This measures ability to balance.
- **Test 5:** Finger to Nose – A Garda will ask the driver to touch his/her nose with both right and left index fingers with eyes closed. This measures ability to perform a basic motor task.

27. The department partnered with Ministry of Sound to target a young audience on the dangers of driving after taking drugs

A button on the Ministry of Sound home page (www.ministryofsound.co.uk) links to advertorial about the campaign and is designed to replicate the feel of the music site. Content has been produced in partnership with jungle music site Breakbeat.co.uk. It includes recordings of people talking about their experiences of driving home after taking drugs, as well as interviews with Surrey Police about the dangers. These recordings will also be available to download as a podcasts. Creative was by Ministry of Sound, with planning and buying by Carat Digital. The new effort builds on an anti-drink driving push from the Department of Transport, which used viral to push a road-safety message last year.

28. Government to pilot new drug drive rehabilitation course

Convicted drink drivers will learn about the dangers of drug-driving as part of a new pilot course. The course has been launched on the back of figures which show that a fifth of convicted drug drivers had previously been banned for drink driving. The new course was trialled by 1,000 drink drive offenders in 2017. The results of the pilot will form the basis for a consultation next year to make the new rehabilitation course available for drug drivers. The course has been introduced after figures show a fifth of convicted drug drivers had previously been banned for drink driving.

29. Draeger Drug Check 3000

Drug check kits can be used by employers on-site. The consumption of illegal drugs at the workplace can have far reaching and lasting consequences. If employees work in a plant while under the influence of drugs, accidents can occur and cause lower worker productivity. Possible safety risks multiply when drugs are added to different workplace scenarios. Especially vulnerable are remote operations and including the risk of drug driving.

Griffin and Botvin, (2010) reported on an evidence-based intervention for preventing substance use disorders in adolescents. Child and adolescent psychiatric clinics of North America, 19(3), 505-526. The scholars recommended a plethora of exemplary school and family-based prevention programs for universal (everyone in population), selected (members of at-risk groups), and indicated (at-risk individuals) target populations to prevent in the future drug consumption.
30. **School Based Preventions:**

Schools are the focus of most attempts to develop and test evidence-based approaches to adolescent drug abuse prevention. School-based efforts are efficient in that they offer access to large numbers of students.

**Social Resistance Skills.** These interventions are designed with the goal of increasing adolescent’s awareness of the various social influences that support substance use and teaching them specific skills for effectively resisting both peer and media pressures to smoke, drink, or use drugs. Resistance skills training programs teach adolescents ways to recognize situations where they are likely to experience peer pressure to smoke, drink, or use drugs. Students are taught ways to avoid or otherwise effectively deal with these high-risk situations. **Normative Education.** Normative education approaches include content and activities to correct inaccurate perceptions regarding the high prevalence of substance use. Many adolescents overestimate the prevalence of smoking, drinking, and the use of certain drugs, which can make substance use seem to be normative behaviour. Educating youth about actual rates of use, which are almost always lower than the perceived rates of use, can reduce perceptions regarding the social acceptability of drug use.

**Competence-Enhancement.** Competence-enhancement programs recognize that social learning processes are important in the development of drug use in adolescents. Further, they recognize that youth with poor personal and social skills are more susceptible to influences that promote drug use. These youth may also be more motivated to use drugs as an alternative to more adaptive coping strategies.

**Model School-Based Programs:**

**Life Skills Training.** The Life Skills Training (LST) program seeks to influence major social and psychological factors that promote substance use. Separate curricula have been developed for elementary school students (grades three to six), middle or junior high students (grades six to eight, or grades seven to nine), and high school students (grades nine or ten). The Life Skills Training Middle School (LST-MS) program has been studied most extensively and is the focus of the following review.

**Community-Based Prevention.** Evidence-based drug abuse prevention programs delivered to entire communities typically have multiple components. These often include a school-based component, family or parenting components, along with mass media campaigns, public policy initiatives, and other types of community organization and activities. These interventions require a significant amount of resources and coordination, given the broad scope of the activities involved. The program components are often managed by a coalition of stakeholders including parents, educators, and community leaders. Research has shown that community-based programs that deliver a coordinated, comprehensive message about prevention can be effective in preventing adolescent substance use.

31. **European Transport Safety Council (2017) recommended a number of interventions to reduce drug driving, which are:**

**Educational interventions:** to address the problem of drug driving by educational and awareness campaigns. Even if an individual is aware that driving under the influence of psychoactive drugs can be illegal, they may not be aware of the specific effects that drugs may have on them and their driving ability. It is also important that policymakers, legislators and the judiciary all have a good understanding of the key facets of driving under the influence of psychoactive drugs.

**Rehabilitation and health care interventions.** Rehabilitation should be provided for drug driving offenders as a path for them to return to driving while also attempting to reduce the likelihood of reoffending. Effective communication between healthcare professionals and driving and licensing authorities can also help to address drug use in general, as drug driving detection naturally includes the detection of illicit substances.
12.0 Lane hogging Behaviour on the SRN

The lane on the far left (Lane one) is the lane a driver should use to travel in. The middle lane (Lane two) and the outside lane (Lane three) are there to give an opportunity to overtake slower moving traffic. Once drivers have overtaken slower traffic they are expected to pull back into Lane one as soon as it is safe to do so. Lane hogging is therefore defined as staying in lane two or three for a significant amount of time without overtaking. Drivers should return to the left-hand lane after overtaking slower-moving vehicles as soon as they are safely past.

12.1 The Impact of Lane Hogging

Apart from the potential increased risk of being involved in a crash due to improper lookout for drivers undertaking and overtaking, drivers hogging a particular lane, even if it is done unconsciously or unintentionally results in sub-optimum traffic flow. Lane hogging behaviour can cause severe congestion on the SRN and may reduce motorway capacity by one third according to the RAC. The DfT stated in its Road Investment Strategy (2015) that the national cost of congestion is £2bn per annum of lost time spent travelling for which lane hogging will contribute an unknown proportion. This figure is conservative because it is at the extreme low end of industry estimates. For instance, The Centre for Economics and Business Research and traffic information company Inrix estimated the figure to be £12.9bn (as reported in the FT.com on 13th October 2014 and based on a $/£ exchange rate of 1.59). A calculation by Highways England for lane Hogging congestion cost savings was conducted based on a North West test area of 63 miles of Motorway on the Main Carriageway as percentage of National SRN (0.65%) prior to a campaign that ran for six months. The national cost of congestion is estimated at £2,000,000,000pa thereby the NW test area cost of congestion is £13,086,439pa. A reduction of congestion in test area of 5.00% gives a value of £654,322pa. Therefore, even a fairly modest improvement in lane hogging could have a major impact on costs.

Lane hogging can lead to other drivers taking risks either due to undertaking on the left-hand lane and/or more frequent overtaking manoeuvres to pass the lane hogger. A survey conducted by Confused.com revealed that at least 32% of drivers admit to hogging the middle lane and more than 11% of drivers have had an accident or near-miss as the result of a middle lane hogger.

According to National Road User’s Satisfaction Survey in 2015 lane hogging was reported as the main factor causing anger and irritation among 50% of SRN customers. An additional 37% of SRN users reported that they were frustrated by lane hogging. Almost two fifths (37%) of drivers are not aware that lane hogging is an offence according to the survey conducted by Confused.com. A 30 minute online survey was conducted by the RAC in mid-May 2016 with 1,714 motorists in the UK. The sample of interviewed motorists was nationally representative in terms of age, gender, socio-economic group, UK regions and car ownership (private vs. company car). In 2014 slower journey times was mentioned by almost one fifth of participants as being of particular concern but this jumped to 27% of the sample in 2016.

Drivers hogging a particular lane, even if it is committed unconsciously or unintentionally, results in sub-optimizing the system. There are clear interdependencies between the behaviours of the complex human systems operating each vehicle. Drivers appear to fail to consider that they are part of an interdependent system of numerous other drivers which is optimized when everyone follows the same rules and norms. Part 264 of the Highway Code says: “You should always drive in the left-hand
lane when the road ahead is clear. If you are overtaking a number of slower-moving vehicles, you should return to the left-hand lane as soon as you are safely past.” A survey conducted by Confused.com revealed that at least 32% of drivers admit to hogging the middle lane and more than 11% of drivers have had an accident or near-miss as the result of a middle-lane hogger. This may explain why almost two fifths (37%) of drivers aren’t aware that middle-lane hogging is even an offence and furthermore - nearly a fifth (19%) admit that they were never taught about middle-lane hogging as a learner driver, according to the survey. The survey also found that apart from causing congestion, lane hogging also irritates other drivers (15%) and middle-lane hoggers are considered being “selfish” by 51% of drivers. According to National Road User’s Satisfaction Survey in 2015 lane hogging was reported as the main factor causing anger and irritation among 50% of SRN customers. An additional 37% of SRN users reported that they were frustrated by lane hogging.

Currently there are several pieces of legislation to address lane hogging including on-the-spot fines introduced in 2013 as part of a wider initiative to tackle “careless driving”. However, since the implementation of this legislation, only 135 drivers were ‘caught’ lane hogging, with only one motorist being convicted in 2015 according to The Telegraph.

12.2 Highways England Lane Hogging Strategy

In 2004 Highways England launched a campaign called ‘Don’t Hog the Middle Lane’ which included large matrix signs on Britain’s motorways asking the driver to keep to the near-side lane unless overtaking. However, no evaluation could be sourced and the campaign was short lived.

Another campaign was launched in collaboration between Highways England and Cheshire Police in 2015 warning middle-lane hoggers that they were putting their lives in danger, as well as risking a fine and penalty points. The main goal of the campaign was to cost effectively use stakeholder engagement and communication activities to positively influence driver behaviour to influence driver attitudes and behaviours.

The campaign consisted of several main components:

- Paid-for poster advertising: five Motorway Service Areas (MSA) over four weeks
- VMS campaign
- Public engagement activity – stakeholders and traffic officers
- Media engagement and coverage
- Social media content – via Twitter hashtag, Facebook etc.

Adverts at five motorway Services advised lane hoggers that they could face a £100 on-the-spot fine and three penalty points, and electronic message signs are being used to encourage drivers to stay safe by keeping left. One advert showed a car coasting in the middle lane with the warning ‘More likely to encounter an undertaker’. Another showed a car sticker on a vehicle parked illegally in a disabled bay, with the slogan ‘My other car hogs lanes’.

The evaluation of the campaign was made using on-road data in response to variable message signs and signals. Motorway Incident Detection and Automatic Signalling (MIDAS) loop data were used to assess lane utilisation and traffic flow. A road user survey was also conducted (samples of 200 - 300 respondents in each round) including interviews conducted at the target MSAs and by the M62. The results showed that lane hogging behaviour and attitudes to lane hogging improved and are more enduring than a change in actual behaviour. The attitudes to the following statements changed during the campaign as follows:
disagreement with “the middle lane is the safest place to drive on the motorway” increased by 17% from 70% to 87%
agreement with “I always return to the left lane unless I’m going to overtake a vehicle in the next few seconds” increased by 12% from 78% to 90%
disagreement with “If you prefer it in the middle lane, you should be able to drive there” increased by 23% from 69% to 92%

The campaign also increased driver’s awareness of the issue and most of the drivers stated that lane hogging should be a priority for Highways England. The campaign cost £34,000 and generated value of at least £150,000 due to lower levels of congestion. However, there has been no evaluation on whether penalty increase has led to a change of behaviour over the longer term and very few drivers have been prosecuted for lane hogging.

12.3 Lane hogging behaviour: A Brief Theoretical and Empirical Review

Driving can be considered as a complex skill, which consists of different functional and operational activities. Lane hogging behaviour has been assumed to be a component in traffic congestion and reduced safety, but only recently have researchers tried to explore the main determinants and impact of lane hogging. In general, there are several approaches that may help to understand the origins of the lane hogging behaviour. These can be divided into three groups of approaches: biological, perceptual-cognitive and psychological (emotional) determinants of the lane hogging behaviour.

A study conducted by Reimer et al. (2013) examined lane change and lane choice tendencies among three age groups of drivers (20’s, 40’s and 60’s). The study showed that both lane choice and changes as well as the likelihood of lane hogging are associated with age. The results suggested that older drivers in general tend to have a conservative driving style and prefer to stay in one lane without passing another vehicle. This could be explained by the fact that with age people tend to self-regulate workload and hence drive slower, and avoid technologies that could possibly distract them and travel during less congested period (Boyle, et al., 1998; D’Ambrosio, et al., 2008; Langford and Koppel, 2006). However, other studies by Holland and Rabbit (1992; 1994) suggest that older drivers vary in their capacity to self-evaluate and can drive beyond their capabilities, which results in low awareness and lane hogging. Contrary to expectations, Drivers in their 20’s were less likely to lane hog and pass another vehicle compared with drivers in their 40’s. It was the middle-aged group that showed the highest likelihood of lane hogging behaviour, which may be explained by greater levels of driving experience and a greater willingness to take risks. The main limitation of this study is that individual differences were not taken into account.

12.4 Perceptual-cognitive determinants of lane-hogging

Cognitive load and demands. Driving performance requires an engagement of a coordinated combination of perceptual and cognitive processing and manipulative actions. Hence, driving is cognitively demanding, especially when it comes to performing not just the actual driving tasks but also some other non-related to driving tasks. Reimer et al. (2011) stated that when cognitive demands are heightened, all drivers tend to choose less risky driving. Interestingly, when it comes to using a hands-free mobile phone, drivers tend to remain behind a slow vehicle without changing lane, which could be viewed as compensatory actions to reduce the workload associated with performing both the driving task and other non-driving activities (Beede and Kass, 2006; Cooper, et al., 2009). Another component that variates cognitive load and demands is driving experience. The less experienced the driver, the higher cognitive demands they need to meet. Although with practice, drivers become more tuned to automatically detect several important visual elements in driving environment, some of their
driving skills become automatized (MacKay, 1982; Norman, 1981; Schneider and Shiffrin, 1977) which possibly can lead to less attention paid to lane keeping without hogging. However, there has been no research to test these hypotheses.

**Situation awareness.** Situation awareness can be defined as simply as “knowing what’s going on”. In the context of driving, it can be defined as the perception of environmental elements and the vehicle’s current position with respect to time or space, or generally speaking – to its destination, the relative positions and behaviour of other vehicles and hazards and also knowing how all these variables are likely to change in the near future (Endsley, 1995; Gugerty, 1998; Sukthankar, 1997). In other words - it is an “operator focus” (Rousseau, et al., 2004). Situation awareness involves being aware of what is happening in the vicinity to understand how information, events, and one’s own actions will impact goals and objectives, both immediately and in the near future. A driver with an adept sense of situation awareness generally has a high degree of knowledge with respect to inputs and outputs of a system, an innate “feel” for situations, people, and events that play out because of variables the subject can control. Lacking or inadequate situation awareness has been identified as one of the primary factors in accidents attributed to human error. In transport safety, a loss of situational awareness could lead to lane hogging but this has not been investigated. Situational awareness may be a relevant theory that could explain why lane hogging behaviour occurs.

**Inattentional blindness.** The term inattentional blindness was originally coined by Mack and Rock (1998) and defined as a lack of attention not due to visual defects or deficits. It occurs as the event in which an individual fails to recognize an unexpected stimulus that is in plain sight. For instance, a driver may experience inattentional blindness after repeated exposure to a particular road (Brown, 1994; Kerr, 1991. The studies based on this paradigm suggest, that those drivers who have greater driving experience are more exposed to the effect of inattention blindness and they are less likely to attend to nonessential stimuli or stimuli located in unusual places (Borowsky, 2008). Cognitive capture or, cognitive tunneling, is an inattentional blindness phenomenon in which the observer is too focused on the vehicle’s instrumentation panel, the task at hand, internal thought, etc. and fails to see a potential hazard in their present environment. For example, while driving, a driver focused on the speedometer has had their attention captured and fails to recognize that they may be lane hogging.

In an experiment conducted by Charlton and Starkey (2012) in which drivers were repeatedly exposed to the same driving situations in a simulator over many days (simulating a regular commuting journey), the results showed that drivers were inattentionally blind for some aspects of the driving environment such as changes to signs or buildings. The participants also had an increased sensitivity for detection of things that had become part of the driving task (Charlton and Starkey, 2011). Whilst this phenomenon may be a useful explanation for lane hogging, no studies have investigated whether inattentional blindness is a factor in lane hogging.

**The tandem model of driving behaviour.** The Tandem model, presented by Charlton and Starkey (2011), states that skilled driving performance involves two interlinked processes; a conscious, intentional level of task engagement referred to as an “operating process”, and an unconscious “monitoring process” continuously engaged with the driving task; its function is to compare incoming stimuli to stored representations of previous instances of driving, particularly instances indicative of potential errors or hazards. When incoming stimuli are congruent with stored representations of familiar or benign situations, the monitoring process aims to maintain most aspects of the driving task without active attention (driving without awareness). The Tandem Model suggests that repeated practice results in a broadening and refinement of the templates (schemata) used by the monitoring process to the point where a wide range of familiar situations and circumstances are processed.
without activation of the operating process (Charlton and Starkey, 2011; 2012). The results of one experiment based on this model showed, that after using the same route for five days in a row, the drivers could recollect all the traffic signs along the route. However, a decrease in recognition accuracy was observed when a target sign was changed and the drivers failed at detecting the changes to the road environment (Martens and Fox, 2007).

12.5 Psychological Determinants of Lane Hogging

Näätänen and Summala (1976) suggested that in addition to the general motives of speed and safety, many drivers are influenced by extra motives, the effect of which may result in lane hogging behaviour. One of the most common motives of unsafe driving behaviour is aggression.

**Aggression.** A growing body of research suggests anger plays a substantial role in risky and aggressive driving and may be an important contributor to lane hogging behaviour. Previous research has also noted that angry drivers: take longer to respond to hazards, follow lead vehicles more closely, have worse vehicle control, cross more yellow/red traffic lights and drive faster (Abdu, et al., 2012; Stephens, et al., 2013). It is therefore no surprise that some researchers have described driving anger as one of the most important predictor of aggressive and risky driving behaviour. Several self-report studies confirm this by highlighting the relationships between anger tendencies, aggressive expressions and crash related conditions, including near misses and crashes (Stephens, et al., 2016). Lane hogging behaviour may be a form of aggression towards other road users.

**Driver fatigue.** Fatigue is known to be one of the most common factors in road traffic incidents but very little research has been conducted to understand the relationship between fatigue and lane hogging. A long time spent driving is a significant factor in fatigue-related accidents on motorways or major roadways. The fatigue caused by driving for extended periods acutely impairs driver alertness and performance and markedly impacts driver psychophysiology (Thiffault and Bergeron, 2003). A high proportion of accidents occur on straight roads with homogeneous scenery over long periods of monotony and this context can negatively impact driver alertness, vigilance and driving performance.

12.6 Self-Explaining Roads

One fruitful method of reducing lane hogging may come from an engineering perspective. By ensuring our roads are easy to understand, a reduced cognitive load may lead to lower levels of lane hogging. Brookhuis (2004) provided a set of design principles to assist in providing ‘self-explaining roads’ to design roads that evoke correct expectations (Charlton, et al., 2010).

1. Reduce the requirement for road users to make calculations
2. Present data in a manner that makes understanding and prediction easier
3. Organise information in a manner that is consistent with road users’ goals
4. Indicators of the current mode or status of the [driver– vehicle–road] system can help to cue the appropriate situational awareness
5. Critical cues should be provided to capture attention during critical events
6. Global situational awareness is supported by providing an overview of the situation across the goals of the [driver]
7. [driver–vehicle–road] system-generated support for projection of future events and states will support situation awareness
8. [driver–vehicle–road] system design should be multi-modal and present data from different sources together rather than individually.
A large proportion of driving performance relies on a cycle of input-processing-output-feedback but some tasks may be performed in a predictive, feed-forward manner. According to Walker et al (2013), this relates largely to design principle #1, principle #2, principle #4 and principle #7 outlined above.

The driver is a part of the situation they find themselves in and can influence its dynamics. So, if risks presented by hazards have been minimised through effective driving behaviours, then the driver has created a more benign situation. For lane hogging, the driver has increased the critical variables he/she needs to be aware of such as at-risk lane switching of other drivers. This kind of risky driving can cause disruptive emotions in other drivers, which in turn can influence these individuals to take risks. This could in turn impact negatively on the emotions of more drivers, including those of the drivers who started the chain of disruptive events.

12.7 Conclusions

Despite the introduction of on-the-spot fines being introduced in 2013, practices such as middle-lane hogging are still going largely unpunished. Motorists who stick to the middle lane not only are likely to avoid punishment while causing irritation to other drivers, but also their manoeuvres can cause congestions and lead to road incidents.

Even though many drivers admitted to hogging the middle lane themselves, they are still unaware that the habit is an offence punishable by at least three points on their license and a £100 fine. However, with motorway training not being part of the current learning-to-drive curriculum, it should be no surprise that many drivers have never been taught not to stick to the middle lane when driving on a motorway. The dangers of drivers staying to the middle lane or lane three is a clear safety issue, which is supported by figures that show how more than one in ten drivers have experienced a vehicle collision or near-miss on account of another road user hogging the middle lane.

Stakeholder engagement that aims to collaboratively design and implement a successful campaign against lane hogging is required. Driving courses should be improved although introducing motorway driving as part of the learning to drive curriculum will help matters in the long term. The system of fines and penalties do not appear to be well enforced.

Recommendations

- One of the possible reasons for lane hogging amongst older drivers may be due to the impact of workload on lane changing. One way in which workload could be reduced is to ensure that lane delineation is strong on the SRN.
- Further research to investigate the role of driver experience and mobile phone use would uncover the target groups that are more likely to lane hog.
- The Tandem Model of driving behaviour suggests that lane hogging may be an unconscious process however, it fails to explain what sorts of road and traffic stimuli are more likely to receive conscious attention and which stimuli may be processed implicitly by the monitoring system, and which ones may be neglected or unprocessed. Further research to identify which stimuli capture attention would help to inform the design of solutions to reduce lane hogging.
- Advanced driver coaching could be designed to make develop awareness of the risks of lane hogging and in particular how other road users respond to the frustration of not being able to make good progress on their journeys.
- There are various psychological factors that may be associated with lane hogging including aggression and driver fatigue. Future research should investigate these associations so that more bespoke interventions can be designed for particular target groups.
- Intervention campaigns should not only ask drivers to ride on the left-hand lane, but also increase their awareness that lane hogging is an offence. A sustainable long term social media...
campaign considering ‘driving ethics’ could be designed to present lane hogging as an impolite driving behaviour
- Smart motorways could use video analytics or image processing to automatically recognize this offence
- Interactive signs could be used to nudge and direct lane hoggers to move left
- Lane hoggers could be detected by CCTV and offered low cost online educational modules

### 12.8 Lane Hogging Interventions Matrix

Lane hogging behaviour has been much neglected and ignored in the literature and in the implementation of interventions to reduce this behaviour. Consequently, there are many gaps in our understanding of lane hogging and how to reduce its effects on traffic flow, incidents and customer satisfaction. Further research to identify the human factors associated with lane hogging would help in the design of more targeted marketing campaigns and innovative solutions to address the problem.

There are clear gaps in solutions designed to reduce lane hogging as evidenced in Table 12 below, in particular those categorised as Hug, Shove and Smack.
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<tr>
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<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
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<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Using Matrix Signs to Reduce Lane Hogging⁷</td>
<td>In-Vehicle Technology to Improve Lane Hogging⁸</td>
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<tr>
<td><strong>Inform</strong></td>
<td>An American Campaign includes Lane Hogging⁴</td>
<td>Highways Agency 2004 Lane Hogging Campaign⁵</td>
<td>Warning Letters to Lane Hoggers¹⁰</td>
<td>Lane Hogging media campaign in Cheshire¹</td>
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<td>The SURVIVE Group Lane Hogging DVD⁶</td>
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<td><strong>Control</strong></td>
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<td>A new Fixed Penalty Notice for lane hogging²</td>
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<td>How to avoid a lane hog fine!³</td>
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<td>Traffic Officer Vehicles and CCTV¹³</td>
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<tr>
<td><strong>Educate</strong></td>
<td>A Communication Strategy to Educate Lane Hoggers¹¹</td>
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<td>Hazard Perception Clips on Lane Hogging¹⁴</td>
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<td>NDORS Motorway Course as a Lane Hogging Intervention¹²</td>
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<td><strong>Support</strong></td>
<td>Road Markings to Reduce Lane Hogging⁹</td>
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An Intervention Framework for Safer Driver Behaviour: Lane hogging behaviour on the SRN

Table 12 - Few interventions consider supporting and educating road users to avoid lane hogging and there are particularly few interventions that consider influencing lane hogging behaviour via reinforcement (hug).

Below are the case studies that could be sourced with respect to lane hogging followed by the research-led interventions based on the preceding and supplementary literature reviews.

1. Lane Hogging media campaign in Cheshire

A new 12-week campaign was launched in Cheshire warning middle-lane hoggers that they are putting their lives in danger, as well as risking an on-the-spot fine. A survey of nearly 300 Cheshire drivers, commissioned by Highways England found that one in seven (15%) admit to road rage if they encounter a middle-lane hogger, saying they either flash their headlights or cut them up. Just under half of all motorists (45%) also believe lane hoggers are among the most dangerous drivers on the motorway. The campaign followed the first prosecution for lane hogging after new legislation was introduced giving the police powers to issue on-the-spot fines. The campaign included adverts at five motorway services in Cheshire warning drivers that middle lane hogging is now an offence, which could lead to a prosecution. One advert (shown in Figure 8) shows a car coasting in the middle lane with the warning 'More likely to encounter an undertaker'. Another advert shows a car sticker on a vehicle parked illegally in a disabled bay, with the slogan 'My other car hogs lanes'.

