Review of deterrence theory and enforcement case studies

Final report

Prepared for the Road Safety Authority (RSA)

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Executive Summary

Introduction

The MAIC-QUT Road Safety Research Collaboration (formerly CARRS-Q) was commissioned by the Road Safety Authority (RSA) of the Republic of Ireland to provide a review of deterrence theory and enforcement case studies relating to road safety.

The report presents the findings from the following three tasks:

- A systematic review of the literature on deterrence theory, applied to the context of traffic offending.
- Case studies of the traffic enforcement approaches of five countries.
- Recommendations for optimal traffic enforcement approaches for Ireland and how these can be supported by education and awareness activities.

Previous research has shown that police traffic enforcement measures reduce crashes (Wu et al., 2021) and subsequent injuries and fatalities (e.g. Elvik, 2024). Example of police enforcement measures include on-road patrols, speed cameras, random breath tests (RBTs), and roadside drug tests (RDTs). In the context of the effectiveness of speed cameras, for example, De Pauw et al (2014) examined the safety effects of 65 fixed speed cameras in Flanders, Belgium between 2002 and 2007. Their results revealed that there was a 29% reduction in crashes involving serious and fatal injuries after the cameras were installed compared to before the cameras were installed. Other studies which have examined the effects of RBTs have also found that this countermeasures reduces alcohol-related crashes, injuries, and fatalities. For example, Morrison et al. (2021) estimated that there was a 12% reduction in alcohol-related crashes at RBT sites in Brisbane, Australia for approximately 1-week post roadside RBTs. Many enforcement approaches that are employed to discourage risky driving behaviours and improve road safety utilise deterrence theory.

Deterrence theories

The three most populator and widely established deterrence theories within the field of road safety are i) classical deterrence theory, ii) Stafford and Warr's (1993) reconceptualised model of deterrence, and iii) Homel's (1988) extended deterrence-based model. Classical deterrence theory consists of three key components: certainty of apprehension (and punishment), severity of sanctions, and swiftness of sanctions, and focuses on people's perceptions of these outcomes. Stafford and Warr's (1993) reconceptualised model of deterrence proposes that there are four ways in which punishment impacts deterrence, including: i) direct experience of punishment, ii) indirect (vicarious) experience of punishment, iii) direct experience of punishment avoidance, and iv) indirect (vicarious) experience of punishment avoidance. Homel's (1988) extended deterrence-based model proposes that there are four non-legal factors (sometimes referred to as informal sanctions) which may also influence engagement in risky driving behaviours. The four non-legal factors include internal loss (i.e., feelings of shame, guilt or embarrassment), physical loss (i.e., fear of physical injury, for self and others), material loss (i.e., fear of receiving a fine or demerit points) and social sanctions (e.g., social judgement, disapproval from those close to you).

Systematic review of the literature

The report systematically reviewed studies on deterrence theory in the context of traffic offending, and how enforcement has been supported by education and awareness activities. The review focused on literature published since 2014 and was guided by the Preferred Reporting Items for

Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Four main databases were searched, including Scopus, Embase, APA PsycINFO (via EBSCOhost) and the Transportation Research Information Database (TRID), with 1,180 articles identified. Thirty-six articles met the inclusion criteria and were included in the review. To provide a more comprehensive overview of deterrence theory in the context of traffic offending and enforcement education and awareness activities, a selection of key articles and reports published prior to 2014 were also reviewed and are reported within.

For the systematic review, 28 studies were identified which applied deterrence theory in the context of traffic offending and eight studies focused on how enforcement can be supported by education and awareness activities. Most of the studies which examined deterrence applied classical deterrence theory (i.e., perceived certainty of apprehension/punishment, severity of sanctions, and swiftness of sanctions). Eleven studies included constructs from Stafford and Warr's (1993) reconceptualization of deterrence theory, and 10 studies included non-legal constructs from Homel's (1988) extended deterrence-based model. The studies addressed a number of illegal driving behaviours including drink and drug driving, speeding behaviour, and hand-held mobile phone use.

Overall, research was mixed regarding the extent to which the three classical deterrence constructs explained engagement in illegal driving behaviours. There was some support for perceived certainty of apprehension/punishment and severity of sanctions, in that stronger perceptions of these two variables have been found to be associated with weaker intentions to engage in illegal driving behaviours. There has been less support for the perceived swiftness of sanctions, with two studies producing findings inconsistent with predictions (i.e., stronger perceptions of the likely swiftness of sanctions being associated with stronger intentions to engage in risky driving behaviours), and nine studies reporting that perceived swiftness was not a significant predictor of intentions. It was reported that these findings may be because penalties are rarely applied swiftly in a road safety context.

Similar to the classical deterrence theory, there has been mixed support for Stafford and Warr's (1993) reconceptualised model of deterrence. For example, while some studies have found that greater reported experience of direct (personal) and indirect (via family and friends) punishment and punishment avoidance were associated with lower intentions to engage in illegal driving behaviours, other studies have found no significant results. That said, direct experience of punishment avoidance has been identified as an important factor associated with illegal driving behaviours including handheld phone use while driving (Truelove et al., 2019a), drink and drug driving (Hasan et al., 2023), and tailgating (Ochenasek, et al., 2022). Therefore, it is important that traffic policing is conducted in a manner that is difficult to avoid and counters the evasion strategies used by drivers.

Similarly, Homel's (1998) non-legal sanctions of anticipated internal loss, physical loss, material loss, and social sanctions have also been shown in some studies to be significant negative predictors of various illegal driving behaviours. That is, higher scores on these variables have been found to be associated with lower self-reported engagement in illegal driving behaviours. Most of the research investigating these constructs has focused on anticipated internal, physical, and material loss as opposed to social sanctions. The findings highlight the importance of considering non-legal sanctions to gain a greater understanding of why road users may engage in risky driving behaviours. In other words, while deterrence-related perceptions and experiences are very important, other factors outside of deterrence also play a key role in road user safety.

It was identified in several studies that road users need to be aware of the sanctions for deterrence to have an effect. As noted above, Truelove et. al. (2019b) argued that a fundamental concept of deterrence theory was that an individual had to be aware that something was illegal for deterrence to have an effect. Thus, and in the context of severity, if an individual is not aware of the punishment associated with a specific behaviour, then severity of punishment is unlikely to be a deterrent.

Most of the historical literature relating to the role of deterrence in road safety has focused on drink driving and the impact of RBT and associated sanctions on this behaviour. This research identified that licence suspension/disqualification is an effective general deterrent for drink driving. For RBTs, the evidence suggested that, "*The aim of RBT is to create a sense of unease about drinking and driving amongst potential offenders through highly visible police enforcement which gives the impression of being unpredictable, unavoidable, and ubiquitous*" (Homel, 1993, p. 28S).

Most of the studies in the review which addressed how enforcement had been supported by education and awareness activities examined the effects of public education campaigns alongside police enforcement approaches. There were mixed findings regarding the extent to which public education campaigns were found to operate independently of enforcement activities, and the extent to which public education campaigns and enforcement activities reinforce one another. For instance, Tay (2005a) reported that anti-drink driving campaigns affected drink driving crashes independently of, and were not dependent on, the levels of enforcement activities. However, Tay (2005b) found that anti-speeding campaigns did not function independently (from enforcement) in reducing speeding-related crashes. Similarly, in his seminal meta-analysis of road safety public education campaigns, Elliott (1993) concluded that public education campaigns are more effective when used to signpost and/or support other initiatives (e.g., enforcement). While the studies reviewed support the use of public education campaigns and advocacy, most studies acknowledged that it is very difficult to measure the independent effects of public education campaigns and advocacy activities which typically are implemented alongside an array of other initiatives including enforcement.