Figure 8 - Advert placed at motorway services in Cheshire showing a car coasting in the middle lane with the warning 'More likely to encounter an undertaker'

Figure 9 – Additional adverts shown in lavatories during the campaign in Cheshire
Middle lane hogging causes delay and frustration. It’s also an offence carrying a £100 fine and 3 points.

So keep left and keep safe.

#leftisright

Figure 10 - Additional advert posted during the campaign in Cheshire
An evaluation of the campaign involved using on-road data in response to variable message signs and signals. MIDAS loop data were used to assess lane utilisation and traffic flow. A road user survey was also conducted (samples of 200-300 respondents in each round) including interviews conducted at the target MSAs and by the M62.

The results showed that lane hogging behaviour and attitudes to lane hogging improved and are more enduring than a change in actual behaviour. The attitudes to the following statements changed during the campaign as follows:

- disagreement with “the middle lane is the safest place to drive on the motorway” increased by 17% points from 70% to 87%
- agreement with “I always return to the left lane unless I’m going to overtake a vehicle in the next few seconds” increased by 12% points from 78% to 90%
- disagreement with “If you prefer it in the middle lane, you should be able to drive there” increased by 23% points from 69% to 92%
- Successfully engage stakeholders
- Reduce incidence of lane hogging, when measured on targeted roads, by 10%
- Reduce congestion in the test area by 2%
- Improve road user scores for attitudes to lane discipline by 10% points

The campaign also increased driver’s awareness of the issue and most of the drivers stated that lane hogging should be a priority for Highways England. The campaign cost £34,000 and generated value of at least £150,000 due to lower levels of congestion. However, there has been no evaluation on whether penalty increase has led to a change of behaviour over the longer term and very few drivers have been prosecuted for lane hogging.


2. A new Fixed Penalty Notice for lane hogging

The new rule to reduce lane hogging implemented in July 2013 gave the police powers to issue on-the-spot fixed penalty notices for careless driving, giving them greater flexibility in dealing with less serious careless driving offences - such as middle lane hogging and freeing them from resource-intensive court processes. The fixed penalty is £100 with three points on the driver’s license. Raising the penalty levels for lane hogging was designed to offer an additional incentive for drivers to take up remedial courses designed to educate drivers over the longer term as an alternative to punishment.

No information to evaluate the effect of this new penalty could be sourced. However, previous research has found a small beneficial effect of penalty points on driving behaviour.


3. How to avoid a lane-hog fine!

Saga gives tips on how to avoid a lane-hog fine and advice on staying in the appropriate lane. They advise to simply not travel in the middle or outside lane unless you are overtaking another vehicle. Saga asks their members to imagine a three-lane motorway, the lane on the far left (Lane 1) is the lane you should use to travel in. The middle lane (Lane 2) and the outside lane (Lane 3) are only there to give an opportunity to overtake slower moving traffic. Saga advise that once drivers have overtaken the slower traffic they should pull back into Lane one as soon as it is safe to do so.

No information to evaluate the effect of this information could be sourced.

https://www.saga.co.uk/magazine/motoring/cars/using/avoid-a-middle-lane-hog-fine

4. An American Campaign includes Lane Hogging

In 2013 the US Department of Transportion (DOT) launched an education campaign to combat reckless driving — specifically speeding, distracted driving, and failure to yield to pedestrians. The campaign also included lane hogging as a risky behaviour. According to the DOT, these violations combined account for 40% of New Yorkers killed in car crashes. The campaign, which was on bus
sifters, billboards, radio and social media, and accompanied by a campaign against drunk driving, features family members of those killed by reckless drivers. No information on the effectiveness of this campaign could be sourced.

5. **Highways Agency 2004 Lane Hogging Campaign**

In 2004 Highways England launched a campaign called ‘Don’t Hog the Middle Lane’ which included large matrix signs on Britain’s motorways asking the driver to keep to the near-side lane unless overtaking. However no evaluation could be sourced and the campaign was short lived.

6. **The SURVIVE Group Lane Hogging DVD**

The SURVIVE Group is a partnership between the Highways Agency, the Police, the breakdown/recovery industry and other service providers established in 1998 following the deaths of six breakdown operators on motorway hard shoulders. The SURVIVE Group has been established to improve the safety of those who work on the road network and the travelling public and is also dedicated to the promotion of driving safety. As part of their publications of materials they offer a DVD in lane hogging. John Stapleton presents the DVD and looks into why people do it and what effects it has on the driver hogging the lane and other road users. John goes on patrol with some Highways Agency Traffic Officers in the West Midlands to try and assess how wide spread the problem is and what can be done about it. No evaluation of the DVD could be sourced.

7. **Using Matrix Signs to Reduce Lane Hogging**

Previous research has found that behaviour changes in response to Variable message signs (Erke, et al., 2007; Hössinger and Berger, 2012). Animated (flashing or moving) signs are more likely to be noticed than immotile signs, and the willingness to behave as requested may also increase (Rämä and Kulmala, 2000). Research has shown that the 3rd repetition of a sign yielded significantly better comprehension with a simple text being better than a picture (Hössinger and Berger, 2012). Warnings about the use of enforcement technology to monitor lane hogging are likely to improve lane compliance alongside matrix signs to nudge drivers. This option will require multifunctional systems and services working in coordination. Data should be collected to evaluate the effect of road signs not to hog lanes.

Matrix signs need to be concise and specific to nudge drivers towards appropriate lane choice. It is recommended that the message ‘KEEP LEFT UNLESS OVERTAKING’ is used to target lane-hogging. It is also recommended that this message is used in locations where lane hogging is more prevalent and trialled to evaluate its effectiveness compared with a baseline measure. In this way, messages can be targeted to specific offenders.

8. **In-Vehicle Technology to Improve Lane Hogging**

The term inattentional blindness was originally coined by Mack and Rock (1998) and defined as a lack of attention not due to visual defects or deficits. The research suggests that those drivers who have greater driving experience are more exposed to the effect of inattention blindness (Borowsky, 2008). Cognitive capture or, cognitive tunneling, is an inattentional blindness phenomenon in which the observer is too focused on the vehicle’s instrumentation panel, the task at hand, internal thought, etc. and fails to see a potential hazard in their present environment and fails to recognize that they may be lane hogging.

In an experiment conducted by Charlton and Starkey (2011) in which drivers were repeatedly exposed to the same driving situations in a simulator over many days (simulating a regular commuting journey), the results showed that drivers were inattentionally blind for some aspects of the driving environment such as changes to signs or buildings.

Lane hogging can lead to ‘undertaking’ and vehicles not seen in blind spots can lead to collisions if drivers fail to look in their mirrors when returning to Lane one or two. Driver Assistance Systems continuously evaluates the status of the vehicle and the surrounding traffic based on information from on-board sensors. When the system detects a hazard, it issues a warning to the driver, depending on the degree of the hazard. Three types of support systems were compared in a study in Japan by Itoh and Inagaki (2014): (1) a warning system that provides the driver with an auditory alert, (2) a ‘soft’ protection system that makes the steering wheel stiffer to tell the driver that a lane-change manoeuvre is not recommended and (3) a ‘hard’ protection system that cancels the driver’s input and controls the tyre angle autonomously to prevent lane departure. The results of the experiment showed that the hard protection system was more effective for collision avoidance than either the warning or the soft protection system. The warning and soft protection systems were almost the same in terms of collision avoidance.

In addition to this type of system, lane departure warning systems have recently been introduced to attract drivers’ attention when lane departures occur by tracking lane markings in front of the vehicle and compute the time until the vehicle will cross the marking. If the driver does not show an intention of leaving the lane by using the indicator, the system will initiate a warning or start
assistance. Alkim et al. (2007) reported a decrease in unintentional lane changes due to a lane-keeping assistant by 30–35% depending on the type of road. Different traffic and accident analyses (Abele, et al., 2005; Alkim, et al., 2007; McKeever, et al., 1998) postulated a reduction of “head-on” and “left roadway” accidents by 25%, as well as a reduction of accident severity. The effects of this system on driver behaviour along a 53km test route containing motorway and rural-road sections were investigated. The system was successful in reducing speed when negotiating curves. Also, lane choice and lane change improved with the system on. A blind-spot warning was found especially useful in the overtaking process (Várhelyi, 2015).

It is recommended that Highways England support vehicle manufacturers in the development of in-vehicle technology to detect lane position, inappropriate lane departure and lane choice.

9. **Road Markings to Reduce Lane Hogging**

Changing lanes increases workload and certain drivers may be reluctant to increase workload for a number of different reasons including habitual driving behaviour, anxiety, lack of confidence in abilities, aggression etc. Providing edge lines and centre lines guides drivers towards improved lane keeping. High visibility of lane delineators is necessary to regulate drivers into an orderly stream of traffic - especially older drivers who tend to drive more cautiously in lower light levels (Owens, et al., 2007) and may be more prone to lane hogging (Reimer, et al., 2013). The presence of such lines shows a 20% reduction in accidents (Miller, 1992) and single vehicle accidents are reduced by 34% (Moses, 1986). Edgelines and centre lines with high retro-reflectivity when wet further improve safety with drivers better able to maintain lane position and speed with the enhanced markings than with the standard markings (Horberry, et al., 2006). Workload was also rated as lower for the enhanced markings compared with the standard markings.

Clear and visible road markings provide perceptual cues to use the appropriate lane. Lane hogging should be monitored to investigate the specific black spots where lane hogging is more likely to occur and check lane delineation in those locations. Highways England should then ensure that lane road markings in this region are clear to prompt lane change back to lane one and two when it is safe to do so.

10. **Warning Letters to Lane Hoggers**

Since November 2016 over 8,000 letters, accompanied by educational information leaflets and feedback requests, have been sent to drivers misusing the hard shoulder or contravening a Red X signal on sections of the M6. Where repeat non-compliance has been identified the police are undertaking additional investigations. This work can be supported by temporary ANPR equipment to capture offences.

Highways England’s warning letter project forms part of the ‘Encouragement’ element of the smart motorway - compliance delivery action plan intended to provide targeted information and advice to drivers. The project dashboard shows the numbers of letters issued for each offence type and the types and levels of feedback being received from customers. There were two successful trials of this measure for drivers who misused the dynamic hard shoulder on a section of the M6 near Birmingham. An initial trial in 2013/14 issued 700 letters to repeat hard shoulder offenders (i.e. those using the closed hard shoulder more than once during the monitoring period). Only 4% of those drivers were identified as re-offending during the subsequent monitoring period of September 2013 to April 2014.

A warning letter in partnership with the police and Driver and Vehicle Licensing Agency (DVLA) could be introduced for lane hogging building on the success of the initiative with regards Red X compliance and misuse of the hard shoulder. Lane hogging could be detected using the Compliance Monitoring Tool (CMT) for the purposes of public safety and crime detection. The CMT is a system that utilises cameras operated and owned by Highways England and by other organisations and Agencies and ANPR cameras for crime prevention purposes, the DVLA and Vehicle and Operator Services Agency (VOSA). The CMT can be used to measure a baseline of lane hogging before sending out warning letters and used to monitor compliance after the intervention. However, a clear definition of what constitutes lane hogging is required in collaboration with the police so that incidents can be detected using ANPR. Prior to any automated signal enforcement triggering warning letters for lane hogging, a customer awareness campaign should be rolled out.

11. **A Communication Strategy to Educate Lane Hoggers**

Public communication campaigns are an important educational tool over a chosen time period often addressing selected target groups with clear goals and tailored messages designed to influence knowledge, attitudes, and behaviour. Amongst academics there is a consensus that public communication campaigns can be effective, if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015; Atkin and Rice, 2012). Several meta-analyses have found that on average campaign effects result in a 9% reduction of road traffic accidents with significant variations regarding the topic of the campaign, additional enforcements (e.g., new laws or increased police controls), campaign duration, and communication channels (Delhomme, et al., 2009; Elvik, et al., 2009).
Radio and online campaign activity should take place specifically targeting lane hogging. The main message is for customers to develop new knowledge about the appropriate use of lanes. The targeted change in behaviour will need to focus on self-reflection to reassess their lane choice behaviour. Other messages should include directing attention towards the consequences of lane hogging and what strategies customers can use to avoid these consequences. Enforcement strategies running alongside campaigns tend to be more effective.

12. **NDORS Motorway Course as a Lane Hogging Interventio**

The Safer Roads - People team has worked closely with the National Driver Offender Retraining Scheme (NDORS) over the past two years and this has resulted in the delivery of a new NDORS motorway course aimed at drivers caught speeding when variable speeds limits are in force. These courses are an alternative to receiving three points and a £100 fine. The courses are educational and informative to help drivers understand smart motorways and remain on the right side of the law. Previous research evaluating NDORS speed awareness course has found evidence that attitude to speed may change, albeit in the short term. Whilst the proposed new motorway course has not yet been evaluated, there are plans to incorporate an evaluation study alongside the roll out expected around the summer of 2017.

It is recommended that Highways England ensure that the curriculum includes the dangers of lane hogging, explaining why it is an offence and its impact. The curriculum should include behaviour change techniques designed to influence lane hogging behaviour. Coordinating stakeholder support for combined communication, enforcement and education will help to reduce lane hogging.

13. **Traffic Officer Vehicles and CCTV**

Elvik (2016) found an intriguing pattern of results evaluating the effect of increasing fixed penalties and an association with a reduction of violations or accidents but only up to a certain point. Beyond that point, the changes as a function of increasing penalties became smaller, in particular for violation rate. Elvik (2016) suggested that the police adapt to increases in fixed penalties by reducing enforcement and this may explain the anomaly. Highways England reported a dose-response relationship between the size of the increase in fixed penalties and the size of the reduction in violations and that this varied over time and between countries. Increases in fixed penalties are associated with a small reduction of the number of accidents, in the order of around 5–10%.

Based on the research evidence, it is clear that any increase in penalties for lane hogging introduced in 2013 must be enforced if behaviour is to change. Given the reduction in roads policing over recent years, one way of improving levels of enforcement is with the use of CCTV in Traffic officer vehicles. It is recommended that on-board front and rear CCTV should collect evidence of lane hogging and refer the evidence to the police. Fitting of a further 100 vehicles (half the fleet) with CCTV capable of being viewed live will take place during spring 2017. CCTV can support operational safety and effective network management to address lane non-compliance including warning letters, police prosecutions and DVLA action against commercial vehicles.

14. **Hazard Perception Clips on Lane Hogging**

Hazard perception refers to the ability to identify potentially dangerous situations on the road. It is typically assessed by showing participants short video clips and asking them to respond as soon as they detect a developing hazard. Shorter response times indicate greater levels of hazard perception skill (Chapman and Underwood, 1998; Horswill and McKenna, 2004; McKenna, et al., 2006; Sagberg and Bjørnskau, 2006; Wetton, et al., 2011). Hazard perception is one of the only components of driving skill that has been consistently linked to collision involvement across multiple studies (Wetton, et al., 2010; McKenna and Horswill, 1997; Quimby, et al., 1986). A prospective study by Drummond (2000) also found that newly licensed drivers’ hazard perception performance was linked to their likelihood of being involved in a fatal collision in the subsequent 12 months. A number of studies suggest that novices have narrower horizontal search and less effective visual search strategies compared with experienced drivers (Chapman and Underwood, 1998; Konstantopoulos, et al., 2010; Underwood, et al., 2002). Although, compared with experienced drivers, novices may not be slower to identify hazards in foveal vision (Sagberg and Bjørnskau, 2006) they tend to fixate on the road ahead at the expense of scanning for hazards in the periphery (Falkmer and Gregersen, 2005; Underwood, et al., 2002). Fixating on the road ahead may be one of the factors involved in lane hogging. It is therefore recommended that a hazard perception training intervention may help drivers to keep their eyes moving and take into account the hazards involved in maintaining to travel in Lane two or three thereby blocking other vehicles and creating problems for other road users wishing to pass. Lane hogging may also lead to a greater number of undertaking incidents and hazard perception training may encourage drivers to maintain a wider horizontal scan of the roadway and mirrors to identify vehicles in their blind spot.

A hazard perception training intervention would help develop a wider field of view and develop skills in mirror checking to identify vehicles in the blind spot. These clips can be viewed online and made available on Highways England website to support drivers wishing to use the SRN.
13.0 Inappropriate Driving in Bad Weather

Weather has an impact due to poor visibility, precipitation, wind speed and temperature. Severe weather conditions affect drivers’ capabilities, vehicles’ stability and the friction of the tyres on the road (Kilpeläinen and Summala, 2007). Extreme weather can also have an effect on vehicle equipment, especially electric cars, because it makes it difficult for vehicles to maintain an equivalent amount of electricity in winter to match their output in normal temperatures. The adverse impact of weather on cars’ performance is therefore influenced by temperature, battery type, whether the vehicle is designed to manage the battery's temperature and how well the vehicle has been maintained. Typically, drivers fail to slow down in bad weather and this can lead to a serious impact on the SRN.

Every type of severe weather conditions has its own effect on driving that should be taken into account by drivers. Precipitation can cause surfaces to be slippery, reducing the grip of the tyres and increasing braking distance. Visibility can also be vastly reduced in heavy snow or rain, and if this is coupled with faded road markings, it could impair the ability to see dangers ahead. High temperatures can soften road surfaces, causing cracks and disrupting the clarity of road markings. Wind can cause debris to blow onto the roads, fell trees or cause other obstructions. Finally, the condition of road surfaces that can be eroded by bad weather means that road markings that are essential for directing and instructing motorists may become faded or damaged and can put road users at risk. This is especially harmful in low visibility conditions caused by weather, as the visibility of the road markings will be relied upon even more.

Inappropriate driving in bad weather mostly refers to driving too fast for the conditions according to an interview study as part of this research project reported elsewhere.

13.1 The Impact of Inappropriate Driving in Bad Weather

Severe weather conditions also cause chaos in traffic flow and slow down the speed with which emergency response agencies can react. Hence, weather condition has significant impact in accident severity. Inappropriate driving can lead to crashes that occur in adverse weather conditions (i.e., rain, sleet, snow, and/or fog). A thorough review of the previous studies indicates that both rain and snow, functioning as precipitation, can lead to a higher level of road traffic accidents. For instance, Norrman et al. (2000) identified that the number of accidents on slippery roads is very high. According to the latest statistical data for Great Britain, in 2016 nearly 22% of all UK road accidents were contributed to by bad weather and 2,918 people were killed or seriously injured on the roads in bad weather. Highways England figures also reveal that travelling too fast for the current conditions was identified as a factor in 1 in 9 road deaths in Great Britain in 2015, with drivers failing to alter how they drive in response to changing conditions on the road. In 2015, 197 people lost their lives on roads during rainfall in Great Britain and 2,721 suffered a serious injury, compared to 14 deaths and 153 serious injuries during fog, and 2 deaths and 95 serious injuries during snow.

According to Liu (2013) among all weather related crashes in Maryland, US 75% happen on wet roads and 47% take place during rainfall, which makes rain a major factor in weather-related crashes. The study also showed that 15% of crashes happen during snow and only 3% happen in foggy weather. In terms of accident severity, among all weather-related road crashes, 41.6% involve personal injury and 0.47% cause fatalities. However, the extent to which these findings can be transferred to the UK is not clear given the obvious climate differences between Maryland in the US and the climate in the UK.
A plethora of factors can lead to road traffic collisions during bad weather conditions, among which the most common are road condition, vehicle condition, and driver behaviour.

According to Highway England’s NRUSS for 2015 10% of respondents checked travel conditions before setting off. Those travelling on an outward journey (12%) were more likely to check the travel conditions compared with those on a return trip (8%), and by journey purpose, respondents travelling for holiday (23%) or on employer’s business (16%) were most likely to check travel conditions, with those travelling on a shopping trip (3%) or on a leisure or entertainment trip (6%) the least likely. Higher proportions of respondents checked conditions where longer trips were being made; 25% of those travelling 200 miles or more made checks, compared to just 4% of those travelling less than 20 miles.

Of those who checked the travel conditions before travelling, 43% used a website, of which 44% used Google Maps and 22% used the AA. Twenty-one percent used a mobile phone with Internet access and 16% used radio. Fourteen percent used Sat-Nav and 13% used television. None used social media. Other comments included looking out of the window (n=5) and BBC Travel app (n=1).

13.2 A Brief Empirical Review of Inappropriate Driving in Bad Weather

Edwards (1999) stated that drivers theoretically acknowledge the need to reduce their speed in inclement weather, but in practice only alter their speed very little. Edwards (1999) examined traffic behaviour in three weather categories: fine, rain and misty conditions. Weekly spot speed surveys undertaken on the M4 Motorway, South Wales. Each survey recorded the two-lane carriageway. Manual observations were made also concerning the weather at the time of each survey. For consistency commuter speeds occurring on the same weekday peak hour were recorded for a six-month period (8–9 am Tuesday mornings), thus, effectively controlling many other external factors that might influence vehicle speeds. Hourly traffic flow information was obtained from an automatic traffic counter located at the survey site. Speeds in inclement weather were compared with those in fine conditions (the control). The study found a small, but significant reduction in mean speeds in both wet weather and misty conditions but these were not sufficient to compensate for the increased hazard due to inclement weather.

13.3 Effects of Age on Driving in Bad Weather

Wet roads and fog can be particularly problematic for older drivers. Several studies have shown that older drivers are at relatively higher risk of causing collisions possibly due to reductions in contrast sensitivity (Scialfa and Kline, 2007) and increases in response time even in well-practiced tasks (Voelcker-Rehage and Alberts, 2007). Fog reduces contrast of the image. This affects the sense of distance, which can prompt rear end collisions (Broughton and Walter, 2007; Buchner, et al., 2006). It can also lead to an underestimation of how fast other vehicles are (Horswill and Plooy, 2008). Moreover, because objects have to be closer to become fully visible, fog reduces the amount of time drivers have to react. The increase of collision risk in fog puts even professional drivers under stress while driving (Vivoli, et al., 1993). It can also be assumed that people who generally worry about safety both actively use weather information and evaluate conditions as being worse than they are (e.g. Matthews, et al., 1991).

13.4 Engineering Interventions

Only a few studies have investigated the effects of variable weather related signs on driver behaviour. Most of the earlier studies concerned variable fog warning signs. Cooper and Sawyer (1993) evaluated
the fog warning system on the M25 London orbital motorway in which a text message “FOG” was presented when fog was formed. An overall reduction in mean vehicle speeds of about 1.8 miles per hour (3km/h) was found when the signals were switched on. The authors concluded that the speed reductions indicate that drivers are alerted to the presence of fog ahead, and drivers were more likely to respond more quickly to the hazard. In the Netherlands, Hogema and Van der Horst (1997) found the effect of the variable fog warning system to be an 8 to 10km/h reduction in mean speed. The standard deviation of speed decreased marginally. In extremely dense fog, the system seemed to have the opposite effect on speed, because drivers tend to rely on the speed limits presented. A field study by Rämä and Kulmala (2000) investigated the effects of two variable message signs (VMS) on driver behaviour. The signs were a warning sign for slippery road conditions and a minimum headway sign. The study was performed as a before-and-after experiment at three test sites in Finland with an after period covering two winter seasons. The results showed that the slippery road condition sign reduced the mean speed on slippery roads by 1–2 km/h in addition to the decrease caused by the adverse road conditions. The minimum headway sign decreased the proportion of headways shorter than 1.5 s for cars in car-following situations, in addition to a speed reduction of 1km/h. The effects were somewhat smaller during the second winter than the first.

Abdel-Aty, et al (2011) conducted a study on visibility obstruction related crashes due to fog and smoke and ways it can be improved. The authors report that head-on and rear-end crashes are the two most prevalent crash types and they occur more prevalently at higher speed, on an undivided, non-sidewalk and on two-lane rural roads. Thus, reduction of speed limits and the installation of road medians were expected to be useful. Another intervention was to improve road lighting at the identified hotspots as these crashes tend to occur more often at night without street light. Solar and battery powered systems were recommended for fog/smoke detection and activate warning in these locations. The authors also recommended subsequent VMS could be installed to warn the drivers of fog up ahead.

![High Visibility Markings](image)

Figure 11 - High Visibility Markings

High visibility white road markings can provide an enhanced guidance system for road users both in wet and adverse weather conditions as well as during hours of darkness. They may also bring benefits to roads on an east-west alignment that may cause difficulties for road users travelling toward a low sun.

An additional benefit of high visibility road markings is the reduced need for maintenance, however, this is dependent on its application, thickness and material type. However, the initial outlay for these road markings is approximately twice as expensive as the cost of normal road markings. On concrete
carriageways, it is recommended that high visibility road markings are used instead of underlying standard lines with black surface treatment.

Drivers do not always adjust their driving behaviour in bad weather. Even when the road is very slippery drivers still drive at speeds somewhat higher than the speed limit and consider it safe (Heinijoki, n.d.). Studded tires that are generally used in Nordic countries (Finland, Sweden and Norway) improve friction considerably on icy roads. However, Summala and Merisalo (1980) showed that drivers partly trade off this effect by driving faster in curves and still maintain a somewhat larger safety marginal.

Tyre Pressure Monitoring Systems (TPMS) are electronic systems which monitor the air pressure of a vehicle's tyres and are increasingly being installed by vehicle manufacturers. There are two types of TPMS; direct (dTPMS) and indirect (iTPMS) and can be provided pre-installed into vehicles as well as post-sale. Direct TPMS uses pressure sensors and can be either internal or external. These sensors physically measure the tyre pressure in each tyre and report it to the vehicle's computer monitoring system. Indirect TPMS measures pressures by monitoring individual wheel rotational speeds. iTPMS cannot measure or display absolute pressure values and should be reset by the driver following air pressure checks and adjustments (TPMS Made Simple, 2010; OMICS, 2014). These systems alert drivers to problems with their tyres and could help to reduce incidents in poor weather due to tyres.