Case studies of enforcement approaches

Case studies of the enforcement approaches of five countries were conducted. These countries included Ireland, the United Kingdom, Australia, Sweden, and Norway. These countries were selected as they are considered global leaders in road safety best practice. For each jurisdiction, the following information is presented herein:

- General overview of the traffic enforcement system,
- Approaches to enforcement regarding speeding behaviour, use of mobile devices, drink and drug driving, and non-and incorrect seat belt use,
- Road policing statistics including the number of enforcement checks and detected offences from 2014-2023, and trends for detected offences between 2020-2023, and
- Key traffic enforcement and offence related metrics.

While transport policy and approaches to enforcement differed across jurisdictions (and within the United Kingdom and Australian states and territories), all jurisdictions impose monetary fines for illegal driving behaviours. While there are set fines for traffic offences for drivers residing in Ireland, the United Kingdom, Australia, and Norway, for some traffic offences in Sweden the amount of the fine is aligned with the driver's income. All jurisdictions have a penalty point system for most traffic offences, with the exception of Sweden which does not have a penalty point system.

The monetary fines applied differed across jurisdictions. The following are examples of monetary fines which apply to speeding behaviour, with further information about fines applied to other illegal behaviours reported within. In Ireland, a driver who exceeds the posted speed limit is fined €160 if the fine is paid within 28 days of the offence and €240 if the fine is paid after 28 days of the offence. If a driver is summoned to court because of nonpayment, then a third payment option allows the driver to pay the fine up to seven days before the court date. In other jurisdictions such as Norway, Sweden, and Australia, the amount of the fine depends on how much a driver was exceeding the posted speed limit (i.e., higher speeds resulting in higher fines), with licence suspension applied for high-range speeding offences.

For all jurisdictions, it is illegal for a driver to use a handheld mobile phone while driving and a requirement for a driver and passengers to wear a seatbelt. However, detecting these illegal behaviours is difficult for police to manually monitor. To overcome this difficulty, some jurisdictions have implemented new mobile phone and seatbelt cameras. As highlighted in the Australian case study, since the introduction of mobile phone and seatbelt detection cameras in some Australian States and Territories, the number of detected seat belt offences has increased from 5,531 in 2021 to 58,073 in 2023, and the number of detected mobile phone offences has increased from 138,987 in 2020 to 311,563 in 2023. This finding highlights the importance of new enforcement technologies.

For all jurisdictions, traffic police resources were allocated to assist with border controls during the COVID-19 pandemic. This reduction in traffic enforcement resulted in a decrease of police activities, including random alcohol breathalyser tests. During this time, and in some countries, there was an increase in the number of offences detected via automatic operations (e.g., speeding behaviour detected via speed cameras) and a reduction in the number of offences detected via manual police operations.

Australia had the highest number of speeding offences detected per licensed vehicle, followed by England and Wales, Northern Ireland, and then Ireland. Both Australia and Ireland recorded a higher number of mobile phone offences detected per licensed vehicle compared to the other jurisdictions. Australia also recorded the highest number of alcohol breathalyser tests performed per licenced vehicle, followed by Sweden, then Ireland. Further specific details are provided herein for all of these findings.

Recommendations

Police enforcement is one of the most effective countermeasures to reduce illegal and risky on-road behaviours. Based on findings from the systematic review and case studies of the enforcement approaches of the five countries, 13 recommendations are provided to optimise enforcement approaches for Ireland. The rationale for each recommendation is outlined on pages 79-85. First, we propose three of what we term “General Recommendations” which reflect what is required in essence for any jurisdiction looking to adhere with deterrence-based principles. That said, the third of these recommendations relating to policing numbers, we have discussed in relation in the context of Gardaí in Roads Policing. These three recommendations are:

- General Recommendation 1: Priority should be given to traffic enforcement approaches that increase drivers’ perceived risk of apprehension and certainty of punishment, while minimising experiences of punishment avoidance.
- General Recommendation 2: Traffic penalties need to be applied swiftly and strictly. The penalty needs to be appropriate and should match the crime.
- General Recommendation 3: Establish an ongoing commitment to benchmark the number of Gardaí dedicated to road policing and the extent of technology (e.g.., cameras) deployed against countries who are global leaders in best practice road safety. Depending on resources, benchmarking could occur every 1-5 years. Further, publishing the number of tests (e.g., breath tests/checks completed) are also required to gain a greater understanding of offence rates, and the pattern of offence rates over time.

Next, a series of more behaviour-specific recommendations (of which there are eight “Specific Behaviour Recommendations” relating to speeding, mobile phones and seatbelts, drink and drug driving) are provided. These eight recommendations are:

- Specific Behaviour Recommendation 1: To use a combination of covert (i.e., hidden) and overt (i.e., visible) automated and manual operated speed cameras for optimal speed enforcement. Random deployment of speed enforcement activities should also be considered to increase the unpredictability of the operations.
- Specific Behaviour Recommendation 2: Consideration should be given to implementing a graduated approach to speeding fines and penalty points, whereby penalties increase based on how much a driver was exceeding the posted speed limit. Immediate licence suspensions should also be considered for high-range speeding offences.
- Specific Behaviour Recommendation 3: The methods used to deploy smart cameras in Ireland to detect handheld mobile phone use and seatbelt non-compliance should be based on learnings from other jurisdictions, including the optimal mix of overt/covert and fixed/mobile operations.
- Specific Behaviour Recommendation 4: Consideration needs to be given to expanding the powers of the Gardaí so that they can stop and breath test and /or drug test a driver at any time, irrespective of the circumstances. This would replicate the powers that police have in jurisdictions such as Australia, which serve to reinforce to drivers that they can be breath/drug tested ‘anywhere and at anytime’.
- Specific Behaviour Recommendation 5: The number of alcohol breathalyser tests return to, at a minimum, pre-COVID levels.
- Specific Behaviour Recommendation 6: Consideration should be given to lowering the BAC limit for learner and novice drivers from 0.02 to 0.00.
- Specific Behaviour Recommendation 7: Ireland should consider introducing a requirement for repeat and/or high range (i.e., a BAC of 0.15 or over) drink drivers to have an alcohol ignition interlock fitted to their vehicle as a condition of relicensing. Ideally, the interlocks should be part of a broader rehabilitation program and remain fitted until the drivers demonstrate sustained compliance with the device.
- Specific Behaviour Recommendation 8: Consideration should be given to implementing a more random approach to roadside drug testing.

Finally, we offer two “Specific Countermeasure Recommendations” pertaining to public education and advertising campaigns. These two recommendations are:

- Specific Countermeasure Recommendation 1: Public education campaigns should continue to be used to support enforcement activities in Ireland as well as in efforts to change road user behaviour. The development of these campaigns needs to be theoretically underpinned.
- Specific Countermeasure Recommendation 2: Public education campaigns are required to signpost any changes to road rules and penalties.

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1. Introduction

The MAIC-QUT Road Safety Research Collaboration (formerly CARRS-Q) was commissioned by the Road Safety Authority (RSA) of the Republic of Ireland to provide a review of deterrence theory and enforcement case studies relating to road safety.

1.1. Background

Each year approximately 1.19 million people die because of a road traffic crash, with many more people sustaining lifelong injuries (WHO 2023). While most road traffic deaths occur in low-and-middle income countries (i.e., over 90%; WHO, 2023), individuals from high-income countries are also susceptible to traffic crashes. For example, in Ireland, there were 172 road fatalities in 2024 (RSA, 2025). In the same calendar year in Australia, 1,306 road users were fatally injured (BITRE, 2025). Risky driving behaviours are one factor which contributes to these road fatalities. Examples of risky driving behaviours include exceeding the posted speed limit, driving under the influence of alcohol or drugs, distracted driving, driving while tired, and incorrect use or non-use of seat belts. Although there have been many initiatives or countermeasures designed to prevent risky driving behaviours, traffic law enforcement is one approach which has shown to be effective at reducing these risky driving behaviours. Traffic law enforcement consists of three components, including: i) traffic rules, regulations, and laws, ii) policing practices, and iii) penalties (Watson et al., 2013).