### 13.5 Educational Interventions

National road administrations often offer a service to inform drivers of forthcoming weather and driving conditions in different regions. A study was conducted by Kilpeläinen and Summala (2007) to investigate the effects of adverse weather and traffic weather forecasts on driver behaviour in Finland. Drivers (n=1437) answered a questionnaire on perceptions of weather, self-reported driving behaviour, pre-trip acquisition of weather information, and possible travel plan changes. Data from traffic weather forecasts, automatic traffic counters and weather measurement stations concerning the same area were also collected. Acquisition of weather information for the trip was associated with low recent driving experience, increasing age, female gender, long trip in question and very poor (local) conditions perceived by the driver. Drivers who had acquired information had also made more changes to travel plans, but information acquisition did not have an effect on their on-road driving behaviour. However, they estimated prevailing risks higher than those who did not acquire weather information. Drivers generally considered the driving conditions better than the forecast, but significantly less so in darkness than in daylight or civil twilight. Leisure trips were clearly underrepresented during very poor driving conditions forecasts, suggesting that some trips are postponed as a result of adverse weather conditions or forecasts. Drivers reported various kinds of compensatory behaviour during adverse conditions, including a 6–7 km/h target speed decrement. This corresponded to traffic flow speed measurements. The results suggest that on-road driving behaviour is predominantly affected by the prevailing observable conditions, rather than traffic weather forecasts. This study suggests that information should be adjusted according to local factors if on-road behaviour in adverse weather conditions may be changed.

Highways England launched a new campaign in 2016 called “When it rains, it kills” aimed at encouraging drivers to slow down when it rains. This campaign was designed since Highways England data showed that road users were 30 times more likely to be killed or seriously injured in rain than in snow. The campaign, ‘when it rains, it kills’ says that even driving within the speed limit in wet weather can be dangerous if drivers don’t allow extra space between them and the vehicle in front. It generally takes at least twice as long to stop on a wet road as on a dry road because tyres have less grip. The message was reinforced with rain-activated paint messages visible to people leaving motorway
services during the rain. The campaign also includes a new video which shows rain falling inside the home of a family imagined to have been involved in a serious road collision, along with a radio ad and posters which can be downloaded and displayed by stakeholders to support the message. No evaluation of this campaign could be sourced.

13.6 Enforcement Interventions

Inappropriate driving for the conditions such as driving too fast in bad weather can lead to prosecution in accordance with recent changes to speeding fines and penalties from April 2017. A driver driving too fast in bad weather may also be prosecuted for other offences such as careless driving (driving without due care and attention) which attracts a fine of up to £5,000 and between 3–9 points. An evaluation of this new rule on inappropriate driving in bad weather could be undertaken.

13.7 Conclusions

Inappropriate driving in bad weather has not received much attention in the academic literature and no interventions with a strong evidence base suggesting effectiveness could be sourced. Winter road maintenance with large direct and indirect costs, has stimulated significant interest in quantitative cost-benefit assessment. In the past decade, research to determine the link between winter road safety, maintenance operations, and weather related factors has been undertaken by Highways England.

Recommendations

- High visibility road markings appear to provide safety benefits in bad weather
- Variable message signs have a positive impact on inappropriate driving in bad weather in Scandinavia and could be more widely used in the UK providing specific instructions about headway and as well as speed.
- Tyre pressure monitoring sensors alert drivers to poorly inflated tyres or damage. The use of vehicles with these systems could be promoted by Highways England to reduce tyre-related incidents in bad weather.
- Driving behaviour in bad weather may be predominantly affected by observable conditions, rather than traffic weather forecasts. Highways England could ensure that information is adjusted according to local factors.
- Educational campaigns need to be evaluated for effectiveness alongside enforcement.

13.8 Driving in Bad Weather Intervention Matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address inappropriate driving in bad weather and categorized according to type of intervention and exchange mode. There are clear gaps showing that little research has been conducted to understand what kind of interventions might improve inappropriate driving for the conditions. In particular, interventions categorized as ‘educate’ and ‘support’ could not be sourced.
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<td>Variable message signs &quot;When Flooded, Turn Around Don't Drown&quot;²</td>
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<td>Inform</td>
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<td>Fines and penalties for inappropriate driving for the conditions¹¹</td>
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<td>Educate</td>
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<td>Support</td>
<td>Test your skills in driving in severe weather conditions⁶</td>
<td>Salting the road¹⁴</td>
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1. **Highways England: When it rains, it kills**
A new road safety video was produced for this 2016 campaign, directed by award-winning photographer Nadav Kander, which shows rain falling inside the home of a family imagined to have been involved in a serious road collision.

2. **Turn Around Don’t Drown**
A Campaign by national weather service
Each year in the US, more deaths occur due to flooding than from any other thunderstorm related hazard. The Centers for Disease Control and Prevention report that over half of all flood-related drownings occur when a vehicle is driven into hazardous flood water. The next highest percentage of flood-related deaths is due to walking into or near flood waters. People underestimate the force and power of water. Many of the deaths occur in automobiles as they are swept downstream. Of these drownings, many are preventable, but too many people continue to drive around the barriers that warn you the road is flooded. A mere 6 inches of fast-moving flood water can knock over an adult. It takes just 12 inches of rushing water to carry away a small car, while 2 feet of rushing water can carry away most vehicles. Permanent road signs are used to warn road users where the incidence of flooding is high, the onset of flooding is rapid, and/or it is not practical to deploy incident signs in a timely manner. A Pink Incident Sign is an official incident management road sign following government specifications and is a Temporary Traffic Control (TTC) sign deployed in response to short-term events which impede the normal flow of traffic such as accidents, natural disasters, hazardous material spills, or other unplanned incidents.

3. **Driving in Bad Weather Winter Conditions campaign**
Highways England and DfT’s “Think!” road safety campaign provides a guide with advice on how to drive in severe winter. This guide has been written to help to stay safe on the roads in winter. It includes advice from the Highways England and the Met Office and is supported by DVSA, the THINK! Campaign and the Institute of Advanced Motorists.

4. **Is your ride ready for foul weather travel?**
The Georgia Emergency Management Agency/Homeland Security’s (GEMA) Ready Georgia campaign reminds Georgians about the importance of avoiding driving during inclement weather, and also provides tips on being prepared in case they must travel. The newest tool for all Georgia drivers is the recently upgraded Ready Georgia mobile app, which features geo-targeted severe weather alerts, a map of shelters during emergencies, maps of live traffic conditions and an emergency supplies checklist.

5. **Young driver who suffered serious injuries in crash raises awareness of road safety**
In 2016 a campaign led by a young driver involved him telling students about his crash when driving in bad weather, to show young drivers the importance of road safety. The campaign was launched with the Norfolk Police and Crime Commissioner’s in collaboration with the #Impact campaign at Norwich City College.

6. **Test Your All-Weather Driving Skills**
This is a quiz to test knowledge about making the right decision when dealing with poor weather and driving conditions while driving. https://www.myimprov.com/test-weather-driving-skills/

7. **IAM winter driving campaign**
The Institute of Advanced Motorists (IAM) launched its winter road safety campaign in 2014, which aims to educate drivers on the dangers of the road during the colder months. As part of the IAM’s new ‘Wheels In Winter campaign’, motorists are reminded of the risks involved with taking to the roads after dark and in wet conditions.

8. **Who is driving you home tonight?**
The 2014 Winter Safe Drive Campaign was launched by Tay FM, Police Scotland and John Clark Motor group as part of a joined force committed to keeping the roads safe in winter. The Winter Safe Drive campaign is designed to encourage safe driving habits across Scottish roads to reduce road traffic incidents that will ultimately save lives.
The campaign gave advice about vehicle maintenance, planning ahead, checking tyres and inappropriate driving for the conditions.

9. **Driving in bad weather campaign**
Winter can bring challenging driving conditions - and often the risks aren't immediately obvious. From surface glare reflecting a low sun into the eyes of drivers, to the risk of black ice, it pays to be alert at all times. A leaflet on Driving in Bad Weather has been updated and relaunched by Transport Scotland and Road Safety Scotland. Covering wet roads, floods, high winds, ice and snow, fog and low light the leaflet has valuable tips appropriate for the season.

10. Free motoring advice leaflets
GEM Motoring Assist produce a range of road safety leaflets available free of charge to road safety officers and members of the public.

11. Fines and penalties for inappropriate driving for the conditions
A Fixed Penalty Notice (FPN) for speeding now leads to three points on a driving licence and a £100 fine. However, if the speed was sufficiently high lead to a prosecution in court or if the FPN is rejected, the penalties could be much worse; the maximum fine for speeding is £1,000 (or £2,500 on the motorway), and the driving licence could be revoked.

There are three main 'bands' of speeding:

- Band A refers to the lowest level of speeding. For example, you could be driving at between 21mph and 30mph in a 20mph zone, 31mph to 40mph in a 30mph zone, or 71mph to 90mph on a 70mph road. Drivers can expect three points on their licence, and a fine of around 50% of their weekly income.

- Band B is for more serious cases of speeding. If the driver is in a 20mph zone and drive at 31mph to 40mph, or in a 40mph zone at 56mph to 65mph, or up to 100mph in a 70mph, this means that they will receive 4 to 6 points on their licence, or disqualification for between 7 and 28 days, plus a fine of 100% of their weekly income.

- Band C is for the most egregious speeding. If the driver is doing 41mph or above in a 20mph zone, 51mph or above in a 30mph zone, or above 100mph in a 70mph zone, this is likely to result in 6 points on their licence or disqualification for between 7 and 56 days, as well as a fine of 150% of their weekly income.

12. Winter tyres and studded Tyres
Winter tyres use a high silicon content rubber which allows the tyre to remain flexible in colder conditions. This feature improves the braking and handling performance on snow and ice as well as on wet roads in cold conditions. For drivers who drive on icy roads frequently studded tyres can be preferable. These are winter tyres with studs embedded in the tread which are designed to grip to ice on the road providing traction.

13. The Use of VMS to alert drivers
A field study by Rämä and Kulmala (2000) investigated the effects of two variable message signs (VMS) on driver behaviour. The signs were a warning sign for slippery road conditions and a minimum headway sign. The study was performed as a before-and-after experiment at three test sites in Finland with an after period covering two winter seasons. The results showed that the slippery road condition sign reduced the mean speed on slippery roads by 1–2 km/h in addition to the decrease caused by the adverse road conditions. The minimum headway sign decreased the proportion of headways shorter than 1.5 s for cars in car-following situations, in addition to a speed reduction of 1km/h. The effects were somewhat smaller during the second winter than the first.

14. Salting the road
The usual measure against accidents on icy and snowy roads has been to improve the road surface conditions with the help of winter maintenance operations (i.e. snow removal, de-icing with salt, sanding, etc.). In spite of investments in winter maintenance, such as preventive salting of the roads based on weather forecasts, there is normally a delay between detection of slipperiness and maintenance operations in which crashes start happening.
14.0 Driver Behaviour and Vehicle Roadworthiness

Road worthiness can generally be considered as one of the main safety requirements for vehicles on the roads. Every vehicle in order to function properly on the roads and serve its purposes need to be in a suitable operating condition and meet safety standards.

14.1 Impact of Poor Vehicle Roadworthiness on the SRN

According to a recent roadworthiness report commissioned by Highways England and published in 2016, more than 85,000 breakdowns on the roads take place every year due to poor vehicle roadworthiness. In the last two years, over 40% of these breakdowns were caused by vehicles running out of fuel, tyre maintenance, power loss and engine trouble. In 2014, there were 38 KSIs which were directly linked to driving without checking that the vehicle was roadworthy. In addition to this, traffic flow is adversely affected by the number of breakdowns that take place when the driver runs out of fuel (7,419 on the SRN in 2015). The highest number of the registered breakdown incidents occurred in the West Midlands and the South East, while the worst regions in terms of the traffic flow were the East Midlands and the East of England. The most common breakdowns were reported as car breakdowns (69.3%) which can be explained by the fact that cars are the most represented vehicle type.

The Highways England report found that:

1. The peak hours of vehicle breakdowns were: between 07:00 and 9:00 and 15:00 and 18:00, which represent the morning and evening commuting time. However, quite a high level of breakdowns was observed during the working day and could be considered as “business traffic”
2. The highest number of incidents occur in July and August, which is commonly a holiday period for most of the roads users and hence – people travel on the network for longer journeys and appear to be ill-prepared.

Almost a third of accidents in the UK in which vehicle defects were a contributory factor were due to underinflated, defective or illegal tyres. Tyres are the sole point of contact between the vehicle and the road. It is the tyre that determines whether the vehicle can stop in time – or whether it stays safely on course. Studies from different tyre manufacturers show that more than 50% of all passenger cars are driven with underinflated tyres. Tests with underinflated tyres show increased risk of adverse safety consequences in emergency situations. The safety performance of cars heavily depends on the residual tread depth because it is decreasing in parallel to its wear. While new tyres have a tread depth of about 8mm the legal limit regarding minimum residual tread depth is not more than 1.6mm for summer and winter tyres – all over the world. However, experts of leading tyre manufacturers strongly recommend a minimum residual tread depth of 3mm for summer tyres due to an over proportional decrease in wet/aquaplaning performance and 4mm for winter tyres due to an over proportional decrease in snow performance.

Most people may be unaware of the importance of tyre inflation, or even the level to which their tyres are and should be inflated. Drivers may judge it to be too difficult to monitor every last detail of car maintenance, and may only focus on what they consider to be the most important things (Gabaix, 2011). This means that drivers might not be aware that tyre inflation improves fuel efficiency and may not even know their own tyre pressure level.
14.2 A Brief Empirical Review of Driver Behaviour and Roadworthiness

Tyre pressure neglect was investigated in a field experiment at gas stations in Chicago (Yeomans and Herberich, 2014). Posters were put up at gas pumps alerting drivers to the costs of under inflation and they also offered to gauge the tyres of any car that pulled up, for free, while gas was being pumped. This is of interest from a policy perspective because recent regulation is focused on impacting behaviour through information. The intervention included treatments with information about tyre pressure neglect with promotions in the form of price reductions from $0.50 to free. A descriptive norm of tyre behaviour was also promoted. The treatments were designed to provide the ability to consider four potential underlying interventions on drivers: information, monetary cost, social norms and social pressure. Treatments that only included information were ineffective, despite average fuel savings of $10.51, but small promotions had substantial impacts. When the air pump price was free, the social norm discouraged inflation. However, when the research assistant offered help, inflation rates were buoyed by the social norm. These results highlight the importance of incentives over mere information treatments, and offer a new perspective on how information and monetary levers can influence decision-making in the presence of negative social norms.

The results of Yeomans and Herberich’s field experiment showed that tyre pressure neglect is widespread with no increase in tyre inflation during their baseline information treatments, even though drivers were presented with information on the importance of tyre inflation and their current tyre pressure level. Cost-benefit calculations suggest that tyre inflation is a valuable investment for
most drivers with potential gas savings that would vastly outweigh the $0.50 price of the pump. The authors considered this puzzling when compared to the large effect of small cost reductions. It appeared that drivers were more responsive to small changes in the upfront costs of inflation ($0.50 in change) than to much larger differences in the future benefits of inflation (news about potential long-term savings). The authors interpret this as evidence of present bias (Laibson, 1997). These conditions also included strong positive injunctive norms and the implied social sanction had no effect.

More practically, the results are evidence that while information may be necessary to induce behaviour change, it was not sufficient. In contrast to the predictions of social norm theory, Yeomans and Herberich found limited support for the suppressing effect of negative descriptive social norms (Cialdini, 2003). In fact, we found wide variation in the effect of social norms across conditions: the social norm discouraged inflation when the pump fee was waived but encouraged inflation when help was offered and social pressure was potentially increased on the subjects. This suggests that negative social norms are discouraging because they question the value of inflation. This mechanism is particularly relevant in domains where neglect is common and well-known such as tyre pressure or fuel levels. If a negative social norm is pervasive, then social sanction may still be effective, while cost reductions may pale in comparison to the signal that is implied by widespread neglect.

14.3 Engineering Interventions

Highways England Keele Tyre Pilot

Project WASP (Weight and Safety Partnership) was a tyre pressure technology pilot from March to December 2015 with 115,209 tyres measured (86,539 from cars and 28,670 from HGVs). Pressure pads can also measure tyre tread. One in eight vehicles were more than 20% away from their nominal pressure with one in twelve for HGVs. This technology could be incorporated into motorway services areas to unobtrusively detect drivers with unsafe tyres before they rejoin the motorway. New tyres and tyre pressure facilities can be made available at the location. DVLA could be asked to do a ‘random check’ of tyres at motorway service areas.

14.4 Educational Interventions

Highways England launched their most recent campaign Vehicle Checks as a part of other co-branded THINK! Campaigns on the 31st of March 2017. The campaign has been designed to prompt people to perform simple vehicle checks before setting off on long journeys, particularly around the Easter holiday period. The target audience of this campaign was 30-50 year olds and drivers on long journeys with families. This will be broadened to include the caravanning audience in phase two – Summer 2017.

The campaign was expected to directly contribute to:

- Making the network safer – reducing the roads incidents rates by 40% by 2020
- Improving user satisfaction.

The main slogan of the campaign is “You wouldn’t expect a pilot to take off without running through checks, so why shouldn’t you take the same approach for an important journey?” The campaign ran through TV, supported by video on demand, radio, display, digital Out of Home all linking to a web page on the THINK! Website, accessible at http://think.direct.gov.uk/video-carchecks.html, which illustrated how to carry out the various checks. THINK! was co-branded on all campaign assets. The campaign was live for two weeks before the Easter break (14th-16th April 2017) which is a key period for significant journeys that will be the most effective triggers for behaviour change. The drivers were
also provided with the informative leaflets within the THINK! campaign that suggest what checks of the vehicle should be done prior to taking a journey on the roads.

**TyreSafe collaboration with Highways England**

TyreSafe is one of the UK’s most prominent tyre safety organisations with the aim of raising awareness about the dangers of driving with defective/illegal tyres.

Research undertaken by TyreSafe found that:

- over 15,000 breakdowns per year on British motorways are tyre-related,
- 30% of tyre-related breakdowns had an impact on live traffic lanes,
- there are over ten million illegal tyres on British Roads,
- braking on tyres with illegal tread levels from 50mph to a standstill in wet conditions takes 14 metres longer.

Whilst causation is difficult to isolate, since TyreSafe started campaigning in 2006 the number of casualties related to illegal, defective or under-inflated tyres has decreased from 1,624 to 1,210 in 2010. TyreSafe is particularly concerned about road users growing up in an age where vehicles in general need less maintenance, it therefore provides education and information about how to check tyre pressures and ensure that tyres are legal. Highways England have been working collaboratively with TyreSafe on a number of campaigns including Tyre Safety month, displaying the Tyre Safe strapline ‘Safe Tyres Save Live’ and through video campaigns showing CCTV footage from motorway cameras of tyre failure incidents.

### 14.5 Enforcement Interventions

It is illegal in the UK to drive a vehicle that has poor roadworthiness. Depending on the type of a violation, drivers caught driving a vehicle in a poor condition can be fined up to £2,500 and receive three points on their driving license. Every vehicle owner is obliged to make sure they have a valid MOT for their vehicle and it is illegal to drive a non-exempt vehicle that requires a test on public roads without a current MOT, except when driving to or from (subject to insurance terms and conditions) a booked MOT Test or to have remedial work done to rectify failures in a previous test. An MOT test certificate only confirms that at the time of test, the vehicle has met the minimum acceptable environmental and road safety standards.

**Highways England and DVSA Joint Working**

At various locations including the Dartford Tunnel, a data sharing pilot aims to improve safety and increase Driver and Vehicle Standards Agency (DVSA) compliance checks by delegating DVSA stopping powers to Highways England Control Room Operators. The pilot has been conducted to minimize disruption commenced in June 2015 and up to 13th October for the North East have shared 73 pieces of data and West Midlands have shared 141 pieces.

### 14.6 Conclusions

Vehicle owners maintain their vehicles within the constraints of their own knowledge, available skills and affordability. Optimizing these factors will improve roadworthiness. Knowledge can be improved with the use of educational campaigns. However, incorporating a better understanding of vehicle maintenance could be achieved via driver training and testing. The affordability of good quality vehicles with their own tyre pressure monitoring sensors could be supported with duty/tax regimes which give an advantage to such vehicles, and deter low quality and sub-standard imports.
Recommendations

- It may be possible to scale down the Tyresafe message and target educational and information campaigns at specific users, for example, working in conjunction with local authorities and other stakeholders and sending information packs to people who have recently passed their driving test.
- Running out of fuel could also be detected using The AA/RAC/police reports and/or TOV CCTV and referred for a Highways England warning letter. A root cause of this behaviour could be the cost of fuel at Motorway service areas.
- Tyre Pressure Monitoring Systems in-vehicle (TPMS) help to permanently monitor a vehicle’s tyre pressure and reliably alert the driver in the event of a loss of air pressure. Since November 2014, legislation in Europe and other countries is mandating TPMS as standard on all new vehicles. However, for older vehicles, maintenance of the correct tyre pressure remains the responsibility of the drivers themselves.

14.7 Road Worthiness Intervention Matrix

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address vehicle roadworthiness use and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of encouraging better vehicle maintenance before travelling on the SRN that have not been implemented – in particular the interventions categorised as ‘educate’ and ‘support’.
# An Intervention Framework for Safer Driver Behaviour: Vehicle Roadworthiness

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<th>Control</th>
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<td>Vehicle tests and inspections&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Fixed penalty notices and campaigns for poor roadworthiness&lt;sup&gt;3, 4&lt;/sup&gt;</td>
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<td>The MOT test&lt;sup&gt;5&lt;/sup&gt;</td>
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<td>Public education campaigns&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>Design</td>
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<td>High-quality vehicles&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Tyre pressure monitoring in-vehicle&lt;sup&gt;6&lt;/sup&gt;</td>
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1. **High quality vehicles for fleet drivers**

The Brake road safety charity organisation proposed two main options to decrease the level of vehicle breakdowns on the roads: to provide the in-vehicle technologies and develop awareness on roadworthiness in road users and employers. Brake consider that consumers and businesses should be encouraged to purchase safer vehicles. Vehicles should be then maintained to the highest safety standards. [http://www.brake.org.uk/component/content/article/15-facts-a-resources/facts/1484-safe-systems-facts-page](http://www.brake.org.uk/component/content/article/15-facts-a-resources/facts/1484-safe-systems-facts-page)

2. **Public Education Campaigns**

THINK! Vehicle checks - Highways England launched their most recent campaign Vehicle Checks as a part of other co-branded THINK! Campaigns on the 31<sup>st</sup> of March 2017. The campaign has been designed to prompt people to perform simple vehicle checks before setting off on long journeys, particularly around the Easter holiday period.

3. **Fixed Penalty Notices for poor roadworthiness**

According to the DVLA, driving a vehicle with defective tyres can lead to a fixed penalty notice up to three points per defective tyre and remains on driving records for four years from the date of the offence. [https://www.gov.uk/penalty-points-endorsements/endorsement-codes-and-penalty-points](https://www.gov.uk/penalty-points-endorsements/endorsement-codes-and-penalty-points)

4. **Police and regulatory authorities may initiate tests and inspections as part of a campaign to take unroadworthy vehicles off the roads.**

For example, a Cumbrian police campaign aimed at checking the roadworthiness of vehicles and found 18 offences being committed. Officers stopped 255 vehicles. Seven drivers received fines and points on their driving licences for having defective tyres, using a mobile phone and speeding. One driver was fined for not wearing a seat belt while four drivers received forms for having defective lights. Five drivers were reported for various offences, including three for no insurance, no driving licence and no MOT. One vehicle was seized for not being insured.

5. **The MOT test**

During an MOT a vehicle is checked to ensure it meets the legal standards and results in a pass or fail. Owners can be fined up to £2,500, be banned from driving and get 3 penalty points for driving a vehicle in a dangerous condition. Some of the important parts checked are listed below and rules for drivers on vehicle roadworthiness (in the UK) can be found on Government websites. [https://www.gov.uk/getting-an-mot/the-mot-test](https://www.gov.uk/getting-an-mot/the-mot-test).

- Body, vehicle structure and general items (Doors, mirrors, bonnet)
- Towbars
6. Tyre pressure monitoring

Tyre Pressure Monitoring Systems (TPMS) are electronic systems which monitor the air pressure of a vehicle’s tyres. There are two types of TPMS; direct (dTPMS) and indirect (iTPMS) and can be provided pre-installed into vehicles as well as post-sale.

Direct TPMS uses pressure sensors and can be either internal or external. These sensors physically measure the tire pressure in each tire and report it to the vehicle’s computer monitoring system.

Indirect TPMS measures pressures by monitoring individual wheel rotational speeds. iTPMS cannot measure or display absolute pressure values and should be reset by the driver following air pressure checks and adjustments. (TPMS Made Simple, 2010; OMICS, 2014)


15.0 Red-X Compliance on Smart Motorways

A smart motorway is a section of motorway in Great Britain that uses active traffic management techniques to increase capacity by use of variable speed limits and hard shoulder running at busy times to increase capacity and reduce congestion. These methods include using the hard shoulder as a running lane and using variable speed limits to control the flow of traffic. Highways England developed smart motorways to manage traffic to minimize environmental impact, as well as cost and time to construct by avoiding the need to build additional lanes. There are three types of scheme which are classed as smart motorways including controlled motorways, dynamic hard shoulder running schemes and all lane running schemes.

All lane running smart motorways use the hard shoulder permanently as a running lane for traffic in which lane one (formerly used solely as the hard shoulder) is only closed to traffic via overhead and verge mounted cantilever signs, in the event of an incident. On these sections broken white lines between all lanes indicates that each lane has the same status. Overhead gantry signs display the mandatory speed limit which varies depending on the traffic conditions and speed cameras are used to enforce these. Signs can also be used to close lanes should that be required.