1.2. Role of enforcement in road safety

Enforcement is critical to road safety. Examples of enforcement measures include, but are not limited to, speed cameras, random breath testing (RBT), and roadside drug testing (RDT). Previous research has shown that police enforcement measures reduce crashes (Wu et al., 2021) and subsequent injuries and fatalities (e.g., De Pauw et al., 2014; Elvik, 2024; Fisa et al., 2022; Wilson et al., 2010). In the context of speed cameras, De Pauw et al (2014) examined the safety effects of 65 fixed speed cameras in Flanders, Belgium between 2002 and 2007. Their results revealed that there was a 29% reduction in crashes involving serious and fatal injuries after the cameras were installed compared to before the cameras were installed. Further, a review by Wilson et al. (2010) of 35 studies showed that both average speeds and crashes (fatal and serious injury crashes) were reduced in the vicinity of camera sites compared to either before the introduction of speed cameras or to comparable sites without speed cameras. In addition to reducing average speeds and crashes, studies have also reported that drivers perceive police enforcement to be more effective at influencing their driving behaviour compared to other speed-related countermeasures. In a recent study by Kaye et al. (2024), it was found that Australian drivers (N=680) reported that police enforcement (i.e., presence of a speed camera or police vehicle) would be most effective at assisting them to comply with posted speed limits on low and high-speed urban and regional roads when compared to other initiatives such as advanced driver assistance systems (ADAS), in-vehicle alerts, messaging (i.e., messages presented on billboards or variable message signs), and other approaches such as checking one's speedometer. Collectively, this research shows that speed enforcement has a positive effect on road safety.

Random breath testing (RBT) is another countermeasure which has been shown to be an effective means of deterring drink driving (e.g., Homel, 1988b). RBT is a highly visible roadside enforcement activity which involves police officers randomly stopping drivers to test their breath samples for alcohol, with studies showing that RBT has resulted in reductions of alcohol related crashes (e.g., Elder et al., 2002; Henstridge et al. 1997; Morrison et al., 2020; Peek-Asa, 1999). For example, Peek-Asa (1999) reviewed 14 studies which examined the effectiveness of RBT (in Australia) and

sobriety checkpoints (in the US). While all studies reviewed in Peek-Asa (1991) showed that both RBT and sobriety checkpoints reduced alcohol-related crashes, injuries, and fatalities, random screening in areas of previous alcohol-related fatalities showed the greatest decreases. A more recent study by Morrison et al. (2021) estimated that there was a 12% reduction in alcohol-related crashes at RBT sites in Brisbane, Australia for approximately 1-week post roadside RBTs. Taken together, this research highlights the importance of RBT in reducing drink driving behaviour.

Roadside drug testing (RDT) is another enforcement countermeasure designed to reduce drug driving. RDT involves police officers stopping drivers to test their saliva and which detects the presence of a relevant drug. This test can be conducted in conjunction with alcohol tests at RBT sites or targeted at specific drug testing sites. However, and compared to RBT, there has been less research which has examined the deterrent effects of RDT. Horyniak et al. (2017) recruited people who had injected drugs at least monthly in the six months prior to participating in their Australian study. They found that the prevalence of self-reported drug driving significantly decreased between 2007 (83%) and 2013 (74%), with the percentage of participants who reported having experienced a RDT significantly increasing between 2007 (4%) and 2013 (18%). However, the findings also showed that there was no significant difference in drug driving between those who had been tested once and those who had been tested more than once. The authors concluded that despite a decrease in drug driving between 2007 and 2013, RDT had no specific deterrent effect on drug driving. In contrast, a Spanish study which was undertaken around the same time (2008/09 to 2013) found a decrease in the prevalence of drug driving after the introduction of screening tests (Fierro et al., 2015). As highlighted in a recent systematic review of factors associated with illegal drug driving (Hasan et al., 2022), the effectiveness of drug driving enforcement approaches may differ between jurisdictions. Alternatively, the differences in the findings reported above may also reflect differences in research methodologies.