If an incident occurs in lane one – formerly the hard shoulder – a red cross (X) symbol is displayed to let motorists know the lane has been closed to traffic. The ‘Red-X’ sign signifies a closed lane or lanes and used to provide a safer area for stranded motorists, emergency workers or road maintenance crews and to provide a clear path to an incident for first responders. Driving in a lane under which the Red X symbol is being shown is illegal and could lead to a driver being prosecuted. CCTV is used extensively to monitor traffic for any incidents. Should drivers break down or be involved in an accident there are emergency refuge areas at the side of the carriageway. These are typically further apart than current sections of motorway operating the dynamic hard shoulder running configuration, with an average spacing of 1.5 miles apart.

15.1 The Impact of Red-X Non-Compliance

The recent increase in the deployment of a SMART motorways network and further development of major routes have highlighted a growing problem with non-compliance in following the Red-X rules. According to the National Road User Survey nearly one third of road users do not know what to do when they see a Red-X sign displayed and only one in twelve said they would stop driving in the lane if they saw a Red-X. Ignoring or reacting inappropriately to a Red X can lead to tragic consequences as it can put lives at risk. Drivers’ incorrect decision to drive in a forbidden lane may lead to traffic conflicts with other vehicles. Most importantly this behaviour can hinder the ability of the emergency services to get to the scene of a road traffic incident.

According to the Department of Transport report more than 4,400 non-compliant motorists (roughly 8% of the traffic) were detected in 45 lane closures on London’s orbital motorway (M25) and between July and December 2014 Red-X non-compliance accounted for 130 of 210 near-misses recorded in all-lane running sections of the M25. Similarly, at the Hindhead Tunnel in Southern England, 75 near-miss incidents have been recorded after drivers ignored the Red-X signs.

A Red-X sign was first set over lane 1 for 10 minutes to allow recovery of a broken down LGV in November 2013 and 145 vehicles were observed on CCTV to be failing to comply with the Red X and risking a collision with the stationary vehicle and the traffic officers recovering it. After that in 2014, 4,156 people were asked about the Red-X sign as part of Highways England NRUS and only 68% of
road users stated they understood what a Red-X signs means. Moreover, the survey also showed that a significant number of drivers do not understand the legal implications of driving through a Red-X; with 39% of road users either not knowing it was against the law or thinking that it was not against the law. Since then Highways England have been working on this issue mainly by increasing awareness on the importance of Red-X compliance and improving enforcement for non-compliance.

15.2 Red-X non-compliance: A Theoretical and Empirical review.

Considering that Red-X signage has only recently been implemented for use on the smart motorways, very little research has been published to explain Red-X non-compliance. However, the research investigating behaviour in response to signals will be reviewed here and this may be transferrable to Red-X compliance.

According to a study of behaviour at traffic lights in which drivers chose to go through a red-light, violators can be categorized into three groups: the first type are drivers who could have changed the lane before the stop sign, but were delayed either by their own indecision (Retting, et al., 2002) or by some other reasons; the second type is drivers in the dilemma zone deciding whether to stop or go (Porter and England, 2000); and the third type is aggressive drivers who could have stopped comfortably, but chose to run the red light deliberately. Even though the dilemma and option zones were introduced to explain drivers stop/go decision when passing yellow/red light (e.g. Bonneson and Zimmerman, 2004), which can often occur when the driver is travelling at a lower speed than the current speed limit - an option zone is created. This option is an area in which the driver can stop or cross the signal successfully. When travelling at a higher than the speed limit a dilemma zone is created, i.e. the driver can neither stop without slamming on the brakes or cross safely without running the red light (Papaioannou, 2007). Similarly to red light passing behaviour, Red-X non-compliance may occur when the density of traffic is too high or too low.

Further research to investigate driver behaviour in response to Red-X signals is required.

15.3 Engineering Interventions

Driver inattention for roadway hazards have been estimated to contribute to 25–50% of road crashes (Stutts et al., 2001). The main method of providing information is to provide warning signs, yet a range of experimental studies have called into question the effectiveness of road hazard warning signs (Donald, 1995; Fisher, 1992; Macdonald and Hoffmann, 1991). Recent studies have noted drivers’ difficulties in understanding the meaning of particular warning signs indicating “slippery when wet”, “road narrows”, “steep descent”, “pavement ends”, and “truck crossing” with correct response rates ranging from 6% to 40% (Cooper, 1989; Dewar et al., 1997; Zakowska, 2001). Another approach to determining the effectiveness of hazard warning signs has been to measure drivers’ recognition or recall of road signs they had recently passed by stopping them after they had driven past a warning sign and questioning them about the content of the sign. The roadblock paradigm indicated very poor memory for road signs. There was an acknowledgement, however, that some degree of memory decay is likely and that stopping of drivers at road blocks may of itself have affected drivers’ memory.

Other researchers have examined how the reflectivity, size, and placement of warning signs affect their ability to attract a driver’s attention (e.g. Cole and Hughes, 1984). These studies measured what drivers verbally reported as attracting their attention as they drove. Conspicuity was found to be quite low; reported by 15–20% of drivers, and only 10% of the traffic signs present were reported. Cole and Hughes (1984) made the distinction between attentional conspicuity and search conspicuity in processing information in road scenes and although visual clutter affected both search and attentional
conspicuity, attentional conspicuity was affected to a greater extent (e.g., in arterial roads as compared to residential roads).

Sign formats designed to increase the conspicuity of hazard warnings (larger size, higher contrast or reflectivity) have been put into service, but relatively few studies of their effectiveness have been conducted. Summala and Hietamäki (1984) measured vehicle speeds and speed changes in the presence of hazard signs and found that placing a flashing light on top of a sign reduced average speeds. Vehicle-activated curve and junction warnings in the UK were found to produce significant reductions in vehicle speeds of up to 7 mph (11 km/h) (Winnett and Wheeler, 2002). Fisher (1992) argued that the true measure of a warning sign’s effectiveness is not recall, recognition, or naming, but the “extent to which, in operational terms, sign content affects drivers’ preparedness for and subsequent responsiveness to events”. He found that many drivers who reduced their speed after passing a warning sign were unable to recall having seen the sign 100 m earlier perhaps serving as an implicit cues for automatically responding.

In a study to assess driver reactions to 16 road hazard warning signs of various formats by projecting life-sized video of road scenes to drivers in a driving simulator (Charlton, 2006), the findings show that a flashing variable message format was only slightly more conspicuous than the large dimension format, equal in comprehensibility, and perhaps somewhat worse in terms of memorability.

These results suggest that decisions about which sign format will be most effective will depend on the type of hazard and this could have implications for Red-X signal design. Perhaps ensuring that the Red-X signal has greater conspicuity could have an impact on its detectability.

15.4 Educational Interventions

A specific NDORS motorway driver diversion course is being launched in 2017 to consider the dangers of not complying to the Red-X signals as well as other offences committed whilst driving on the motorway. Evaluations are planned but currently it is not possible to know how effective this course might be for improving Red-X compliance.

In terms of educational campaigns, Highways England has been engaging with the police services in England to promote the enforcement of Red-X non-compliance through the use of mobile patrols. Hertfordshire Constabulary, Surrey Police and Kent Police are among those actively engaging in Red X enforcement. As part of the “Get smart, know your motorway” campaign in 2015 Highways England attempted to increase awareness about Red-X signals among the road users through:

- Radio adverts, which were aired across the country telling drivers what to do when they see a Red-X.
- Posters were on display in motorway service areas, pointing people to the Highways England website to find out more about the Red X and its use on smart motorways.

Hazard perception Skills and Red-X Compliance

Poor Red-X compliance may be explained in part due to poor perception of hazards. The Red-X is rather small on the gantry compared with the speed limit signs and this may mean that drivers are less likely to see it given that a smaller image is cast on the retina.

Drivers tend to consider themselves as skilful and ready to meet any roadside challenges (e.g. Groeger and Grande, 1996; Horswill et al., 2013; Waylen, et al., 2004; Dogan, et al., 2012). Horswill et al. (2004) found that UK drivers rated themselves as significantly better than both (a) peers with exactly the same driving characteristics as themselves and (b) the average UK driver, for 18 out of 18 specific components of driving skill. This superiority bias was significantly greater for the hazard perception
items (85.6% of the sample thought that they were better at hazard perception than their peers) than for either overall driving skill or items relating to vehicle control skill. However, the studies suggest that drivers can not properly assess themselves in terms of hazard perception skills especially when they are quite experienced. However, this lack of insight could be a direct result of the lack of performance feedback in driving, as previously discussed.

15.5 Enforcement Interventions

Driving in a lane with a Red-X signal is an offence and motorists face three penalty points and a fine of up to £1,000. Magistrates also have the discretion to disqualify drivers. There is a call to introduce a camera-based fixed penalty regime for those drivers who ignore Red X lane closures on motorways given that the penalties do not seem to achieve desirable results probably due to low levels of enforcement. A specific motorway driver diversion course is being launched in 2017 to consider the dangers of not complying with Red-X signals as well as other offences committed whilst driving on the motorway.

The compliance Monitoring Tool (discussed in more detail in section 7.5) has led to a significant impact on repeat offending of ignoring a Red-X signal. A new warning letter capability has been developed in partnership with the police and DVLA. Since November 2016 over 8,000 letters, accompanied by educational information leaflets and feedback requests, have been sent to drivers misusing the hard shoulder or contravening a Red-X signal on sections of the M6 in the West Midlands. Where repeat non-compliance has been identified the police are undertaking additional investigations. An increase in the number of warning letters issued for Red-X offences is planned over the coming months to 4,000 to 10,000 per month, supported by temporary automatic number plate recognition (ANPR) equipment which was installed at five sites on the M25 during February 2017 and negotiations with the police to access existing ANPR equipment at other locations including the M1 near Toddington Services and at the Dartford Crossing. Further offence detection sites have also been identified and are being progressed either using temporary ANPR infrastructure or by capturing offences from a vehicle which is able to respond to relevant incidents. A leaflet is also included along with a portal in which feedback can be gathered about the offence to build up Highways England understanding. The CMT was used as a Red X compliance intervention in which there has been a 97% reduced recidivism on follow up for the same vehicle using ANPR. 15-20% of the offenders gave feedback online.

CCTV has also been installed in Traffic Officers vehicles in the expectation that better levels of detection can be achieved and evidence referred to the police.

15.6 Conclusions

Many road users show lack of awareness Red-X signs and what the possible consequences of violating this signal and driving in a forbidden lane may lead to traffic conflicts and hinder the emergency services to get to the scene of a road traffic incident. Comparatively little research has been conducted on driver’s responses to Red-Xs and further research is required.

Recommendations

- When the driver is travelling at a lower speed than the current speed limit the driver can stop or cross a signal successfully but when travelling at a higher speed Red-X non-compliance may worsen due to a reduced capacity to detect the signal. Future work could investigate how the signal itself could have greater conspicuity.
- The detection of offenders, and sending warning letters shows significant improvements in compliance levels and could be rolled out nationally.
- Whilst the introduction of a fixed penalty notice might assist with improving Red-X compliance in the longer term, there may be an advantage of improving knowledge about the meaning of a Red-X signal first (e.g. via social media, leaflets via the CMT, online resources etc.).
- Hazard perception training could also be implemented to improve Red-X compliance as distinct from hazard perception testing (see section 7.4 for further information).
- The CMT is a promising tool for improving Red-X compliance and further works could seek to investigate modifications to the warning letter content taking into account Behavioural Change Techniques for even greater more sustainable compliance.

15.7 Intervention Matrix for Red-X Non-compliance

The intervention matrix below represents the output of research to investigate what countermeasures have been implemented to address Red-X non-compliance and categorized according to type of intervention and exchange mode. There are clear gaps in the research showing that there are many different methods of changing driver behaviour that have not been implemented – in particular the interventions categorised as ‘educate’ and ‘support’.
<table>
<thead>
<tr>
<th>Hug</th>
<th>Nudge</th>
<th>Shove</th>
<th>Smack</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td><strong>Use of CCTV detection for Red-X non-compliance</strong>¹</td>
<td><strong>Penalties for Red-X non-compliance</strong>⁴</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td>Get smart, know your motorway³</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Highways England compliance monitoring tool warning letter trial in progress</strong>⁸</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Shoulder lane improvements²</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Educate</strong></td>
<td>DriveIQ⁷</td>
<td></td>
<td>National Driver Offender Retraining Scheme (NDORS)⁵</td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>Hazard perception training⁶</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Police tracked down more than 40 motorists who flouted the motorway rule about driving down a lane with a Red-X over it. Greater Manchester Police warned drivers that using lanes which are marked as closed can cause accidents and endanger lives. The police also warn about the fines up to £1000 and three penalty points if drivers are caught not complying with a Red-X signal. [http://www.manchestereveningnews.co.uk/news/40-drivers-contacted-police-after-7277630](http://www.manchestereveningnews.co.uk/news/40-drivers-contacted-police-after-7277630)

5. National Driver Offender Retraining Scheme course

It is a scheme that been implemented in several parts of the UK the main goal of which is to offer a training course as an alternative to prosecution to drivers who committed a driving offence. The NDORS scheme is governed by guidance issued by the Association of Chief Police Officers and endorsed by the Crown Prosecution Service. In the year 2010-11, 41% of drivers caught on committing a driving offence nationally took a course; in the following year, the figure rose to 54%.

There are four types of course:

- National driver alertness course (for non-serious collisions and complaints by 3rd parties)
- National speed awareness course (for speeding up to 10% + 9 mph over the speed limit)
- What’s driving Us course (for conscious bad driving not resulting in a collision)
- Driving 4 change course (for careless driving not resulting in a collision)

Each of these courses is designed to address different types of driver error, including offences such as speeding, driving without due care and attention (careless driving), using a mobile phone and failing to wear a seat belt. A specific motorway driver diversion course is being launched in 2017 to consider the dangers of not complying to the Red-X signals as well as other offences committed whilst driving on the motorway.

6. Hazard perception training

Wetton, et al (2013) suggested that wide implementation of advanced driving courses for the novice drivers is the only option to improve driver safety. The key component of the courses should be hazard perception commentary drive training that usually involves either an expert instructor or the trainee performing a running verbal commentary of the safety-related observations during a real, simulated or video-recorded drive. The authors also highlighted that novice drivers should be taught on how to predict the results of their driving decisions/ choices by implementing a technique into the training which is called “What happens next exercise”. In each of these exercises, trainees viewed video footage of a traffic situation, which was freeze-framed at a given point (usually just before a hazard eventuated). At the point of the freeze-frame, trainees were asked “what might be about to happen?” Subsequently, they were provided with feedback on the accuracy and appropriateness of their responses.

7. DriveIQ

Driver education software company a2om International has designed a hazard perception training package called DriveIQ. High definition video footage is collected using an instrumented car which has been driven around the UK in different road and weather conditions including rural, motorway, dual and single carriageway and urban shopping areas, capturing traffic scenarios as they naturally unfold. Filming has taken place in different weather and light conditions including in ice, in the rain and at night, given the increased risk to novice drivers under such difficult driving conditions (Konstantopoulos et al., 2010). The scenarios are then carefully selected and the video material is synchronized and compressed. DRIVEIQ presents video sequences that have three rearward mirror views synchronized with the forward action. Part of a car’s interior is also visible in the foreground so that normal instruments (particularly the speedometer) are displayed in the field of view on screen. Clips pause at a pre-determined position which is unknown to the trainee. A question is then presented either on the events that have just transpired or on how the scenario will develop. Immediate feedback is provided to responses to cement learning, along with the option to replay the clip to revisit what the trainee got wrong or right. The efficacy of the hazard perception training materials used within DriveIQ has been the subject of at least two evaluation studies (Isler et al., 2009; af Wåhlberg, 2010).

8. Compliance Monitoring Tool (CMT)

Highways England has a warning letter trial in progress with results expected in the summer of 2017 with the aim of issuing a nominal amount of letters but there are a limited number of trial detection sites. The Compliance Monitoring Tool (CMT) will detect close following and enable letters to be sent to warn drivers about the offence. A leaflet is also included along with a portal in which feedback can be gathered about the offence to build up Highways England understanding. The CMT is expected to be effective when considering the success of a recent Red X
compliance intervention using the same methodology in which there has been a 97% reduced recidivism on follow up for the vehicle using ANPR. 15-20% of the offenders gave feedback online. The cost is about 50 pence per letter.
16.0 Implementation Plans

Based on the current research, three implementation plans were designed in order to address three priority behaviours on the SRN selected based on KSiS, customer satisfaction and the availability of reliable benchmark data to monitor the impact of interventions. In 2015 the number of KSiS for inappropriate speed were 241, 114 for close following and 20 for mobile phone use. In addition, of the customers angered by an aspect of poor driver behaviour in 2016 according to a Highways England satisfaction survey - 35% said it was due to speed, 43% reported it was due to close following and 48% reported that seeing drivers using their mobile phone whilst driving made them angry. Therefore the priority behaviours selected were inappropriate speed, close following and mobile phone use.

16.1 Applying the Safe Systems Approach

To influence driver behaviour for the priority behaviours it is important to take a safe systems approach. Scott-Parker et al (2016) considers that a systems approach is required to achieve further reductions in road casualties (Larsson, et al., 2010; Read, et al., 2013; Salmon and Lenné, 2015; Salmon, et al., 2012). The systems approach is underpinned by the idea that collisions are emergent properties arising from interactions between system components including people, groups, and artefacts across the overall transport system comprising many levels. Road user behaviour is impacted by decisions and actions across all levels of the system, not just by the human driver (Leveson, 2004).

In the road transport context, this implies that an approach focused on “fixing-the-driver” will ultimately prove ineffective, since there are other factors across the system that influence driver behaviour (Larsson, et al., 2010; Salmon and Lenné, 2015).

Within the larger road safety context, Salmon and Lenne (2014) consider that:

1. Road traffic crashes are emergent properties impacted by the decisions and action of all actors, not just road users alone;
2. Threats to road safety are caused by multiple contributing factors, not just a single poor decision or action;
3. Threats to road safety can result from poor communication and feedback (vertical integration) across levels of the system, not just from deficiencies at one level alone;
4. Lack of vertical integration is caused, in part, by lack of feedback across levels of the road transport system;
5. Road system behaviours are not static; they migrate over time and under the influence of various pressures (e.g., financial, psychological);
6. Migration occurs at multiple levels of the road transport system;
7. Migration of practices cause system defences to degrade and erode gradually over time, not all at once. Road crashes are caused by a combination of this migration and (a) triggering event(s).

The implementation plans take account of the safe systems approach by introducing a range of different interventions designed to address the various systems operating on the driver including the vehicle, road designers, local and national government, regulators, enforcement agencies etc.

16.2 Interventions: Theoretical Approaches

Different theories can be utilised in different contexts to explain different aspects of driver behaviour. There is no one single theory that can explain all the complexities of driver behaviour. The focus of this research project is to consider what theory best explains behaviour in different contexts and
situations. This is critical to the development of effective interventions. A transparent consideration of the theoretical underpinnings and assumptions informing behavioural intervention selection, development and design will impact on effectiveness. An appreciation of the theories using an integrated theoretical approach facilitates wider thinking and innovation. For example, there has been an overemphasis in traffic psychology of the Theory of Planned Behaviour (TPB) as a way of explaining driver behaviour (Parker, et al., 1992; 1996). Much of the development of this theory has been based on self-report and prone to common method variance error. Armitage and Conner (2001) reported that the TPB constructs explained 50% more variance when the outcome was self-reported, as compared to when objectively measured. Such results were also reported specifically for the TPB versus simulator speed behaviour by Elliott, Armitage and Baughan (2007). Unfortunately, such direct comparisons of explained variance can seldom be used for collisions, as the archive sources almost always suffer from lower variance than self-reports. When this is not the case, the expected difference occurs (af Wåhlberg, Dorn and Kline, 2010; 2011). By adopting an integrated theoretical approach there is an opportunity to take a wider view of the element of driver behaviour in question and in context.

When designing interventions an integrated theoretical approach allows the research team to consider what area of theory they may be drawing from rather than an unquestioning use of the same theory. This gives flexibility in the design of interventions drawing from theoretical perspectives that best explain, predict and change behaviour. This approach will facilitate a more conscious and active appreciation of the benefits of particular theory for addressing the non-compliant behaviour in question.

16.3 A Multi-phased Approach

Taking these facets into account it is essential that an implementation plan considers the multi-level systems that operate to address different elements of driver behaviour. The implementation plans include different types of interventions with reference to engineering, education and enforcement for each priority behaviour. No element of the system should be omitted as far as possible. It is known that behaviour change needs a tailored mix of interventions, delivered over a long period of time and modified in response to the measurement of its impact. An integrated and holistic approach is required for this purpose. As part of any behavioural intervention, it is necessary to understand the barriers to behaviour change. A multi-faceted approach to increase driver compliance in one study included public information campaigns, public signs, increased enforcement and engineering changes (Van Houten, et al., 2013). Road users were given compliance feedback via signs to increase awareness and the researchers found a change in the perception of a particular type of violation towards greater social unacceptance.

The time scale required for interventions to achieve their maximum effectiveness will differ substantially across the range of policy areas and instruments. Behavioural measures to avoid speeding for example, appear to be most effective when they include strong enforcement accompanied by powerful awareness-raising campaigns. They can have an immediate impact in reducing road deaths and injuries, but need to be repeated regularly to foster a cultural shift towards safer behaviours (ITF, 2016). There may also be resource-intensive steps, requiring effort from roads policing, investment in safer road infrastructure, incentives to use safer vehicles etc. There will be differences in impact delivery for each intervention and this needs to be integrated into the implementation of interventions. The implementation plan aims to support behavioural change from a safe systems perspective taking into account different modes of exchange (hug, nudge, shove,
smack) and different types of interventions as categorised in the main body of this report (Design, Inform, Control, Educate and Support).

The interventions were chosen based on the strength of the evidence base with regards their effectiveness for tackling the priority behaviours.

### 16.4 Structure of the Implementation Plans

The implementation plans were created based on a number of components: The rationale; Stakeholder Engagement; Intervention Procedures and Governance and Evaluation.

#### The Rationale
- The implementation plan includes evidence from case studies, evaluations and academic research for each intervention
- Aims and measurable behavioural objectives for the interventions will be provided
- The implementation plan provides an outline of the theoretical perspectives that have been used to formulate each intervention
- The implementation plan will identify which interventions Highways England can implement immediately
- With reference to the evidence base, the target audience and/or segments will be specified where applicable

#### Stakeholder Engagement
- The implementation plan provides detail about what type of stakeholders are required for each intervention
- The implementation plan considers whether each intervention requires stakeholders only, stakeholders and Highways England in partnership or only Highways England
- Stakeholder groups terms of reference forms part of the implementation plan to establish expectations and ensure relationships are maintained before, during and after the implementation programme is rolled out.

#### Intervention Procedures
- The implementation plan includes cost, ease of delivery and level of impact on KSI reduction where possible
- The implementation plan sets out any coordinated action between international, national, regional and local delivery
- Key barriers are identified as part of the implementation plan

#### Governance and Evaluation
- The implementation plan sets out the ownership, governance and coordination of the interventions programme
- The implementation plan will include detail on how prototype interventions or pilots will be evaluated
- The implementation plan outline baseline data (if available) which can be used for an evaluation of the intervention trials

The implementation plans can be found in Appendix C.
17.0 Overall Recommendations and Next Steps

Our research has provided some background on the literature with regards to the current methods used to improve eleven non-compliant behaviours. However, historically, the focus for interventions has been on engineering and enforcement. Both these approaches have their place in managing risk and the smooth operation of the SRN, but they fail to engage the customer to nudge behaviour towards increased road safety.

In general, the underlying messages via communication strategies and enforcement tend to be punitive in nature. From a behavioural perspective this approach can mean that behaviour may only change when the likelihood of being caught increases (e.g. drivers drive slower in the presence of speed cameras). A behavioural approach requires a softer method targeting motivational factors. Changing social norms about what behaviours on the SRN are socially acceptable is likely to have multiple benefits including safer driver behaviour, operational efficiency and increasing feelings of perceived safety and customer satisfaction (Highways England, 2015). A ‘graduated’ response to non-compliant behaviour might be considered, in which those who break the rules of the road are given warnings (e.g. sending a warning letter, offered a course, fined etc.) to ensure the response is proportionate.

Next Steps

To support a reduction of KSI casualties on the SRN the output from this research recommends several next steps for Highways England.

First, it is recommended that the findings in this report are fed into the Highways England Compliance Action Plan to secure agreement with internal stakeholders on the structure and content of the implementation plans for speeding, close following and mobile phone use.

Second, it is recommended that Highways England engages with a broad range of stakeholders to ensure that road safety messages are consistent. This involves using the stakeholder management plan and terms of reference for close collaborative working to improve the non-compliant behaviour in question. For example, image processing of non-compliant behaviours such as close following might be selected to benchmark the behaviour. Stakeholders will need to agree what constitutes close following and determine what might be an appropriate response from an enforcement, engineering and educational perspective.

Third, it is recommended that the road user types need to be targeted for specific interventions contained within the relevant implementation plan to identify the situations where non-compliance is more likely and where baseline monitoring of the priority non-compliant behaviour could be established.

Fourth, it is recommended that perhaps one or two interventions are piloted to identify any practical constraints or limitations. The findings from the pilot could then be fed back and the procedures adapted accordingly.

Finally, we recommend that the interventions are rolled out in a consistent and concise way across the entire SRN with full recording of data before, during and after the intervention in order to evaluate effectiveness.
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APPENDIX A: HEALTH REVIEW TABLE

<table>
<thead>
<tr>
<th>Trial</th>
<th>Target</th>
<th>Participants</th>
<th>Theoretical framework</th>
<th>Interventions</th>
<th>Duration</th>
<th>Findings/results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal-setting and spouse involvement in the treatment of obesity, (Dubbert and Wilson, 1984)</td>
<td>To evaluate the effect of two types of goals setting (daily/weekley) and two levels of spouse involvement (couples vs individual treatments)</td>
<td>48 females and 14 males, including seven couples with both spouses participating.</td>
<td>Social learning theory (Bandura, 1977)</td>
<td>Four-week educational phase consisting of 2 hour lecture and small-group discussion meetings. Discussions and educational materials distributed to participants covered such topics as facts about weight reduction, basic nutrition, techniques for controlling eating and safely increasing exercise, coping with negative emotions and self-defeating cognition asserting oneself to obtain the necessary support from significant others and the importance of keeping records and setting goals.</td>
<td>Four weeks of monthly telephone follow-up for all participants</td>
<td>Nineteen weeks with six months’ clinic follow-up and further mail and telephone follow-up at 12 and 30 months.</td>
</tr>
<tr>
<td>Comparative effectiveness of two weight-loss interventions. (Appel, et al., 2011)</td>
<td>To examine the effects of two behavioural weight-loss interventions (p-person vs. remote/online).</td>
<td>415 obese patients with at least one cardiovascular risk factor (mean age 54.0 years).</td>
<td>Social cognitive theory with incorporated behavioural self-management approaches.</td>
<td>Motivational interviewing was the primary approach to interactions with participants. Participants in the two intervention groups were encouraged to lose 5% of their baseline weight within six months and to maintain the reduced weight until the end of the study.</td>
<td>24 months.</td>
<td>Two goal-setting conditions and the two spouse treatments did not differ in their influence on weight losses. However, correlational analysis indicated that cooperation by spouses influenced treatment outcome in a good way.</td>
</tr>
</tbody>
</table>
### Reducing cardiovascular risk factors in postmenopausal women through a lifestyle change intervention. (Carels, et al., 2004)

#### Trial

To examine the impact of a 6-month lifestyle change intervention on cardiovascular risk factors in obese, sedentary, postmenopausal women and to determine whether the addition of self-control skills training to an empirically supported lifestyle changer intervention would result in greater cardiovascular risk reduction.

44 obese, sedentary, postmenopausal women were assigned to receive lifestyle change intervention or lifestyle change intervention plus self-control skills training. They also had to be non-smokers, and have medical clearance from their primary physician.

Intervention was based on the LEARN Program. The LEARN Program is a comprehensive, empirically supported lifestyle change approach to weight management and physical activity and has five essential components: lifestyle, exercise, attitudes, relationships, and nutrition.

#### Theoretical framework

- Prompt self-monitoring of behaviour
- Provide feedback on performance
- Provide contingent rewards
- Agree on behavioural contract
- Provide opportunities for social comparison

#### Interventions

- At baseline, participants completed assessments of body composition, physical activity, cardiorespiratory fitness, BP, blood lipids, fasting glucose, psychological functioning, and self-control.
- All assessments were again obtained at the conclusion of the 6-month intervention.
- Participants made daily recordings of their calories expended from activity and the duration of planned exercise.
- A clinical health psychologist and a graduate student in clinical psychology administered the weekly sessions in small groups.
- Women in lifestyle change intervention met weekly for 60-75 minute sessions.
- Women in the lifestyle change plus self-control skills intervention met for 90-120 minutes.
- Participants were weighted weekly at the end of each session.
- Women who were also getting self-control skills training received a didactic instruction, individual activities, and weekly out-of-class assignments.
- Women who received self-control training also were instructed how to mediate and use progressive muscle relaxation, how to eliminate factors that contribute to fatigue and self-control depletion throughout their daily lives and they were taught coping skills for overcoming moments of low self-control etc.

#### Behaviour change techniques applied:

- Prompt intention formation.
- Prompt self-monitoring of behaviour.
- Provide opportunities for social comparison.
- Relapse prevention (relapse prevention therapy)
- Stress management.

#### Duration

- Six months lifestyle change intervention and the one-year follow-up.

#### Findings/results

The addition of self-control skills training did not significantly improve cardiovascular risk reduction.

The women significantly increased their PA, fitness, reduced their body weight, fat mass, BP, total cholesterol, (and other blood components) and improved their diet in both of the groups with no significant difference.

At the 1-year follow-up, women had regained approximately 63% of their post-treatment weight loss, however, maintained previous physical activity.

### Using self-efficacy and a transteoretical model to develop a physical activity intervention for obese women (Dallow and Anderson, 2003)

#### Trial

To assess the effectiveness of applying behaviour change theory to physical activity intervention for obese, sedentary women. One group received a theory-based intervention and the other one had standard exercise program with access to a fitness facility (usual care group).

58 sedentary, obese women, with a BMI of more than 30, primarily white, younger than 50 years (mean age 46.7 years), non-smoking and healthy.

#### Theoretical framework and the self-efficacy theory.

- Assessments of motivational readiness and use of the process of change, along with energy expenditure in physical activity, cardiorespiratory fitness level, and other physical parameters were conducted at baseline, 24-weeks, and 48-weeks.
- Subjects in both groups were given the same physical activity goal based on national recommendations: 30 minutes of moderate-intensity activity on most days of the week (operationally defined as 4 or more days of the week). This amount of activity is equivalent to 26 kcal/kg daily in moderate activity or approximately 1.5 to 2 miles of walking per day, depending on body weight. Participants were advised to gradually increase their activity level to reach this goal by the end of 24 weeks.
- The Lifestyle group were divided into two smaller groups to better facilitate discussion and to allow for easier group interaction. Each group met weekly for 16 weeks, then once every other week for the remaining eight weeks. Meetings were 90 minutes long and were facilitated by the same instructor. The curriculum focused on identifying barriers to physical activity and using each of the ten cognitive and behavioural processes of change to reduce or eliminate the barriers to physical activity based on the stages of change model. Subjects were also taught to integrate shorter, more frequent bouts of activity into their daily routine (e.g., lifestyle physical activity). To help increase self-efficacy for physical activity and facilitate the reduction of barriers, field trips in which subjects were given the opportunity to try various types of activities were also integrated into the lifestyle intervention.
- The usual care group had a restricted intervention experience. They were offered to join a health club or recreational facility. Participants were provided with an individualised exercise prescription and received a 24-week free membership to a local health club with four educational group classes on how to start

#### Interventions

- 48-week randomized controlled trial. A 24-week theory based physical activity program and follow-up at 48 weeks.

#### Findings/results

Twenty seven of the 29 participants in the treatments group had significant improvements and all but one of these changes were maintained at 48 weeks. In the control group, significant changes occurred in only two processes of change and no change occurred in self-efficacy, physical activity, or cardiorespiratory fitness at 24 or 48 weeks.

### Using self-efficacy and a transteoretical model to develop a physical activity intervention for obese women (Dallow and Anderson, 2003)

#### Trial

To examine the impact of a 6-month lifestyle change intervention on cardiovascular risk factors in obese, sedentary, postmenopausal women and to determine whether the addition of self-control skills training to an empirically supported lifestyle changer intervention would result in greater cardiovascular risk reduction.

44 obese, sedentary, postmenopausal women were assigned to receive lifestyle change intervention or lifestyle change intervention plus self-control skills training. They also had to be non-smokers, and have medical clearance from their primary physician.

Intervention was based on the LEARN Program. The LEARN Program is a comprehensive, empirically supported lifestyle change approach to weight management and physical activity and has five essential components: lifestyle, exercise, attitudes, relationships, and nutrition.

#### Theoretical framework

- Prompt self-monitoring of behaviour
- Provide feedback on performance
- Provide contingent rewards
- Agree on behavioural contract
- Provide opportunities for social comparison

#### Interventions

- Weight loss coaches encouraged participants to complete the learning modules and provided positive reinforcement of key behaviours, with an emphasis on self-monitoring of weight, calorie intake, and exercise.
- Individual sessions (in person or by telephone) were approximately 20 minutes long; group sessions conducted for the group receiving in-person support typically lasted 90 minutes. Participants in both intervention groups were offered weekly contact with coaches during the first three months (nine group sessions and three individual sessions for participants receiving in-person support, and 12 weekly calls for those receiving only remote support). During the next three months, participants receiving in-person support were offered three monthly contacts (one group session and two individual sessions), whereas the group receiving only remote support were offered one call each month. For the remainder of the study, participants in the group receiving in-person support were offered two monthly contacts (one group session and one individual session, with the latter conducted either in person or by telephone), and the group receiving only remote support continued to be offered monthly calls.
- Participants in the control group met with a weight-loss coach at the time of randomization and, if desired, after the final data-collection visit, at 24 months. They also received brochures and a list of recommended Web sites promoting weight loss.
### Supervised exercise in behavioral treatment for moderate obesity (Craighead and Blum, 1989)

To determine the most effective way to provide treatment for the moderately overweight, the population for whom short term behavioral programs seems most appropriate. A standard behavioral intervention was compared to a more intensive intervention and a minimal contact one.

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<td>42 young women (aged between 18-30), between 15 and 45 pounds overweight, and a score below 19 on the Beck Depression Inventory.</td>
<td>Behaviour programs (?) focused on strengthening the role of exercise</td>
<td>The experimental conditions provided three levels of therapeutic interventions designed to promote changes in both eating and exercise habits: Supervised exercise, Contracted Exercise, and Minimal Contact. Subjects in all three conditions received 12 identical written lessons (one each week) which described standard weight control procedures. Each week there was a specific homework assignment relevant to the lesson for that week. Self-monitoring forms were given out and the prior week's forms were returned with suggestions and feedback. The lessons included self-control techniques, environment altering strategies, cognitive restructuring and exercise information. Supervised group during the first five weeks met once a week for an hour. beginning at week five, subjects were assigned to a smaller exercise subgroup of three to five subjects. In addition to the weekly large group meeting, each small group met for about 40 minutes, three times a week for seven weeks at the university's indoor track. Two sessions were devoted to a walk-job program, while the third session consisted of calisthenics, stretching, and flexibility exercises. Contracted group was identical for the first five weeks to the supervised group. At week five each participant received a written handout describing a walk-job/calisthenic program. Each participant was free to choose any specific exercise program, and each signed an exercise contract to complete at least 90 minutes of exercise each week. Minimal-Contact group were provided with the same information as the other two conditions but not the therapist contact and group support.</td>
<td>A 12-week treatment program with a follow-up assessment scheduled one year.</td>
<td>At post-test, both conditions involving weekly meetings had lost significantly more weight than the minimal contact condition. By the one-year follow-up, subjects in the Supervised Exercise group condition maintained significantly larger weight loss than subjects in either of the other two conditions. The supervised exercise condition was also the only condition to demonstrate significant changes in fitness during the treatment period, and these changes were maintained at the follow-up.</td>
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### Computerized self-monitoring and technology-assisted feedback for weight loss with and without an enhanced behavioral component (Chambliss, et al., 2011)

To evaluate a 12-week weight management intervention involving computerized self-monitoring and technology-assisted feedback with and without an enhanced behavioral component (computerized self-monitoring with Basic feedback vs Enhanced behavioral feedback vs. wait-list control). Intervention participants used a computer software program to record dietary and physical activity information.

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<td>120 overweight (30.5 kg/m²; mean age 45.0) with computer and email access, no significant weight change in the last three months, not currently participating in any self-directed or commercial nutrition etc., and no major health problems.</td>
<td>Behavioural skills building was a cornerstone of obesity treatment and technology-assisted interventions have included behavioral strategies to varying degrees.</td>
<td>Participants in the Basic group met with a trained health educator and received and individualized report of their measured resting metabolic rate, tailored calorie plan, and obtained instructions on use of the weight management software system. In addition, Basic participants attended a one hour group seminar on weight management and received basic guidance for healthy eating and physical activity. Participants in the Enhanced group received all components of the Basic group. Enhanced group participants received additional components: 2H seminar which included behavioral weight management strategies in addition to the basic seminar information; step counters; monthly email newsletters providing information on physical activity, nutrition, behavioural skills, and weight loss; brief monthly telephone consultations with their health educator to discuss a progress. Control participants were assigned to a waiting list and agreed not to change any eating or physical activity habits for a 12-week period, after which they were offered the opportunity to participate in the basic program.</td>
<td>A 12-week program (participants measured at baseline and at 12 weeks)</td>
<td>Basic and Enhanced groups experienced significant weight reduction in comparison to the control group. A program using computerized self-monitoring, technology-assisted feedback, and monthly measurement visits produced significant weight loss after 12 weeks. The addition of an enhanced behavioral component did not improve the effectiveness of the program.</td>
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### A Controlled Trial of Physician Counselling to promote the Adoption of Physical Activity (Caffales, et al., 1996)

To test the efficacy of brief physician-based counselling to increase physical activity in sedentary patients in a non-randomized controlled trial.

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<td>255 apparently healthy, sedentary, adult patients were recruited from 17 physician offices, mean age = 39 years, 84% female, 28% races other than white, mean education of 14 years, 67% employed, and 62% married.</td>
<td>The program was based on Physician-based Assessment and Counselling for Exercise (PACE), designed to overcome several of the current barriers to physician counselling. The intervention was based on a model of health behaviour change called the ‘stages of change,’ which postulates that people make health behaviour changes in stages and that different interventions are required at each stage of change.</td>
<td>Intervention physicians delivered three to five min of structured physical activity counselling during a ‘well’ visit or follow-up for a chronic condition. A health educator made a brief booster phone call to patients two weeks after receiving physician counselling. Self-reported physical activity and stage of change (i.e., behavioural readiness to adopt or maintain activity) were collected at baseline and at four to six-week follow-up. Objective activity monitoring was conducted on a subsample.</td>
<td>One structured physical activity counselling and one phone call in two weeks and self-reports at four to six weeks follow (in total ~ nearly six weeks).</td>
<td>Intervention patients reported increased walking more than control patients (+13 min/week vs. +7 min/week). There was a significant intervention effect on the activity monitor. Intervention participants also demonstrated a greater increase in readiness to adopt activity than control subjects. Physician-based counselling for physical activity is efficacious in producing short-term increases in moderate physical activity.</td>
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An Intervention Framework for Safer Driver Behaviour: Appendix A

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| An intervention for multi-ethnic obese parents and overweight children (Berry, et al., 2007)
To determine the effects of the addition of coping skills training for obese multi-ethnic parents whose overweight children were attending a weight management program. | 80 parent-child dyads, parents having a BMI>25, mean age 41.1, 70 females and ten males for parents, and mean age 11.9 for children with 47 females and 33 males. | Coping skills training (CST) is a form of a cognitive behavioural intervention and is based on social learning theory (Bandura, 1977), which is designed to improve self-efficacy outcomes. CST includes skills training, which includes social skills training and assertiveness training, social problem solving, conflict resolution, and cognitive behaviour modification. | All children and parents received the nutrition and exercise education program (NEEP). All children received formal exercise and behaviour modification, and all parents were encouraged to exercise as detailed below. Only the parents in the experimental group received coping strategies training. | Parents in the experimental group participated in six weeks of NEEP, six weeks of coping strategies training, and 12 weeks of exercise. Parents in the control group received six weeks of NEEP, and 12 weeks of exercise. Children in the both experimental and control groups received six weeks of NEEP, six weeks of behaviour modification and NEEP, and 12 weeks of exercise. The registered dietitians taught the NEEP classes once a week. Nutrition education focused on making better food choices, ethnic menu plans, lowering fat and calories, and portion control. Exercise education focused on increasing physical activity and decreasing sedentary behaviours. Parents and children in both the experimental and control groups attended six weekly 45-minute classes together, and then children in both the experimental and control groups attended additional six weekly 45-minute NEEP classes with behaviour modification without their parents. Physiologists taught the exercise classes twice a week. Children in both the experimental and control groups attended 12 twice-a-week, 45-minute classes. Parents in the experimental and control groups were encouraged by the research assistants to walk between 30 and 60 minutes a day and keep track of their progress in their pedometer logbooks. The dietitians taught the behaviour modification classes with NEEP to the children in both the experimental and control groups without their parents once a week for 45 minutes during the last six weeks of classes. The coping strategies training classes were taught to the parents in the experimental group by an advanced practice nurse in six weekly 60-minute classes. | Data were collected at baseline and at three months (completion of the 12-week intervention) and six months on all clinical and health behaviour outcome. | At six months, parents in the experimental group had significantly lower body mass index (BMI) and body fat percentage (BFP) and higher numbers of pedometer steps compared with those in the control group. Parents in the experimental group also demonstrated significant improvement in interpersonal relationships, behaviour control, and stress management compared with those in the control group. Children in the experimental group demonstrated trends toward decreased BMI and BFP and increased pedometer steps. The data suggest CST delivered to parents adds an important component to a traditional weight management program for children. The partnership between parent and child with the parent role modelling healthy behaviour change may be effective in changing family health behaviour. |
| A 12-week Commercial Web-Based Weight-Loss Program for Overweight and Obese Adults: Randomized Controlled Trial Comparing Basic Versus Enhanced Features (Collins, et al., 2012) | 309 people (aged 18 to 60 years), BMI 25 to 40 kg/m², who were self identified as either a commercial weight loss program (n=106), and control group (n=104). The Web-based program was based on social cognitive theory and targeted key mediators of behaviour change, including self-efficacy, goal setting, and self-monitoring of weight, body measurements, exercise, and diet; outcome expectations (knowledge-enhanced Web components); modelling (interactive website features and demonstrations); and social support (forums, blogs, feedback, email, and telephone contact). | The interventions were Web based and delivered for 12 weeks Participation was in a quasi-anonymous manner. Participants were given an instruction sheet and the Web address and asked to set up their own login. | The results showed reduced BMI in both intervention groups compared with the controls, and lost significant weight but no differences were observed between the basic and enhanced groups. The addition of personalized e-feedback and contact provided limited additional benefits compared with the basic program. A commercial Web-based weight-loss program can be efficacious across a range of weight-related outcomes and lifestyle behaviours and achieve clinically important weight loss. |
| Walking towards health in a university community: A feasibility study (Gillon, et al., 2007) | 58 women (age 42 ± 10 years) and 6 men (age 40 ± 11 years). | Behaviour change techniques applied: • Prompt specific goal setting. • Prompt self-monitoring behaviour. | Pre-intervention body fat, waist circumference and systolic/diastolic blood pressure were assessed. At this point, participants were also distributed unscaled pedometers and asked to record consecutive work day step counts (walking to bedtime) for five days (Monday-to-Friday), using instructions and pro-forma. Pedometers were kept for the duration of the study. Following pre-intervention measures, participants were randomly and equally assigned, via block stratification based on random numbers tables, to one of three groups, using total steps/day as an indicator of activity level. These groups were a control (n=24), which received no intervention and continued with normal behaviour, and two treatment groups. The first of these treatment groups, termed “walking routes” (n=23), employed prescribed walks around campus, with participants asked to complete at least 15 minutes continuous brisk walking every working day. The second treatment group, termed “walking within tasks” (n=23), encouraged the accumulation of step counts through the working day. Rather than prescribed routes, the office, lectures and seminars were targeted as contexts where tasks were completed standing and walking, rather than sitting, for example “walk and talk” tutorials. | 10 working weeks A significant intervention effect was found for step count indicating a decrease in steps for the control group and increases in the “walking routes” and “walking in tasks” groups. Small non-significant changes were found in % body fat, waist circumference and blood pressure. Findings have implications for work-based physical activity promotion and the development of walking interventions within the completion of work-based tasks. |
### Weight Management

#### Using the Internet

(Hunter, et al., 2008)

To evaluate the efficacy of an Internet-based program for weight-loss and weight-gain prevention with a two-group, prospective, randomized controlled trial.

- **Participants**: 222 men; 224 women with a mean age of 34 years and a mean BMI of 29.8

#### Behaviour Internet therapy

**Behaviour change techniques applied:**
- Provide information on consequences.
- Prompt self-monitoring behaviour.
- Provide feedback on performance.
- Prompt specific goal setting.
- Plan social support or social change.
- Provide instructions.
- Prompt review of behavioural goals.
- Prompt barrier identification.

- The study used a two-group parallel randomized controlled trial design.
- Eligible individuals were scheduled for baseline assessment where they completed informed consent, questionnaires, and were measured for height, weight, waist circumference, and body composition.
- Participants were then randomized to usual care or behavioural Internet therapy (BIT) plus usual care.
- All measures were repeated at a six-month post-baseline randomization.
- The usual care group participants attended their primary care provider for an assessment of diet and weight. They were allowed to visit a fitness centre, weight loss and healthy cooking classes, available nutrition consultants, and have individual fitness assessments and recommendations. Further members are expected to work out with their unit a minimum of three times per week.
- In addition to usual care, the BIT participants attended an in-person orientation where they were given instructions about the components of BIT to include details about calculating calories and energy expenditure, how to submit electronic food and exercise diaries, when to expect weekly counselor feedback on their Internet diaries, and establishment of any weight loss and calorie goals.
- The BIT program included behavioural, dietary, and exercise recommendations designed to facilitate the loss of small-to-moderate amounts of weight and prevent future weight gain. BIT participants received weekly personalized feedback on the food, exercise, and weight information they submitted online.
- Participants were assigned weekly lessons on the website that included common strategies associated with behavioural weight loss such as stimulus control, behaviour modification, and stress management.
- The lessons took approximately 20–30 minutes a week for the participants to complete.
- Each participant was assigned one Internet counselor for the duration of the intervention and these counselors spent 10–15 minutes per participant each week providing written feedback in response to submitted self-monitoring diaries.
- Participants were also scheduled for two brief motivational interviewing telephone calls scheduled at four and eight weeks post-baseline.

### The Relative Efficacy of Directive and Non directive Treatment in Behavioural Weight Control 

(James and May Hampton, 1982)

To examine the efficacy of a behavioural weight reduction regimen under conditions which systematically varied the level of task direction given by a therapist among four groups of women with no contact with a therapist, or treatment which was minimally, partially, or highly directive.

- **Participants**: 80 women (mean age 37.7) who were at least 10kg overweight, not suffering from an obesity-related ailment such as diabetes, a thyroid condition, ulcers, or colitis, not on any medication that may affect weight

#### Behavioural therapy

**Behaviour change techniques applied:**
- Provide instruction.
- Prompt self-monitoring of behaviour.
- Provide opportunities for social comparison.
- Stress management

- The least directive of the four conditions was the no-contact (NC) group. NC subjects attended two assessment sessions spaced six weeks apart and received no intervening therapist contact. NC subjects received no instruction on how to implement weight loss, and as such provided a control against which to compare the performance of the other three groups.
- Subjects in the minimally-directive (MD) condition also attended two assessment sessions with no therapist contact during the intervening 6-week period. In addition, subjects received information on weight-reduction procedures which they were advised to implement on their own during the 6-week period between sessions. At the first session, the MD group was provided with a nutrition and exercise manual, a weight-loss graph, and daily record charts. The daily record charts were offered to the subjects with the instruction that they should self-monitor eating behaviour, exercise and calories consumed and expended.
- In the two remaining groups, subjects were also arranged into pairs of buddies, received identical instructions and materials as those given to MD subjects, and in addition attended six 90-min group meetings scheduled at weekly intervals. The weekly meetings were designed to allow more directive treatment than that received by MD subjects. The degree of therapist-mediated task direction was organized on two levels, "partial" and "high."
- For partially directed (PD) subjects, the first 30 minutes of each meeting was occupied by the assessment of weight, skinfold, and physical fitness, while the remaining 60 minutes was devoted to lectures and discussion. The lecture component was designed to elaborate and extend the material contained in the diet and exercise manual. During each session, specific behavioural techniques were described and subjects were advised that the suggested techniques would help them achieve weight losses equal to or better than those indicated by the weight-loss graph. The sequence and content of the lectures were (1) self-monitoring and nutrition, (2) exercise, (3) stimulus control, (4) alternative eating behaviours, (5) preplanning, social support, and self-control, (6) relaxation and review. Discussions centred on specific problems encountered by participants in their attempt to apply the suggested procedures. PD subjects were also provided with the self-monitoring charts given to MD subjects, and they received the same instruction to self-monitor calorie intake and expenditure by recording daily eating and exercise behaviour. However, PD subjects were given the additional directive that they were to present their records of calorie consumption at the weekly meetings. This task was compulsory in that...
### Efficacy of a Weight-Loss Website Based on Positive Deviance (Kraschnewski et al., 2010)

To evaluate the efficacy of Achieve Together, a web-based weight-loss intervention for adults based on user-generated weight-loss strategies from successful weight losers.

100 overweight or obese adults aged 21-65, BMI between 27-40. Most participants were women (68.7%) and white (90.8%), with a mean age of 50.3 years and baseline BMI of 33.2.

### Positive deviance framework (Stuckey et al, 2010)

#### Behaviour change techniques applied:
- Provide information on consequences.
- Prompt self-monitoring of behaviour.
- Provide feedback on performance.
- Plan social support or social change.
- Prompt specific goal setting.
- Provide instruction.
- Prompt review of behavioural goals.
- Prompts barrier identification.

### Interventions

- **Theoretical framework**
  - Continuance in the program was conditional on completed self-monitoring sheets being submitted at the meetings.
  - The highly directive (HD) treatment extended the PD procedures to include additional prescribed self-monitoring tasks and specific homework assignments to be completed between sessions. Specifically, while PD subjects were required to self-monitor caloric consumption as a condition of treatment, HD subjects were also required to self-monitor calories expended during exercise. HD subjects were requested to select two techniques for particular attention from among those presented each week (e.g., replacing coffee breaks with exercise breaks, using a specific set of eating utensils including a smaller cup and plate, eating only at specified times, preparing lunch soon after breakfast and dinner soon after lunch). Subjects were required to report their daily implementation of the selected procedures, and the overall task was cumulative in that two new procedures were added each week to those already being reported. In addition to the above, PD and HD subjects were required to deposit $30 which was refunded contingent on attendance at the scheduled meetings and completion of their respective self-monitoring tasks. On completion of the six-week treatment program $25 was refunded, while the remaining $5 was returned at the 3-month follow-up session contingent on attendance at the preceding 4-week follow-up.

- **Duration**
  - 12 weeks

- **Findings/results**
  - Mean weight loss among intervention participants was 1.4kg, compared with a mean weight gain of 0.6kg in control participants. User-generated weight-loss practices from “positive deviants” could promote weight control in web-based interventions; however, further research is needed to improve program efficacy

### Are tailored health education materials always more effective than non-tailored materials? (Freter et al., 2000)

To evaluate the effect of tailored health education materials in comparison with non-tailored materials in overweight adults measuring their cognitive, affective and behavioural responses.

198 overweight adults older than 18 and willing to lose weight.

### Behaviour change techniques applied:
- Provide information about behaviour health link.
- Prompt intention formation.
- Prompt barrier identification.
- Plan social support or social change.

### Interventions

- **Theoretical framework**
  - Participants completed a brief weight loss survey by telephone during their enrolment interview and made an appointment to complete the on-site portion of the study. Each was then randomly assigned to receive either tailored or non-tailored weight loss materials. On site, participants’ eligibility was confirmed and, according to study group assignment, each was given printed weight loss materials that were either tailored or non-tailored. After reading the materials, participants completed a questionnaire rating the materials on 14 criteria indicative of effective communication, information processing, persuasion and behaviour change, and also completed a thought listing task.
  - The tailored weight loss materials generated in this study were based entirely upon participants’ answers to questions about beliefs, motives, barriers, triggers, self-efficacy, diet, physical activity, goal-setting, food shopping and preparation, preferred media, and learning style, plus their BMI and gender. Each of these questions included multiple response options, thus messages were created for all possible answers. In all, there were 99 total messages in the tailored message library. Each set of tailored materials included only 14 of these messages, although more than 2.4 billion different combinations of messages were possible. All materials were fully tailored; no part of their content was generic.
  - Non-tailored materials consisted of either a pre-printed American Heart Association (AHA) booklet on weight loss or the exact content from that booklet presented in a format similar to that of the tailored materials (i.e. not a pre-printed booklet). For the purpose of this study, the two non-tailored groups are combined into one and all statistical analyses include a covariate controlling for this variation in formatting.

To determine how well or poorly the non-tailored materials addressed the weight loss needs of each individual participant, we created a ‘goodness-of-fit’ variable. We reviewed the content of the non-tailored materials and identified distinct topic areas that were addressed (e.g. developing an eating plan, realistic weight loss, the role of physical activity).

### Findings/results

- One month (one measurement at baseline and at one month follow-up)

The study showed that good-fitting non-tailored materials can perform as well or better than tailored materials for a variety of cognitive, affective and behavioural outcomes. At the same time, moderate- and poor-fitting non-tailored materials were usually inferior to both approaches. One overarching conclusion is that customization is important for materials to be effective.
### Controlled Outcome Evaluation of the First Step Program: A daily physical activity intervention for individuals with type II diabetes.

(Tudor-Locke, et al., 2000)

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<td>Controlled Outcome Evaluation of the First Step Program: A daily physical activity intervention for individuals with type II diabetes.</td>
<td>To conduct a randomised trial of a physical activity (PA) intervention, The First Step Program (FSP) for adults with type II diabetes.</td>
<td>A total of 47 overweight/obese, sedentary individual (55% male; 45% females; age=52.7; BMI=33.3) recruited through a diabetes education centre.</td>
<td>The intervention was based on the First Step Program (FSP), developed and evaluated systematically and in collaboration with diabetes educators and adults with type II diabetes. The FSP is a facilitated, behaviour modification program based on the theoretical principles of self-efficacy and social support, the common clinical practices of goal-setting, self-monitoring and feedback, as well as the simple premise that walking can be gradually increased throughout the day at work and home and during leisure. The FSP uses a pedometer as a motivational and monitoring tool. In the FSP, pedometers are used to establish baseline level of PA, show participants how many steps they normally take in a given amount of time and facilitate personal goal-setting, self-monitoring and feedback.</td>
<td><strong>Interventions</strong>&lt;br&gt;• Those individuals who agreed to participate were randomly assigned to either the FSP group or the waitlist control group (CONTROL).&lt;br&gt;• The 16-week FSP was delivered by PA experts. During the first four weeks, participants were asked to attend four weekly group meetings.&lt;br&gt;• They were given pedometers and the program manual containing goal-setting and problem-solving exercises, as well as calendars for self-monitoring steps/day. No specific advice was given concerning diet or glycomic control.&lt;br&gt;• During the 12 weeks, participants were asked to use their pedometers and calendars for goal-setting and self-monitoring. Postcards were mailed at six and at ten weeks thanking people for participating in the FSP.&lt;br&gt;• Simultaneously, the CONTROL group received postcards thanking them for their participation in the study.&lt;br&gt;• Pedometers and calendars were returned at the 16-week assessment.&lt;br&gt;Calendars were examined to verify pedometer use, the number of days/week personal goals were achieved (for each of the first 4 weeks), and to calculate the mean steps/day.</td>
<td>A 16-week intervention study and 24-week follow-up assessment.</td>
<td>Relative to the CONTROL group, FSP participants increased their PA &gt;3000 steps/day during the intervention. Waist and hip girth decreased, but did not differ significantly between groups. Significant changes did not emerge for any of the other variables. The FSP is a practical intervention that elicits an immediate and profound change in walking behaviour. Such change is an important ‘first step’ towards increasing the volume and/or intensity of PA necessary to improve long-term health outcomes in this largely sedentary and overweight or obese population. Relapse by 24 weeks indicated that other strategies such as booster sessions are needed to maintain lifestyle change.</td>
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#### Behavioural Choice Treatment Promotes Continuing Weight Loss: Preliminary Results of a Cognitive-Behavioural Decision-Based Treatment for Obesity

(Sbrocco, et al., 1999)

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<td>Behavioural Choice Treatment Promotes Continuing Weight Loss: Preliminary Results of a Cognitive-Behavioural Decision-Based Treatment for Obesity</td>
<td>To test the effect of a cognitive-behavioural decision-based treatment on weight loss.</td>
<td>The participants were 24 obese non-smokers women in good health, had not lost more than ten lbs in the past month or 20lbs in the past six months, and had a physician’s approval for participation.</td>
<td>A decision-making model of women’s food choice, with a traditional behavioural weight-management program that incorporated moderate calorie restriction to promote weight loss. This decision-making model of women’s eating behaviour relates situation-specific eating behaviour to outcomes and goals using decision theory. The outcomes and goals governing food choice extended beyond food-related factors (e.g., hunger) to include self-esteem and social acceptance.</td>
<td><strong>Interventions</strong>&lt;br&gt;• Women were randomly assigned to one of two group treatments: behavioural choice treatment (BCT) or traditional behavioural treatment (TBT).&lt;br&gt;• An orientation was held to introduce the program. Women were told that they would be randomly assigned to one of two programs, a traditional behavioural weight-loss program or a new weight-management program. At orientation, participants received an hour of instruction in the use of the Psion palmtop computers and began two weeks of self-monitoring. Contingent on completion of the self-monitoring, participants within each cohort were then randomly assigned either to BCT (n=12) or to TBT (n=12) and attended 13 weekly 1.5-hr group treatment sessions, with five to seven members per group.&lt;br&gt;• Treatment was conducted by a clinical psychologist or a clinical social worker (also a psychology graduate student), who had extensive experience in the behaviour treatment of obesity, and two inexperienced psychology graduate student coleades.&lt;br&gt;• Group leaders were crossed by treatment type over the two cohorts.&lt;br&gt;• Follow-up group meetings were conducted at three and six months posttreatment. Follow-up weights were obtained at three, six and twelve-months posttreatment.&lt;br&gt;• All participants received two-week meal plans and recipe booklets that differed only in the amount of food. Both plans were low fat, with macronutrient composition as follows: 60% carbohydrate, 25% fat, and 15% protein. TBT participants were prescribed a 1,200 kcal/day diet. BCT participants were</td>
<td>15 weeks and 12 months follow-up.</td>
<td>The TBT group evidenced greater weight loss at posttreatment. However, the TBT group also evidenced a trend to regain weight, whereas the BCT group continued a slow weight loss during follow-up. Exercise followed a similar pattern. Both groups decreased in restraint and increased in self-esteem.</td>
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Evaluation of a Healthy-Lifestyle Approach to Weight Management (Riebe, et al., 2003)\textsuperscript{10} To investigate intervention strategies designed to help individuals manage their weight by improving diet and exercise behaviours

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<td>144 overweight and obese adults (BMI = 32.5 ± 3.8)</td>
<td>Behavioural changes based on the Transtheoretical Model</td>
<td>Weight Management Intervention Program: The six-month clinical program was provided to groups of 11–15 participants. The program began with an intensive, three-month phase during which participants attended two 2-hour sessions each week. Each session involved one hour of behavioural or dietary instruction and one hour of exercise. Following the intensive phase, participants attended a three-month tapering phase during which the amount and frequency of clinical contact decreased. During this phase, participants met for one hour once per week for four weeks and then every other week for the following eight weeks, for a total of eight visits over three months. Exercise treatment involved biweekly supervised sessions. Subjects were instructed to exercise an additional two times per week outside the program. Weekly activity logs were submitted to ensure compliance. Supervised exercise sessions were conducted at 60–70% of measured maximum heart rate and the intensity was verified by trained exercise leaders using heart rate palpation. The duration of exercise was 15 minutes during week one and 20 minutes during weeks two and three. Thereafter, the duration increased five minutes every two weeks until subjects were able to maintain 45 min of continuous exercise. During the initial weeks of the program, the time that was not spent exercising was used to present relevant information about exercise, including heart rate measurement, rating of perceived exertion, exercise options, and selecting proper footwear. Individual results from treadmill testing, body composition analyses, and blood analyses were also presented with a detailed explanation. The dietary intervention focused on modifying eating behaviours for life-long health promotion. Traditional dieting, short-term caloric restriction for weight loss, was discouraged. Participants were encouraged to set daily fat gram goals at 20, 25, or 30% of calories, monitor fat intake, to increase their consumption of fruits, vegetables, and whole grains, and to follow the principles of balance, variety, and moderation. Participants were asked to submit food records four days per week with a goal of meeting their fat gram target three days of four during the first three months of the program. Overall, they submitted 78% of their food records. Overall, the behavioural component used motivational and behavioural principles to modify eating patterns, initiate and/or continue moderate exercise, and to increase the activities of daily living.</td>
<td>Six months</td>
<td>Participants experienced significant decreases in weight, percentage body fat, BMI, total cholesterol, LDL-C, total caloric intake, and the percentage of energy intake from dietary fat at three months. Changes were maintained at six months, with weight, total cholesterol, and LDL-C demonstrating further improvement. A clinic-based weight management program that focuses on lifestyle is successful at promoting changes in exercise and dietary behaviours. These changes appear to promote good health, as evidenced by moderate weight loss, increased cardiovascular fitness, and improved lipid profiles.</td>
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Long-term maintenance of exercise and healthy eating behaviours in overweight adults (Riebe, et al., 2005)\textsuperscript{10} To describe the long-term efficacy of a Transtheoretical Model of Health Behaviour (TTM) Change-based healthy weight management program and determine if additional feedback on TTM variables improves maintenance of diet and exercise behaviours, and to determine if TTM mediator variables differentiated between successful maintainers of the behaviours and those either failing to change or changing but relapsing.

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<th>Findings/results</th>
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<td>144 overweight and obese with a BMI between 27 and 40 kg/m\textsuperscript{2}</td>
<td>Transtheoretical Model of Health Behaviour Change (TTM)</td>
<td>Subjects were assessed at baseline, after the intensive portion of the clinical program (three months), after completion of the clinical program (6 months), and during follow-up (12 and 24 months). All participants completed a 6-month clinical weight management program. The multidisciplinary program, delivered to groups of 11–15 participants, focused on changing lifestyle rather than weight loss per se. The program began with an intensive three-month phase during which subjects attended two 2-hour sessions each week. Each session involved 1.5 hours of behavioural or dietary instruction and 1 hour of exercise. Following the intensive phase, participants attended a tapering phase where subjects met for a total of eight visits over three months. Program highlighted three key components: exercise, nutrition education, and behavioural counselling. Duration of the sessions gradually increased from 15 to 45 minutes during the first 12 weeks of the program. Subjects were instructed to exercise at least two additional days per week outside of the program. The behavioural component of the intervention was based on the principles and processes of the TTM. Motivational and behavioural principles to modify eating patterns, initiate, and/or continue moderate exercise and to increase the activities of daily living were introduced. During the clinical program, subjects received three computer-generated individualized expert system reports on TTM mediator variables at baseline, three, and six months. The first two reports were distributed in the groups, and reports were discussed as part of the group process; the third report was delivered via mail. Subjects also received reports about anthropometric, biochemical, and dietary variables at baseline, three, and six months. Participants were encouraged to attend all sessions and were contacted by phone if they failed to attend a session without notifying the clinical staff. Prior to participation in the clinical program, subjects were randomly assigned into one of two extended care intervention groups. Both groups attended the same 6-month clinical program and received identical reports about anthropometric, biochemical, and dietary variables at 12 and 24 months. The extended care treatment group received two additional computer-generated, individualized TTM reports, via mail, at nine and 12 months. The extended care comparison group received generic, action-oriented information about diet and exercise at the same two-time points. There was no additional contact with subjects during the 18-month follow-up period.</td>
<td>24 months</td>
<td>At 24 months, subjects maintained decreases in weight, % body fat, caloric intake, % kcal saturated fat, and increases in weekly exercise minutes. Individuals who maintained regular exercise at 24 months had higher confidence scores and higher use of experiential and behavioural processes. Individuals who maintained a healthy diet at 24 months had lower temptation scores and higher use of experiential and behavioural processes. A healthy lifestyle weight management program is successful at promoting long-term changes in exercise and dietary behaviours. Individuals who actively engage in the maintenance process are more likely to succeed.</td>
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### Trial

- **Effectiveness of Physician-Based Assessment and Counselling for Exercise in a Staff Model HMO (Norris, et al., 2000)**

  - **Target:** To assess the effectiveness of Physician-Based Assessment and Counselling for Exercise (PACE), a brief, behaviour-based tool for primary care providers counselling healthy adults.
  - **Participants:** 812 patients aged 30 years or older registered for well visits at 32 primary care physician offices at a staff model health maintenance organization.

- **Increased physical activity in abdominally obese women through support for changed commuting habits: a randomized clinical trial (Hemmingson, et al., 2009)**

  - **Target:** To compare two different support programmes for increased physical activity through changed commuting habits among abdominally obese women.
  - **Participants:** 120 Physically active commuting (cycling and walking) middle-aged (30-60 years), abdominally obese women.

### Theoretical framework

- **Physician-based assessment and counselling for exercise (PACE):**
  - **Behaviour change techniques applied:**
    - Provide information on consequences.
    - Prompt intention formation.
    - Prompt barrier identification.
    - Provide general encouragement.
    - Provide instruction.
    - Prompt specific goal setting.
    - Agree on behavioural contract.
    - Use follow-up prompts.
    - Plan social support or social change.
    - Relapse prevention (relapse prevention therapy)

### Interventions

- **Thirty-four providers from three geographically separate primary care clinics were recruited to in the study.**
- **Providers were randomized into the intervention group and control group.**
- **The intervention group was then randomized into a regular intervention group and an enhanced intervention group.**
- **PACE physical activity counselling protocols are on the theory that people make behavioural changes in progressive stages and that they have different counselling needs at each stage.**
- **Although the stages of change model was originally developed for an addictive behaviour of smoking, it is applicable to physical activity.**
- **PACE protocols also incorporate the behavioural counselling methods of goal-setting, identifying barriers, problem-solving, and contracting.**
- **On arrival to the clinic, patients completed a form to determine their PACE score (Pre-contemplator, contemplator or active).**
- **The intervention group received after physical activity information according to their stage which contained tips on how to deal with the barriers, recommendations etc.**
- **The physician then counselled these patients with PACE protocol**
- **In four weeks after the index visit, the patients were called to reinforce the initial protocol.**
- **The enhanced intervention group received an augmented follow-up protocol (enhanced PACE)**
- **The control group just received usual care.**
- **One-third of the intervention patients were randomly selected from each practice to receive booster telephone calls at two, three and four months and postcard reminders at 2, 3, 4, and 5 months.**

### Duration

- **6 months**

### Findings/results

- **At the 6-month follow-up, the control group did not differ significantly from the intervention group for energy expended, time spent in walking or other moderate to vigorous activities, mental health, physical function, or behaviours. Among the intervention patients, the stages of change score for Contemplators increased significantly compared with controls, but without a significant change in energy expended. Baseline levels of physical activity counselling were high (50%), as were baseline patient physical activity levels (61% exercised at least three times a week).**
- **These results suggest that a one-time PACE counselling session with minimal reinforcement, in a setting with high baseline levels of activity, does not further increase activity. The finding that Contemplators advanced in stage of behaviour change suggests that further studies are needed to examine long-term, repeated counselling interventions.**

### Effects of exercise-focused versus weight-focused maintenance programs on the management of obesity (Leermakers, et al., 1999)

- **To determine whether the exercise-focused program would produce greater maintenance of physical activity and weight loss than the weight-focused program.**
- **Participants:** 69 adults who completed 6-month behavioural group weight-loss program.

### Extended therapy programme

- **Behaviour change techniques applied:**
  - Provide information.
  - Prompt self-monitoring of behaviour.
  - Provide contingent rewards.
  - Prompt practice.
  - Use follow-up prompts.
  - Provide opportunities for social comparison.
  - Relapse prevention (relapse prevention therapy)

### Intervention group

- **Participants were assigned randomly by group to either an exercise-focused maintenance program (n=38) or a weight-focused maintenance program (n=29).**
- **Both extended therapy programmes included 12 biweekly group sessions conducted during the 6 months following initial treatment (i.e., Months 7–12).**
- **Participants were expected to complete written daily diaries of food intake and physical activity during the extended therapy period.**
- **An individual contingency contract provided for each participant to receive $1 for session attendance and a second dollar for completion of written self-monitoring.**
- **Participants in both conditions were instructed to maintain a caloric intake of 1,200 kcal/day for women and 1,500 kcal/day for men and to limit their intake of fats to less than 30% of total energy intake.**
- **All participants were instructed to walk 30 minutes per day, five days per week.**
- **Participants in the exercise-focused condition received a multifaceted intervention designed to sustain the maintenance of physical activity.**

### Six months of treatment and six months of maintenance programme

- **The control group received usual care.**
- **In four weeks after the index visit, the patients were called to reinforce the initial protocol.**
- **The enhanced intervention group received an augmented follow-up protocol (enhanced PACE)**
- **The control group just received usual care.**
- **One-third of the intervention patients were randomly selected from each practice to receive booster telephone calls at two, three and four months and postcard reminders at 2, 3, 4, and 5 months.**

### Increased physical activity in abdominally obese women through support for changed commuting habits: a randomized clinical trial

- **Participants:** 812 patients aged 30 years or older registered for well visits at 32 primary care physician offices at a staff model health maintenance organization.

### Behaviour change theory

- **Transtheoretical model, specifically focused on three processes of change:**
  - Raising awareness (3)
  - Countering (3)
  - Helping relationships

### Behaviour change techniques applied:

- **Provide information about behaviour health link.**
- **Prompt intention formation.**
- **Provide instruction.**
- **Prompt self-monitoring of behaviour.**

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Pell Frischman
Interventions

- The instructions aimed to achieve a balance between meaningful behaviour change and increased risk of relapse and injuries. The women were encouraged to work out on their own physical activity plan, and eventually become self-sufficient walkers. No specific time management skills were taught.

- **Intervention group (added care)** consisted of all aspects of standard care combined with a more intensive behavioural counselling package:
  1. Three individual 30 min sessions with a physician experienced in behaviour change theory and practice at baseline, six and 12 months, including detailed physical activity prescriptions. The prescriptions focused on increased cycling and walking, mainly between work and home. The physician meetings aimed at changing PA behaviour. For example, enhancing motivation for physically active commuting, especially bicycling, routine building, overcoming barriers, strengthening self-efficacy, relapse prevention and preventing injuries.
  2. Two added two hour group counselling sessions during the cycling season (at months two and 14).
  3. A new ladies model bicycle complete with seven gears, basket, trip meter, foot brake and helmet with free of charge bicycle service.

Findings/results

16-week treatment period and a 16-mo follow-up

Participants in the behaviour modification condition lost significantly more weight during the initial 4 months of treatment than did patients in either the nutrition education or the standard-care conditions. However, weight losses of the behaviour modification condition were poorly maintained, so that at the end of the 16-month study, there were no differences in the weight losses of behavioural and non-behavioural conditions. The behaviour modification program used in the present study was effective in producing initial weight losses but did not lead to successful maintenance of treatment effects. Further efforts are clearly needed to develop a behavioural treatment program for patients with diabetes that will help patients achieve long-term weight loss and hopefully will result in long-term improvements in metabolic control.

Duration

- bicycling commuting habits. Active commuting by bicycle does not, therefore, appear to occur at the expense of walking in women. In contrast, commuting by car and public transport decreased in both groups as commuting by bicycle and walking increased.

Abdominally obese women can increase PA long-term through moderate-intensity behavioural support aimed at changing commuting habits.

Behaviour change, weight loss, and physiological improvements in Type II diabetic patients (Wing, et al., 1985)²⁶

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|       | To determine whether behaviour modification would improve short- and long-term weight losses in patients with diabetes and to assess the behaviour changes that mediate long-term maintenance of weight loss. In addition, the study analysed the relation between weight loss and physiological improvements in patients with Type II diabetes to determine whether weight loss is associated with short- and long-term improvements in metabolic control. | 53 obese patients (20 males and 30 females) 30-70 years old with Type 2 diabetes treated by diet only or oral medication | Behaviour modification program

**Behaviour change techniques applied:**
- Provide information about behaviour health link.
- Set graded tasks.
- Provide instruction.
- Provide feedback on performance.
- Prompt practice.
- Use follow-up prompts.
- Provide opportunities for social comparison
- Plan social support or social change.

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Subjects were randomly assigned to either the behaviour modification, nutrition education, or standard-care condition. All three conditions met in a small group format, with each meeting consisting of an individual weigh-in and a lecture-discussion on a topic related to the role of diet and exercise in improving diabetic control. Patients in all conditions were given a calorie goal per day. The frequency of contact and the strategies used to improve adherence to the diets differed in the three treatment conditions.

- Each of the three treatment conditions was offered at two alternate times, once during a lunch hour and once during an evening. Patients were free to choose whether to come in the daytime or the evening, and some alternated between the two times. Approximately 40% of patients attended daytime sessions.
- Patients assigned to the behaviour modification condition participated in a weight control program similar to that which is traditionally used for nondiabetic patients. Patients were seen weekly for 16 weeks. The behaviour modification condition included information on nutrition, exercise, and diabetes, and a variety of behavioural strategies to help patients change their behaviour:
  1. A calorie book and self-monitoring diaries were distributed. Patients were asked to record the calorie content of all food and drink they consumed.
  2. Walking was stressed as a form of exercise. Patients were given gradually increasing goals for caloric expenditure from exercise, with a final goal of 1,000 calories per week. Each meeting included a period of group exercise to model appropriate exercises and to provide social support for exercise.
  3. Patients in the behaviour modification condition were refunded $3 per lb (0.45kg) of weight loss until reaching a maximum of 20lb (8.1kg) ($60). Patients had the full 16-week period to earn back their $60 but could not be refunded more than $6 per meeting. This latter stipulation was included to prevent crash dieting. The remaining $25 was refunded for attendance at the 10- and 16-month blood-work sessions.
  4. Clients were instructed to remove the stimuli from the environment that were associated with eating and to change the act of eating by slowing down their meals.
  5. Patients were taught to modify their self-statements regarding food, dieting, and diabetes. Cue cards were made of appropriate self-statements, and patients were encouraged to review these cards daily. Role-playing techniques were used to allow patients to practice countering negative self-statements with more positive thoughts.

- The nutrition education condition met weekly for 16 weeks. Their program provided basic information on diabetes, nutrition, and exercise but included none of the behavioural techniques to improve compliance.
  1. The nutrition education condition was given a calorie goal at a level comparable to that used in the behaviour modification condition. Patients were asked to follow the Exchange List Eating Plan closest to that calorie goal. All patients were given a pocket-sized handout of the Exchange List but were not asked to monitor their intake.
  2. Basic information about the Exchange List and the principles behind its use were presented. In addition, a nutrition topic, such as sugar, fibre, cholesterol, or meatless meals was discussed at each weekly meeting. These topics were presented as general information, but specific dietary goals were not set.
  3. Information about the importance of exercise and the calorie cost of various exercises was presented, but patients were not given specific goals for exercise, and group exercises were not conducted.
Key Health Psychology Review References

APPENDIX B – SUMMARY TRANSCRIPTS

Below are summary transcripts from one-to-one interviews with road safety experts from sixteen organisations.

Road Safety GB Interview

**Which of these behaviours could you see your expertise adding value for Highways England?**

Distraction and inappropriate speed

**List effective interventions for inappropriate speed and close following.**

Our safety camera programme is the only one with an independent evidence base. Providing enforcement is the single biggest educational engine. The bulk of our driver education programmes are delivered via camera enforcement activity.

Distractions – police referral course which are provided in the locality.

Learn to live event – stage event that is high on emotion and probably low on effect. We do follow up with classroom advisors. There is a heavy emphasis on distraction in this course, but more from peer group influence. The second element of this module is to help people who may be passengers to develop the social skills that they need in order to intervene within the vehicle. We use a cascade model, in that we run a mass audience event with hundreds of students, this cascades down to the classroom level with Question Time and then we drill down to the individual driver with the Honest Truth.

**Effectiveness of the interventions regarding KSIs?**

The safety camera programme has an evidence base.

The effectiveness of the driver education programmes is currently unknown. There is nothing locally or nationally to say the SAC courses are definitely effective.

The effectiveness of the police referral course (distraction) is also unknown.

Learning to Live Question Time has not been evaluated yet, but there was a Learning to Live evaluation (not Question Time) published about two years ago (self-report).

**Practical limitations affecting work?**

No control group for evaluation of Learning to Live.

There is a limit to the number of interventions we can do and the smaller the group the higher the cost (thus less interaction).

Practical limitations of using telematics

**Have you linked up with Highways England to co-ordinate work?**

We don’t work very much with Highways England currently. We are a known operator, but there is a long way to go to make the two organisations work relatively seamlessly. Much more work is needed to create tighter collaboration with RSGB and Highways England.

**How could the work together with Highways England on their ambitious goals?**

Need to work on a transition point from non-SRN into SRN, a quarter of a mile (or something) transit area.
What does compliance mean? There is no understanding from the public of what good behaviour looks like.

We are pulling together a meeting of collision investigators to find out whether there is commonality in methodology, resources, interpretation and use of data. This is important. Highways England could take the lead in setting a set of minimum standards for collision investigation and the following process.

**Would you be interested in working with Highways England?**

Very keen.

**Innovative Interventions**

If the telematics companies released travel data we could track movement and behaviour in 20mph zones and we could inform people before they leave the house about the types of routes they are likely to follow.

Telematics should translate well onto the Highways England network. There is a relationship between the presence of telematics and collision vulnerability. The options are large – including communicating with the driver (not while moving).

**Any quick wins for Highways England?**

They need to re-think the marketing programmes. The inclement weather advert was beautiful, but did it strike the right tone in asking people to make positive changes for positive reasons?

**Surrey and Greater Manchester Fire and Rescue Service**

Which of these behaviours could you see your expertise adding value for Highways England?

**Distractions.**

We have two driving simulators housed in the back of a VW and the simulator has a distraction module. They can demonstrate for themselves the dangers of driving distracted (there is a keypad and they are asked questions). They can see themselves sway and go onto the footpath.

**Effectiveness of the interventions regarding KSIs?**

They have reports which detail what they have done with the simulator (not KSIs).

There are several self-report studies about safe Drive Stay Alive (SDSA), including a recent (before, 3 month and 12 month) assessment with a control group. There were some statistically significant results. The extended resource pack for SDSA has not been evaluated yet. Also, there is nothing about the longer-term impact on behaviour or crash involvement.

**Practical limitations affecting work?**

The simulator is quite resource intensive, as there must be two trained staff members present at all times. Capacity-wise, we are not reaching as many people with SDSA. We have introduced more behaviour change techniques.

Funding and continuity of funding are needed to provide us with some certainty and the ability to plan ahead. Currently we rely on the good will of the fire and ambulance services.

There needs to be training for the support staff at schools to deliver the resource package, as currently no quality control.
Have you linked up with Highways England to co-ordinate work?

Not really. We do not know who to contact, whether it be the regional person or the national Highways England person.

Innovative Interventions

We have had several modules developed (by Fiona Fylan) which follow on from SDSA and deal with things like how to handle peer pressure, impulsivity, mobile phones and drugs and alcohol. There are a series of group activities and discussion to try and extend their learning.

Any quick wins for Highways England?

Greater police visibility on the roads is needed. There are no police pulling people over and the Highways England traffic police do not have the power.

Support the existing programmes that have some evidence behind them (SDSA).

ROAD POLICING

Which of these behaviours could you see your expertise adding value for Highways England?

Distraction, seatbelts, drug/drink driving, and inappropriate speed.

List Effective Interventions for these behaviours.

Speeding - Enforcement and fear of enforcement changes attitudes and behaviours (speed cameras and speed operations).

Distractions – Operation Tramline. We are getting evidence of distracted drivers as we drive past from an elevated position and can video and enforce this effectively.

Intelligence Forum every two months, where we bring together partners (e.g. heavy goods vehicles and the freight industry).

A new motorway course has been developed, as people are ignoring signs and signals. Also, not believing the signs, so we need to focus on communications to make them more believable and timely.

Seatbelts – enforcement during Road Safety Week.

Drug driving - Government has changed the law on drug driving and in the first 12 months we had a 5 fold increase in the number of convictions.

Driving while fatigued – technology is the answer. We also have Operation Velopy (Central Motorway Police Group) where we speak to hundreds of motorists and particularly caravan drivers at service stations, to stress the importance of having a break.

Operation Stammtisch – for HGV drivers. Drivers can come across and have a chat with the police while having a break and a free coffee.

CLEAR (Collision, Leadership, Enforcement, Action and Resource) needs to be resurrected.

Practical limitations affecting work?

34% reduction in police since 2010 and thus Stammtisch has gone.

Who pays for the coffee? Who crunches the data? Who pays for the leaflets?

Have you linked up with Highways England to co-ordinate work?
We have a really good relationship with Highways England, but they will never reach their targets alone. They have paid for us to have cabinets with stingers (road spikes) that officers can go to and take the device out. However, we definitely could do more with Highways England.

**How could you work together with Highways England?**

They could help with funding.

There are lots of good pockets of work, but nothing that ties it all together, no central coordination. We could share best practice and make sure every penny is spent properly.

**What are the risks?**

Smart motorways have taken the hard shoulder that has traditionally been used for road policing, which presents some challenges. We need better communication between ourselves and Highways England. Perhaps even a shared control room, as in West Mids. Also, how do we get boots on the ground to the collisions?

**Innovative Interventions**

2 + 1 roads in Sweden and Australia, which have wire barriers. I think there was an 85% reduction in KSIs in Sweden.

Ride Scheme – for motor bikes. Highways England purchased 10 bikes to support police forces educating and re-educating riders.

Partnership Hub – personnel coming together to share knowledge, of which Highways England is a part.

**Quick wins for Highways England?**

Tackling the most dangerous roads would be a quick win. Highways England brings funding to tackle these top 50 roads. Highways England could fund ANPR cameras or police vehicles so we could enforce the law. There is no Highways England police liaison.

**Institute of Advanced Motorists**

**List Effective Interventions**

Training courses and new modules.

Publicity – supporting our own campaigns or those of Highways England or Think!

Supporting MCIA document – are our roads motorcycle friendly, are the barriers, no slippery surfaces, etc.

A lot of details about how their training works and that they have included some BCTs in their training and trying to get drivers with less time to also take part in some of the training (different price points and times).

**Effectiveness of the interventions regarding KSIs?**

Do happy sheets after courses and look at metrics from our PR campaigns.

If we were working with Highways England we’d expect to evaluate the impact down the line.

Have done evaluation of IAM car drivers with non-IAM (1000 of each) and compared them on self-reported incidences and attitudes. This report is imminent.
An Intervention Framework for Safer Driver Behaviour: Appendix B

Also have 5 year claims history for IAM vs. non-IAM trained, which is ok up to 5 years and then the difference is lost. Need a refresher.

No proper evaluation, at this point.

Practical limitations affecting IAM work?

How to target trunk road users. Most of what we do is social media (Twitter, Facebook, etc), sharing campaigns of others.

How could you improve interventions you have mentioned?

Making them more targeted.

Do you think the IAM approach helps to improve journey times?

Yes, as most problems are caused by crashes, so being safer reduces these delays.

Quick wins or added value experiences for Highways England?

Highways England using our modules (see below) like NDORS.

Continuing to support their campaigns.

Could you work more closely with Highways England?

Yes. Our annual safety culture survey (2000 drivers) tells us distraction is a key problem. Those who passed the ADT will be able to cope, but only 92,000 out of 30 million have this qualification. Trying to address this by broadening the appeal, through courses that require less time (online, for example). Developing a lot of new modules (e.g. driving on motorways, distractions, rural roads, overtaking, speed management, motorcycling, towing, fleet) that will be offering next year.

How could you see this working?

Highways England could offer (or require) that people observed being bad on the motorway could be asked to undertake these modules. They could be co-branded with Highways England, so sort of like an unofficial NDORS. We could train the Highways England traffic officers.

Williams Lea Tag

Which of these behaviours could you offer most in terms of this interview?

Distraction and Roadworthiness

Could Williams Lea Tag offer an extra level of engagement with Highways England?

We have hooked up with DVSA and DfT to amplify the DfT campaign regarding locking your mobile phone in the glove box. If all parties (incl. Highways England) hooked up there would be even greater reach and a stronger message.

List Specific Interventions that you think are effective and targeted towards the behaviours mentioned previously.

No specific interventions were mentioned, only ideas.

Ideas were expressed – DVSA should cover topics such as mobile phones within actual testing and training environment. Increased focus is needed within driver training. Expanding the Hazard Perception Test so that it is no longer a silent test and also includes actual in-car distractions. A lot of talk about things they could do (e.g. feedback information back to the DVSA regarding focus groups).
Similarly, for roadworthiness, only ideas. Have been thinking how to get public thinking more about vehicle roadworthiness. There are touch points, with the MOT being the best one, as giving information on this when they are actually thinking about this issue. Who can we partner with, how can we get the information to them, which medium.

Safe Driving for live website – has videos, practice theory tests, things that can be purchased.

**Effectiveness of the interventions regarding KSIs?**

No evaluations mentioned. Only number of page visits (600-700,000/month) and people spend 5 minutes on the site. Accessed mostly by mobile, desktop then tablet. Mostly learner drivers, but how can we get them to come back. The idea of an App to engage them before the training starts and stays beyond passing the test. Do some user experience work. App may be ready in 2019, depending on contract renewal.

**Practical limitations affecting your work?**

Cost limitations – would like to do more CGI and virtual reality, but too expensive.

Measuring effectiveness – very difficult. Can only measure what we sell, website analytics, pass rates, etc.

**Have you linked up with Highways England to co-ordinate work?**

We have published things for Highways England, but there is not a lot of cross over between Highways England and DVSA.

**How could you see this gap bridged [working]?**

More joined up thinking (between agencies).

**How could Highways England use some of these ideas we have talked about?**

There are messages and communications that Highways England could get to people at these touch points. Need to figure out what these messages are and how to deliver them. Feed people information at a time they might be susceptible to thinking about it.

**RoSPA**

**List Effective Interventions (RoSPA) for inappropriate speed and distraction.**

Road Safety Advice and Information Service: Raises awareness about issues to do with inappropriate speed and distraction (why it’s an issue, consequences and what can be done). Driver Training Projects and courses: Inappropriate speed is one important part of these, including managing occupational road risk. This involves raising awareness amongst employers, training in journey schedules, assessing drivers’ likelihood of engaging in inappropriate speed. Also distraction.

Social and traditional media: Giving advice on things people can do to avoid inappropriate speed and distraction. Education and raising awareness. Use Twitter (road safety – 17,000, occupational – 8000 followers), Facebook (4,500 likes), Linkedin (road safety – 153 members), Blog (13,000 views), and Youtube (21,000 views).

Health and Safety Award Scheme: Accrediting organisations, including a section about managing occupational road risk.

Roadsafetyevaluation.com: E-valu-it – helps practitioners to do simple evaluations of small interventions. More work is needed on this.
Olderdrivers.org.uk: Designed to raise awareness about the changes people may experience as they age. Covers things like where to get a driver’s assessment, potential vehicle adaptations and considering limiting their driving to times and places where they feel safer.

Government Consultations: A lot of effort is put into responding to government consultations.

Road Safety Observatory: Is a depository for research evidence on specific topics to make them accessible for practitioners and the public. Highways England is on the programme board.

**Effectiveness of the interventions regarding KSIs?**

No evaluations, would be very difficult to undertake.

There are some case studies published on “Driving for better business” and ORSA (orsa.org.uk) – Funders or senior managers are more interested in getting a project visibly delivered and less in using resources to evaluate it.

**Practical limitations affecting RoSPA work?**

Funding.

Being able to evaluate their impact, other than the number of people downloading material.

*Have RoSPA linked up with Highways England to co-ordinate work?*

Not formally, but promote their campaigns and advice on social media.

Highways England are on our National Road Safety Committee.

**Could you work more closely with Highways England?**

Yes, would be more than happy to work with Highways England (mentioned later as well – in general) promote their work and use their knowledge to inform relevant parts of our work.

*How could you see this working?*

We could help to promote their campaigns through our various communications channels.

**Innovative Interventions**

Vehicle technologies (i.e. autonomous vehicles) and HGV platoons. Highways England should have an input into how this will be used on their network.

Enforcement is important as both an incentive and deterrent.

*How could Highways England work with you to improve your work and make it more applicable [to SRN]?*

Working together to improve coverage of issues that are specific to SRN in our interventions.

Secondly mutual promotion of interventions and messages.

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**Brake the Road Safety Charity**

*Which of these behaviours would you like to focus on?*

Fatigue, distraction, speed, drink driving, drug driving.

*Which interventions target these behaviours?*

Brake has campaigns targeting these behaviours.
Brake pro service targets fleet operators – established in 1996 and involves sharing tools, training and guidance on best practice among its members. How to keep an eye on telematics data and reducing the chances of them being caught under the influence of drink or drugs. Service is open to anyone around the world. Regular webinars, best practice guidance and annual events like Fleet Safety Conference. Also fleet safety awards.

**Effectiveness of the interventions regarding KSIs?**

Pro-Brake has had regular surveys with fleet managers. These suggest an increased interest in promoting positive behaviours within the workplace.

We are doing some partnership work with 2020 and we have our own GO 20 campaign focused on encouraging the use of lower driving (speed) limits within local communities. The primary aspect of this is lobbying the Government and local authorities, showing how this intervention can improve the quality of life within their areas and hopefully reduce deaths and injuries. In some areas, there has been a reduction in KSIs but in others there has been no change or an increase (20mph limits).

DISTRACTION - Road Safety Week – run annually and one part is called the pledge, where people pledge not to do certain behaviours. We saw quite a lot of people (9226 – but not just distraction) make a pledge.

DISTRACTION - We promote the THINK campaign. They gave us information ahead of the launch and we prepared background resources and were prepared for the launch. There was quite a good uptake in terms of media attention.

Fatigue – we do a lot of webinars and have some resources that are targeted specifically at reducing fatigue among fleet operators and those driving for work. There has been a positive uptake from employers. Cannot think of any evidence that this has had an impact on KSIs.

Drink/Drug Driving – Road Safety week (see above) – pledge not to drink driving. We have a Driver Survey Report, where we survey 1000 drivers which asks how often they have done different behaviours. This information is used for future campaigns and also as an evidence base. The campaigns are evaluated [what does the evaluation say about these campaigns?] these campaigns are currently under construction so we won’t really have a full idea until the year is complete. Developing a campaign called Driving for Zero.

Roads to Justice (focuses on establishing attention to the driver sentencing laws) – we have had massively positive feedback on that campaign, high level of community engagement, social media referrals, press involvement and there is consultation ongoing about driver sentencing that we are involved in.

**Practical limitations or risks affecting your work?**

Trying to quantify driver behaviour. We can record contributory factors but some road crashes and stuff are under reported or get miss-reported.

We engage and inform, but we cannot enforce it in any way.

**Would Brake be interested in working alongside Highways England? Have you had experience working with Highways England?**

Brake has worked with Highways England. We would be very interested in providing any insight we can give to make the roads safer. Collaborative work.

**Any quick wins or added value information you’d like to share?**

Segregating vulnerable road users from motor vehicles is one way.
Promoting greater public services – buses, trams, trains etc.

**Innovative interventions?**

There are some technologies that can prevent use of a mobile in the car.

Construction of roads – such as in Switzerland or Austria they have new lights with run LEDs on the pavement so that mobile phone users can see the traffic lights. Due to a recent increase in the number of pedestrians hit while using mobile phones. Like Light Initiative.

Glow in the dark cycle lanes in Sweden. Make sure cycles can be seen.

**PACTS**

**Which of these behaviours do you want to focus on?**

Drink and drunk driving, fatigue and health issues.

**Are there any behaviours where PACTs could offer an extra level of engagement?**

We do research and we do conferences each year, which Highways England have been supporting. We are in the space of education, stakeholder engagement, networking and lobbying government. One of the roles we play is bringing people together.

**List Effective Interventions (PACTs) for inappropriate speed and close following.**

I think technology is the answer to distraction, rather than the behavioural thing. There have been a lot of campaigns (RAC, AA, etc.) but in the end I think it depends on the police being out there. There could also be more automatic detection and the DfT have been talking about technologies to block mobile phone use.

I support the educational approach and the behavioural approach, but it is hard to demonstrate any effectiveness. People tend to measure if the message has been noticed or remembered, but it is harder to go on and say they have changed their behaviour. I think information alone is not effective, but as a part of a package. I am more positive about training, giving people more skills.

Improved hazard perception training should be progressed.

Once we leave the EU we can set our own driving test standards and arrangements.

Speed – the Department has commissioned a big study on how effective Speed Awareness courses are. There are some interim result and they are quite positive. It seems to suggest that the difference between speed awareness and points are actually quite small (IpsoMori, DVLA and Leeds involved).

PACTS publication last year “Fit to Drive” which was around fatigue and health issues was well as seatbelts.

Drink and drug driving – the DfT is piloting a combined rehabilitation course for offenders, as they do not have the legal powers to do a drug driving course. Related to that we are publishing a European piece on drug driving (ETSC) and the experts do not support combining the courses. They thought they needed very different approaches.

Think! Campaign has started to try and not only monitor who notices their adverts and stuff, but how the drivers are responding (e.g. Country Roads). Claim that drivers did moderate their behaviour.

Driving for work – we have set up a forum which Highways England sits on and the HSE and DfT. A report will be published on that.
UK Road Safety – Seizing the Opportunities – these are the main issues and some of the opportunities.

**Freight Transport Association**

**Which of these behaviours could you see your expertise adding value for Highways England?**

Inappropriate speed, vehicle roadworthiness and distraction

**List Effective Interventions (FTA) for inappropriate speed.**

The Van Excellence programme:

Physically limiting speed to 70mph or robustly and timely managed telematics driven speed management programme. Every vehicle going into the fleet has to be managed using one of these two methods (don’t insist on retrofitting existing fleet vehicles). Also do a lot of hearts and minds stuff – skill savings and better driver well-being.

Distraction – require a proper policy in relation to the use of mobile equipment, not just phones. We don’t insist on banning hands-free kits, but many of our operators do. We don’t test how strongly the policy is being followed.

Roadworthiness – need to demonstrate drivers can carry out competent pre-use check on the vehicle. Some form of duty of care inspection, driven by the VOSA guide to maintaining roadworthiness. So the vehicle is examined each year by well qualified person.

3.5 tonne van training offers – no empirical data but companies have found improved MPG and improved retention rates.

**Effectiveness of the interventions regarding KSIs?**

Difficult to demonstrate the effect of Van Excellence – most of the early adopters were operating at a high standard, so it was more of a validation. Now we are trying to get operators who aspire to be recognised as operating at a high standard who will have to change their approach. Contractors vans (indistinguishable from the companies own) working for the same company were attracting twice as many complaints for inconsiderate driving, but once Van Excellence the complaints equalised. One of our companies won Fleet Awards. We have 125 accredited operators (125,000 vans). It takes operators 10 weeks to satisfy the code. Accreditation takes place via auditing company records, not physical inspection.

There is anecdotal evidence we are having an impact on KSIs (e.g. one of the companies noticed a blip in collisions), but not objective. Finding evidence is very difficult. Virtually impossible to identify a cause and effect, but we tend to see collision rates fall and MPG improve. Journey reliability, journey times are more predictable (managing speed does not slow down journey times). In another company, the defect checks went from 65-70% to virtually 100%.

**Could you work more closely with Highways England?**

Would love too.

**How could you see this working?**

Working with Highways England we could extend our reach to organisations that would benefit from funding? Work together to support best practice blogs and events.

**The AA**

**Which of these behaviours could you see your expertise adding value for Highways England?**
Close following, and inappropriate speed

**List Effective Interventions (AA) for inappropriate speed and close following.**

There is very little. Believe that drivers have not been taught the dangers of tailgating. A re-education campaign is needed. 8/10 times it is BMW drivers.

Chevrons – probably not at all effective. A broader education campaign like the THINK! Campaigns on seatbelts and drink driving, and driver distraction are needed.

Safety interventions need legislation, education and enforcement.

AA driving school can influence drivers and has done on other topics, such as cyclists in urban areas and distraction. When a learner gets into the car then they are told to take their phone out and put it in the glove box (phone box – DfT). Once instructors are able to go on the motorways then they can target close following. Could also be used to target lane discipline (middle lane hogs).

Inappropriate driving for conditions – there is still mistrust of Highways England signs. “Fog” on a clear day, so people tend not to believe it. This is related to the Red X problem, people ignore them. Highways England should use the variable messages appropriately with the appropriate warnings.

**Have AA linked up with Highways England to co-ordinate work?**

Main interaction is via the DfT motorist forum. We get up-to-the-minute updates on what is happening on the SRN. Beneath that there are various other groups: Road works sub-group, Smart motorway sub-group. Fighting Highways England regarding the distance between laybys, which are not frequent enough on some motorways (to save cost).

**How could the AA work together with Highways England on their ambitious goals?**

We are, but are they listening? We poll our members on these issues and share them with ministers and Highways England, but some of the things they take no action on.

Publicity – we take their advice on things like Smart motorways and put it on our website, so we work quite closely on that kind of stuff.

**Innovative Interventions**

RDS could be used to provide weather news as well as traffic news (to help inappropriate driving for the conditions). Not done yet, but could be.

National courtesy day (10 years ago) – was a gimmick, but helped remind drivers about some of the disciplines on the road. Perhaps we could do an anti-tailgating week?

**The THINK! Campaign**

**Which of these behaviours are most important for KSIs?**

Inappropriate speed mixed with inappropriate driving conditions.

**List Effective Interventions for THINK!**

The aim of the country roads campaign is to reduce the number killed on country roads. Specifically, it aims to get people to brake before the bend and not on it, reducing speed. This costs about £1.2 million, with the bulk going on advertising. Targeting 17-34 year olds who are over represented in the statistics. We run a burst of activity for 4-6 weeks once a year. Also, at different intervals throughout the year (3-4 times) we push out some of the content on social [media]. The main burst of activity is
in October, when the nights get a bit darker and there tend to be more accidents. Use social media and on demand video that is a pre-roll like in the cinema. Do a lot of work with media agency to make sure our message resonates with the target group. Works best on Facebook and Youtube. Around 4-5 million “impressions”. In the cinema, the number of admissions can be as low as 3 million, depending on the movie.

We would like to improve this using telematics to measure the driving behaviour, as putting cameras in the car may affect their behaviour. Also considering using a targeted radio signal that triggers when the driver comes to a trigger point in the bend. Would like to tie in with insurance companies and use the data they record with telematics or car rental companies. We look at the speed approaching the bend and then speed out of the bend. There is no control group this year, but have had a control group previously. There is no follow up period, the measurements are taken essentially instantly. Some data has shown that some drivers broke 0.5 seconds earlier going into a bent, but accelerated out of the bend faster.

**Effectiveness of the interventions regarding KSIs?**

We do look at KSI data changes, but we cannot attribute any changes to a particular campaign. If we see an increase in a particular area then we would focus the campaign around that.

**Practical limitations affecting Country Roads work?**

We have enough data to target the driver we want.

The issue is when we are evaluating the effectiveness. We can measure engagement through media results but we cannot attribute any behaviour change to our activity.

We also do in-car measures with around 30 drivers. Camera is put in their car, they are told they are evaluating the camera and when they are rating the camera they are forced to watch the advertising message (campaign content). When the camera is in the car we can measure their speed into the bend before and after exposure. We need bigger samples, but cannot afford to do so using the current methodology.

May be fatigue from the campaign, as the results this year were not amazing. The message was too negative, so we may try and do something about being a better faster driver and how to do that more safely.

**In what way do you work with Highways England?**

Depends on the campaign. We work with Highways England to amplify the campaign message, but not during the development phase. Highways England was not a part of the Country Roads campaign during the development phase. Our senior marking leads talk with Highways England and DfT and various agencies about what is coming up.

We worked closely with Highways England on the mobiles campaign. They worked with the police who used an HGV mounted camera to catch people while they were out and about. We wanted to work closely with them to make sure our messages were aligned and that we were amplifying what they were doing.

Motorcycle safety – we do work closely with them on that.

We update Highways England periodically through a campaign about what we are doing.

**Do you think your current level of working with Highways England could be improved?**

There is always room for improvement. We could be more heavily involved together if the campaign lent itself to that. Perhaps we could lay out our campaign strategy for the year and they could lay out
there’s and see if there are any activities that we could tie our activities into. Possibly when developing the strategy there is scope to work more closely.

**Innovative Interventions that could be done by Highways England to reduce KSI reduction?**

We have looked into signage, such as the flashing messages that gives you a sad face when you are over 30mph. We would like to look into the impact of that and whether there is a flashing message that you can give people before a particularly dangerous stretch of road.

**Roadsafe: Driving for Better Business**

We are working with Highways England to reinvigorate driving for better business, so that all their customers are properly engaged in the programme and understand the benefits of good management. We run a new outreach programme to their stakeholders and the interventions will mesh with it.

**List Effective Interventions (RoadSafe)**

In every case these have been technological interventions. Close following – autonomous emergency braking. Seatbelts it is the seatbelt reminder and beeper that made the single largest contribution to seatbelt wearing. Road design – narrow the road, put in a bend or a roundabout to slow people down. Driver distraction – use the technology to block mobiles phones [how much does it cost?], it probably costs nothing. The difficulty is explaining the benefit to the business. If the workplace has a tracker then they can see when their employee is going to be late and they can ring and inform the client. [how widespread has this technology been?] VERY [evidence of this?] none. [how could you improve uptake?] make the business case more obvious.

AEB – reduces the number and severity of rear-end shunts. This is available, it is cheap, has no drawbacks and we should be encouraging uptake as quickly as possible.

THINK! Campaigns are well researched, well-resourced and properly delivered with the right level of investment and are successful. If you are going down the “inform” route then it needs to be done nationally and consistently with simple messages. The audience has to be targeted (e.g. the drug driving campaign).

Enforcement works – but must be targeted carefully.

**Effectiveness of the interventions regarding KSIs?**

The evidence base on AEB is all there, but Thatcham’s have it. Serious injuries are not investigated adequately. They should be investigated to the same degree as fatalities and the information is needed. STATS19 does not go deep enough.

**Practical limitations affecting your work?**

None.

**How could the RoadSafe support Highways England?**

They are paying us to do that. Our network is strong and effective and we are putting together a Board workshop for them so they can review their progress against international standards. As a part of that we are having a live demonstration of AEB and motorcycle ABS.

**Any quick wins or added value you’d like to share?**

Have proper speed management systems in place on high risk roads. Poor road engineering, which seems to continue due to political reluctance to put in a proper speed management intervention. Also
includes public education. There also needs to be much better stakeholder engagement with the businesses that operate these roads.

Safe system plan on SRN we are pleased with. Need more drilling down on the evidence and to find out the real causes of serious injuries.

Road Safety Trust

List Effective Interventions (the Trust) for inappropriate speed [others not mentioned].

NDORS – about a million people go through the speed awareness course.

Childrens’ traffic club – children sent a book or DVD in London. But there was no follow through beyond this age group (3-5 years).

Effectiveness of the interventions regarding KSIs?

New course is too new. The standard NDORS programme has only been evaluated at a regional level, not national. We are happy with the satisfaction produced by the courses and an evaluation of what are the effective ways of changing offending drivers’ behaviour. We also have unsolicited anecdotal evidence. A national evaluation will be produced in 18 months time.

[what convinces you that an intervention would have an impact on KSIs] – it is not just an intervention, it is a before and a follow up. That is expensive.

The most successful interventions will be those where we manage to martial all the interventions together.

Practical limitations affecting your work?

You need to know there are enough organisations and individuals who do the training out there to provide the courses in the quantity and time that is required. Training provider is given the course materials and licensed by NDORS to do the training. We assess the trainers every two years and so also need a large team of assessors. Do we have enough assessors?

How could your organisation work with Highways England?

There is a place for developing a road safety research capacity framework where we all start to think about what we are (together) funding and what we think we are going to get out of it. Highways England funds stuff, DfT fund stuff, as does RST, RAC Foundation, RSF. Sometimes they are funding the same things. We could have an overarching structure, like vision zero, safe systems approach to coordinate better. This would help Highways England by pointing them in the direction of the right research approaches to adopt and the right partners.

How could the Trust help Highways England?

National motorway speed awareness course – will help to contribute on the inappropriate speed, ignoring signs and signals, including red x.

What’s driving us course and Driver Alertness courses which are intended for drivers who make an error of judgement that led to a crash or a near miss. They are courses for people driving for work, but not specific to SRN.

What interventions are there out there that could help us manage behaviour better on SRN?

It is more about understanding in detail what the cause of collisions are.
In-car engineering interventions – a large number of newer vehicles have got blindspot systems. Middle lane hoggers could be targeted using leaflet or web-based communications. Some of the lane hogs may be doing it as they have had a holiday in USA where it is normal.

Then there are some very specific interventions about infractions where you know much more about who it was and what did they do. You can target the message specifically at them.

The RAC

List Effective Interventions (RAC) for red x and distraction.

Mobile phones – have launched a pledge website which encourages people to sign up to a code of practice on using mobile phones. This is endorsed by DfT, but not Highways England. We could work more closely with Highways England on one or two areas like this.

Communications – we work more closely with DfT Think! campaigns than Highways England. There are clearly links between Highways England and THINK!, but I am not sure they talk directly. Mobile phone campaign, working with DfT Think! and organisations like IAM to progress issues.

A lot of social media activity. We re-tweet anything that anyone credible has to say about this. We try to influence through the social media activity. Trying to change the mindset and make using a HH mobile phone socially unacceptable, like drink driving. RAC have 8 million members, so media and politicians are interested in what we have to say and press is likely to pick it up. Trick is to have a common message, whether they hear it from RAC, AA or Highways England. Changing behaviour is a war of attrition, so the more of us saying the same thing the more likely people will listen and change their mind and behaviour.

RAC Report on Motoring. Cross sectional survey of UK drivers asking the m what their concerns are and questions on a broad range of their own behaviours. Mobile phones were right on the top, alongside the condition of local roads.

Motorists’ Forum – meet quarterly (AA President, CE Highways England, CE IAM, CE Freight Transport Association, CE Road Haulage Association, CE British Vehicle Rental and Leasing Association, etc. and typically a minister). We have debates around safety and there is a subgroup on Smart Motorways and red x compliance. The Expert Advisory Group meets once a month.

From the RAC report on motoring, as mobile phones were such a problem we sought allies and on the launch day of our report Daily Mirror and Daily Mail both devoted their front page to the mobile phone distraction story. Within 48 hours the Secretary of State announced increased penalties.

Effectiveness of the interventions regarding KSIs?

Difficult to understand cause and effect. Biggest challenge in our community. Media campaigns and the like, appeared to be having an effect (speeding) was getting better, but it was actually the cost of fuel that caused people to slow down. As fuel went down again, speed went up.

We have an annual measure on what people say regarding mobile phone use and what they use them for.

Enforcement is not a good measure either, as the falling number of police officers going on to the motorway means less people are being caught.
The single thing that would make the most difference is an expectation that they would be caught. Enforcement is absolutely essential. Perhaps giving traffic officers some enforcement powers to enforce really poor behaviour might be worthwhile.

**Have RAC linked up with Highways England to co-ordinate work?**

Red X we are probably working as closely as possible on this topic. We talk with Highways England almost weekly, meet every month, our PR teams are in contact and we are trying to prominently publicise on our website how one should behave on the smart motorway (including Red X).


Highways England are working with the DfT regarding camera enforcement on this and we are getting weekly reports on this, so we are working on many levels with Highways England.

Definitely an opportunity for our Comms team to work more closely with Highways England for social media/PR campaigns.

**Innovative Interventions?**

Look to technologies for enforcement.

Communications that are more like in New Zealand (very different more relaxed style).

**Problems?**

Enforcement is a really big challenge. There has been a 27% reduction in dedicated road policing in the last 3-4 years. Due to media coverage, there are a number of high profile enforcement campaigns, but in 3-6 months they will have moved onto something else.

**DVSA**

**List Interventions (DVSA)**

First Car magazine – aimed specifically at young drivers. Covers all the behaviours and interventions we need people to develop after their test. 750,000 print run a year, but has increased due to demand.

Practical tests – 1.5 million a year and most receive First Car magazine.

Been involved with the Think! campaign and other stakeholder. The opportunity of the increased penalties that have come to the Highway Code and that can be a theory question that will appear when learning to drive.

Meme on mobile phones (Bill doing good things and a guy in a van being a “dick”). Trying to stigmatize the behaviour.

Want to be open so that if someone comes with a good idea that will fund itself, then we are open to that (such as First Car).

Social and traditional media

Highway Code twitter, Facebook (I can’t wait to pass my test) and email alerts.

“Safe driving for life” blog – 600,000 a month. Mostly due to the practice theory tests. Largely for new drivers, but want to instil a culture of lifelong learning (as things change).

Publish audio books – better biking, better driving, etc.
Highway Code and “Driving: The essential skills”.

**Effectiveness of the interventions regarding KSIs?**

We have a readers’ survey of First Car (competition to win a Corsa) and it was welcomed, people thought they would be a safer driver because of it, 80% satisfaction, 2/3rds thought their behaviour would be adapted because of it.

Social media – 80% said they learnt something and 2/3rds said their behaviour got better.

**Practical limitations affecting DVSA work?**

Technology and the price of virtual reality and 3D modelling.

Commercial partners expect some return from anything, so need to be creative.

Coordinating different stakeholder groups.

Meetings to knock down silos between Network Rail, TfL, DfT and Highways England. We will use the best channels there are and amplify each other’s messages.

**Could you work more closely with Highways England?**

There are hazard perception clips being developed for the motorway? Do you know about that? We are developing clips, as TRL did some research which highlighted hazard perception as a type of intervention that might be useful.

Looking at an innovation fund to work on 3D models or virtual reality approaches to put people through an experience, rather than posing a question. Behavioural change techniques and giving people virtual experiences are two quantum leaps.
APPENDIX C – IMPLEMENTATION PLANS: INAPPROPRIATE SPEEDING BEHAVIOUR
Inappropriate Speed

**Rationale**

Roadway treatments are designed to target drivers' perception of risk to increase the perceived threat of the road environment. Road treatments nudge appropriate speed for the conditions (e.g. Kennedy, 2005).

**Stakeholders**

- Highways England, contractors and local authorities
- Insurance companies, telematics providers, driver education providers
- Local Authority Road Safety Teams, Schools, Police, Fire, and Ambulance Services, including Greater Manchester, Surrey, Lancashire and Devon and Cornwall Fire and Rescue Services
- Community workers, health professionals and teachers
- Freight Transport Association, Driving for Better Business, IAM, The AA, DriverMetrics, IDS, telematics providers, driver training providers
- Highways England, DFT (THINK), BRAKE, Driving for Better Business, The AA, RAC, RoSPA, IAM, Police, RSGB, road safety consultants etc
- Highways England and police

**Intervention Procedures**

- Identification of locations, selection and design of road engineering measures
- Data recorder installed in vehicle, smartphone or self-installed device provides reports, alerts or voice call supplemented with online education or motivational interviewing
- Delivery of standardised presentation in a theatre context. Use of standardised follow-up modules for classroom sessions
- Seminar day, preceded and followed by in-school activities on risk taking, alcohol, drugs, safe celebrating using trained group facilitators
- Application to join, followed by consultation, audit and accreditation by the FTA based on successful audit
- Develop content, deploy campaign and deliver via social media, Highways England website, radio etc tailored for SRN driver segments and specific locations
- Installation of hardware and signage, engagement with police forces for enforcement

**Evaluation**

- Combination of comparisons of speed, crash rate and/or road users' perceptions pre and post implementation
- Comparisons on insurer claims data pre and post implementation, fleet crash rates and individual driver safety improvements pre and post intervention
- Quantitative/qualitative data collection and analysis (Symons et al, 2008)
- Quantitative and qualitative self-report of knowledge and attitudes pre, post and at 3 months. Possible opportunities to evaluate speed using telematics
- Comparisons of claims data pre and post accreditation, comparisons of insurer claims data for accredited and non-accredited fleets
- Comparison of speed pre and post campaign deployment. Monitoring of speed at selected locations, pre and post campaign
- Longitudinal study of impact on speed and crash rates

**Enforcement**

- Average Speed Cameras

**Education**

- Safe Drive Stay Alive
- RRISK
- Van Excellence

**Engineering**

- Road Engineering Treatments
- Insurance-Based Telematics

**Procedures**

- Planned interventions designed to educate drivers' beliefs, reduce crashes and improve road safety outcomes (Theory of Planned Behaviour; Ajzen, 1996). SDSA follow-up format evaluated by Fosdick (2017)
- RRISK is a health promotion program for young people in Australia to build resilience to and develop safer driving practices leading to a 44% reduction in relative crash risk compared with a control group (Senserrick et al, 2009)
- Code of Practice for Operator Accreditation with telematics as a core tool along with driver safety policies, fleet risk assessments and training (Murray, 2012)
- Public communication campaigns can be effective if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015). On average campaign effects result in a 9% reduction in road traffic accidents with significant variations regarding the topic of the campaign and additional enforcement (Delhomme, et al., 2009; Elvik et al., 2009)
- Route-based road safety treatment to enforce speed limits monitoring average speed between two locations rather than site-specific with average 36.4% reduction in KSIs (Owen et al, 2016)
On road 1 Implementation,

Insurance companies in conjunction with telematics providers and education providers

In-vehicle data recorders, reporting portals, feedback mechanisms

HE, local authorities

Signage, road markings Identification of HE, local authorities - existing relationships

1 main presentation, then 2-4 follow-up sessions

To reduce speeds at key locations using alternative treatments to influence speed choice.

identifying excess speed incidents and triggering communication with the driver to analyse the factors underpinning the... and rewards can be applied to reinforce behaviour, e.g. Mazureck and van Hattem (2006); DeLeonardis et al (2014).

Reduction in frequency and magnitude of risky behaviours detected, such as excess speed.

Delivery of standardised presentation in a theatre context. Use of standardised follow-up materials to facilitate additional sessions.

Combination of comparisons of measured traffic speeds pre and post implementation, crash rates pre and post implementation, and local residents and/or road users' perceptions of the impact of the interventions.

Engineering Y The majority of hardware specific and smartphone...based telematics systems detect speeding events and can provide feedback either directly to the driver or to the system... and limits are exceeded.

Self-evaluation

Social support

Rationale for use Aims Quantifiable objectives BCT1 BCT2 BCT3 BCT4 BCT5

Speeding events...and rewards can be applied to reinforce behaviour, e.g. Mazureck and van Hattem (2006); DeLeonardis et al (2014).

Reduction in frequency and severity of risky behaviours (e.g. speeding incidents), and corresponding reduction in crash rates and costs

Alcohol and drugs component: up-to-date research reviews, presentation covering planning ahead, risky consequences, and safety, with props for practical evaluation including tyres, seatbelts, windscreen wipers and car lights. For...compared with no reduction in observed crash risk among participants in a purely driver-focused intervention.

1 seminar day consisting of 5 sessions

Satisfaction levels generally very high from participants and teachers Senserrick et al. (2009) reported a substantial reduction in crash...
APPENDIX D – IMPLEMENTATION PLANS: MOBILE PHONE USE
Enforcement

Alternate Interface apps

Online mobile phone course

Multi-Stakeholder Campaign

Camera-based systems

Blocking apps and technology

Smartphone apps can block and divert incoming calls and messages whilst driving as a direct means of managing mobile phone use. There are three completed studies of smartphone applications to block mobile phone use while driving, with all three demonstrating a reduction in phone use while driving. (Delgado et al, 2016)

Smartphone apps that provide an alternative means of interacting with the device other than touch, (e.g. voice control, gestures, HUD information presentation) have been found to reduce workload when using a mobile phone whilst driving (e.g. Terken et al, 2011). Combining voice input with a HUD, using technologies like Google Glass, provides a compounded safety benefit (Tippey et al, 2014)

Behaviourally-focused, interactive, pathway-based online educational module to inform drivers of the risks of mobile phone with customisable pathways to maximise personal relevance to the individual driver and/or target group. A positive effect on attitudes and behavioural intentions has been found and some evidence of reduced re-offending (af Wahlberg, 2011).

Public communication campaigns can be effective if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015). On average campaign effects result in a 9% reduction in road traffic accidents with significant variations regarding the topic of the campaign and additional enforcements (Delhomme et al, 2009; Elvik et al, 2009).

Better enforcement can be achieved with the use of camera technologies to capture evidence of mobile phone use while driving including a Police HGV-based camera system, CCTV in traffic officer vehicles and a fixed camera system to detect mobile phone users. Apps to report and record mobile phone use widely used in the U.S. (Park et al, 2017).

Stakeholders

App developers and promoters such as BRAKE, RoSPA, AIRSO, Local Authority road safety officers

App developers and promoters such as BRAKE, RoSPA, AIRSO, Local Authority road safety officers

Existing online course providers, BRAKE, DIT (THINK!), road safety consultants, fleet-based organisations and road safety groups such as Driving for Better Business

Highways England, DIT (THINK!), BRAKE, Driving for Better Business, The AA, RAC, RoSPA, IAM, Police, RSGB, road safety consultants

Local police forces, contractors, app developers and promoters such as BRAKE, RoSPA, AIRSO, Local Authority road safety officers

Rationale

Intervention Procedures

Download and activate app alongside behavioural engagement strategies to maintain behavioural change

Download and activate app or promote vehicles with HUD combined with voice input or Google Glass

Individual driver logs in to complete online course, completion registered and certified. Supplementary education via a downloadable app can provide feedback and coaching on mobile phone use

Develop content, deploy campaign and deliver via social media, Highways England website, radio etc tailored for SRN driver segments and specific locations

Download and activate app, development of reporting processes and criteria for public submissions, engagement of offence management providers. Deployment of fixed cameras for mobile phone detection.

Evaluation

Comparison of observed mobile phone use while driving pre and post implementation. Comparison of company phone records pre and post implementation and verification of activation and deactivation of app.

Comparison of perceived risk of mobile phone use by users pre and post implementation. Comparison of telematics data to show average scores and frequency of highlighted incidents or thresholds exceeded pre and post implementation.

Comparison of self-reported beliefs, attitudes and behaviours pre and post e-learning participation. Re-offending rates, observational monitoring of mobile phone use or monitoring of phone use via telematics.

Comparison of close following pre and post campaign deployment. Monitoring of mobile phone use at selected locations, pre and post campaign.

Comparison of public perceptions of risk of conviction for mobile phone offences pre and post implementation. Comparison of distraction-related crashes pre and post implementation (insurance data, fleet internal data, STATS19 data). Qualitative research into public perception of camera footage for mobile phone enforcement.
According to Delgado et al. (2016), evaluations by Creaser, Edwards, Morris, & Donath (2015), Ebel et al. (2015), and others report on the impact of using smartphones while driving. The number of text messages sent increased by one year since licensure in the UK, indicating a significant rise in distraction. Testing of apps on different devices periodically is necessary to check functionality.

Circumnavigation strategies, such as using a second phone, disabling the app, or ensuring the device is not charged, help in reducing distraction caused by interacting with the smartphone while driving. Minimizing additional cognitive workload is crucial for safe driving.

App developers, promoters, and organizations like BRAKE, RoSPA, AIRSO, and Local Authority RSTs play a key role in reducing smartphone usage while driving. Measures include online education modules to inform drivers about the risks of mobile phone use, such as divided attention increasing cognitive demand, stress, and distraction. The theoretical rationale is to reduce the chance of mobile phone use while driving.

The BCT3 framework is useful for designing educational campaigns that target mobile phone use, based on psychological principles to motivate behavioral change. Targeting hands-free as well as hand-held phone usage would deliver optimal safety benefits.

Education campaigns can be designed or adjusted to utilize relevant identified Behavioural Change Techniques. For example, course content mapping to key BCTs, user feedback mechanism, and analysis of volume of participation by demographics to monitor uptake levels are essential components.

Incentivization of take-up outside of driver diversion is also necessary for sustained effectiveness. For instance, rewarding drivers for not using their phones while driving can lead to long-term behavioral changes.

Behavioural change campaigns can be effective in reducing mobile phone use, as seen in evaluations of community speeding programmes in the US, China, Taiwan, Russia, and Israel, as well as the UK. Published case studies report the effectiveness of these programmes.

To increase reporting and enforcement of mobile phone use, schemes like the ICE and Speed Camera Systems can be introduced. For example, the ICE app launched in Michigan in June 2015 and the use of cameras in India allow citizens to capture videos and send them to state officers. In the UK, mobile phone use is subject to a penalty, but phone use frequency returns to baseline levels after the first year. In the US, mobile phone use penalties have been enforced, but compliance is variable.

Enforcement strategies, such as roadside enforcement of mobile phone use, can be effective in reducing mobile phone use while driving. AI-based detection systems and user feedback mechanisms are one way to ensure consistent and fair enforcement. For example, systems like those developed by Bauer and colleagues in 2013 have shown to be effective in reducing speeding incidents.
APPENDIX E – IMPLEMENTATION PLANS: CLOSE FOLLOWING
Enforcement

Compliance

Hazard

Monitoring Tool

TailGuardian is an interactive sign on the back of a vehicle to providing feedback to a close following driver. TailGuardian encourages greater awareness of following distance. A national bus company found a 60% reduction in rear-end collisions for 150 buses fitted with the sign. with the sign.

Public communication campaigns can be effective if they are based on social science theory (e.g. Friemel and Bonfadelli, 2015). On average campaign effects result in a 9% reduction in road traffic accidents with significant variations regarding the topic of the campaign and additional enforcement (Delhomme, et al., 2009; Elvik, et al., 2009).

The CMT is a Highways England system that utilises cameras to detect a number of non-compliant behaviours and a warning letter is issued. Drivers are motivated to avoid a penalty and change their driver behaviour accordingly (Broughton 2008, Corbett et al 2008).

Rationale

ACC automatically maintains an appropriate speed and distance to the vehicle in front showing significant increase in mean headway in on-road driving. A large-scale field test called EuroFOT showed that ACC led to an 80% reduction in critical events.

Stakeholders

Highways England, car manufacturers, leasing companies and fleet operators

Highways England and contractors

TailGuardian, MSAs, Highways England, police, traffic officers, retail outlets such as Halfords etc.

Indirect - arrangement and co-ordination of provision of hazard perception training

HE, DIT (THINK!), BRAKE, Driving for Better Business, The AA, RAC, RoSPA, IAM, Police, RSGB, road safety consultants etc

Highways England, DVSA, DVLA and police forces

Intervention Procedures

In-vehicle technology sold as standard in certain models of vehicles

Matrix, truck-mounted or trailer-mounted VMSes can be programmed to display close following messages in combination with marketing and enforcement campaigns such as 'THINK! If I can stop can you?'

Recruit volunteers to display TailGuardian perhaps by making the sign widely available at a close following black spot at the nearest MSA.

Completion of at least 2 x 20 mins hazard perception training module streamed on the web including clips to present close following scenarios

Develop content, deploy campaign and deliver via social media, Highways England website, radio etc tailored for SRN driver segments and specific locations

Installation of hardware and signage, engagement with police forces for enforcement

Evaluation

Comparison of following distances for ACC installed vehicles compared with non-ACC installed vehicles

Comparisons of pre and post intervention following distances for road sections with VMS message

Comparisons of pre and post intervention following distances for roads with VMS message

Comparisons of pre and post campaign intervention following distances for drivers completing hazard perception training.

Comparison of close following pre and post campaign deployment. Monitoring of close following at selected locations, pre and post campaign.

Comparisons of pre and post intervention following distances for drivers that have received a warning letter. A longitudinal study of the impact of the CMT on KSIs is recommended
Comparisons of following distances for ACC installed in many vehicles. For those that are kitted out, the settings depend on individual preferences and the impact on workload suggests that drivers may not be engaged and counterindications suggest an over-reliance on ACC.

Car manufacturers sell ACC functions and/or Forward Warning Alert functions as standard in their cars. DeWinter et al (2014) investigated the effects of ACC on drivers' workload and situation awareness through a meta-analysis. If drivers are engaged in non-driving tasks, situation awareness deteriorates for ACC compared to manual driving.

To increase following distance, reductions in recorded time headways significantly lower than two seconds are targeted. Adaptive Cruise Control Active or adaptive cruise control automatically adjusts the distance between vehicles compared with non-ACC vehicles.

Variable message signs (VMS) are increasingly being used to provide drivers with up-to-date dynamic information to inform drivers as well as influence driver behaviour. Hazard perception training can be streamed on the web, meaning that hundreds of thousands of drivers can access the training. The development of hazard perception clips to display on VMS and found some messages resulted in reduced driving speeds for relatively short distances after implementation.

Driving too close - time headways significantly lower than two seconds is a concern. A study found that drivers are three times more likely to have a rear-end collision when following too closely, with factors such as anger or seeking thrill (Dorn and Hunt, 2016). Power source, availability of hardware and cost are important considerations.

An unpublished review of psychological influences on close following behaviour carried out at TRL in 2011 summarised the reasons such as anger or seeking thrill. Delmonte et al (2014) investigated the effectiveness of the TailGuardian on drivers' self-reported close following intentions using a self-completion survey. The study found that drivers who used the TailGuardian were less likely to engage in close following.

To improve traffic flow, inform road users and reduce incidents, variable messaging signs (VMS) are being used. Highways England is involved in a standardised campaign to reduce driver speed through road work zones.

Driving too close - time headways significantly lower than two seconds and rear-end crashes happen partly due to driver error, improper lookout and failure to perceive the risk. Reasons such as anger or seeking thrill are a concern.

Feedback from users on realism of clips is important for the effectiveness of hazard perception training. Online delivery is available anywhere via laptop with a one session of 20 minutes. Clips depicting close following are shown to improve hazard perception skills.

The dis-benefits of close following are addressed by the campaign. Reduction in close following is targeted as a benefit. Fleet operators, and (increasingly) private motorists are involved in the campaign.

Highways England, local police forces - existing relationships are involved in enforcement, and installation of hardware and signage is required. Encouraging SRN users to complete the online training is an important aspect of the campaign.

Installation of hardware and signage, engagement with police forces for enforcement is required. A Compliance Monitoring Tool is used to monitor compliance. Hawkesworth et al (2017) carried out a longitudinal study of the impact of hazard perception training on close following and KSIs on the SRN compared to baseline.

Cost of signs, ensuring that a critical mass of vehicles are fitted with the signs is important. The development of hazard perception clips to display on VMS and found some messages resulted in reduced driving speeds for relatively short distances after implementation.

To increase following distance, reductions in recorded time headways significantly lower than two seconds are targeted. Adaptive Cruise Control Active or adaptive cruise control automatically adjusts the distance between vehicles compared with non-ACC vehicles.