1.3. Deterrence theories

Today, many enforcement approaches that are employed to discourage risky driving behaviours and improve road safety utilise deterrence theory. The three most populator and widely known deterrence theories are classical deterrence theory, Stafford and Warr's (1993) reconceptualised model of deterrence, and (1988) extended deterrence-based model. These three theories are outlined in the subsequent sections. The systematic review of this project (and as reported in Section 2 of this report) outlines recent studies published since 2014 which have applied classical deterrence theory, the reconceptualised model of deterrence, and extended deterrence-based model in the context of traffic offending. Key or seminal studies which were published prior to 2014 were also included for completeness.

1.3.1. Classical deterrence theory

Deterrence theory was originally established in the 18th century by Beccaria and Bentham. They proposed that individuals are motivated by a combination of punishment and rewards. Beccaria and Bentham's work lays the foundation for classical deterrence theory. Classical deterrence theory consists of three key components: certainty of apprehension (and punishment), severity of sanctions, and swiftness of sanctions, and focuses on people's perceptions of these outcomes. Certainty of apprehension refers to the likelihood that an offender will be apprehended for a crime. Thus, for example, if an individual perceives a high likelihood of being arrested for a crime, they will be less likely to offend. Further, certainty does not just relate to apprehension, but also to punishment. For example, it is possible that some people might think it is likely they will be detected, but unlikely they will be punished because they may believe that there is some inconsistency in the way police apply the laws. The second component, severity of sanctions, relates to the perceived severity of the penalty for committing an offence. The theory proposes that the punishment for the crime needs to

be appropriate (i.e., is just) for severity to be seen as a factor in deterrence. The final component, swiftness of sanctions, refers to the timing of punishment. It is proposed that punishment which is delivered swiftly relative to the detected offence will have a greater deterrent effect than punishment delivered at some later time.

Classical deterrence theory proposes that there are two main types of deterrents: general deterrence and specific deterrence. General deterrence is a means of preventing crime at the general population level, whereas specific deterrence targets the individual. Specifically, general deterrence occurs when an individual is deterred from committing an offence due to witnessing (or hearing of) others being punished for that offence. Specific deterrence relates to deterring individuals who have previously been punished for an committing an offence. In this case, the individual may be deterred from committing a future offence to avoid further punishment. RBT exemplifies both a general and specific deterrent effect (Homel, 1988a; Watson & Freeman, 2007). As a general deterrent, RBT (in Australia) is highly visible on the road and can occur anywhere and at any time. While, as a specific deterrent, RBT acts to deter previous drink driving offenders against future offending behaviours (Watson & Freeman, 2007).

1.3.2. Reconceptualised model of deterrence

Stafford and Warr (1993) reconceptualised general and specific deterrence. They proposed that there are four ways in which punishment impacts deterrence, including: i) direct experience of punishment, ii) the indirect experience of punishment, iii) the direct experience of punishment avoidance, and iv) the indirect experience of punishment avoidance. Direct experience refers to the individual themselves having had the experience (e.g., receiving a speeding fine) where indirect experience relates to knowing of someone who has the experience (e.g., family/friend receiving a speeding fine). Punishment refers to whether an individual is caught and punished (i.e., punishment) or commits a crime, or is not caught and punished (i.e., punishment avoidance). An example of punishment avoidance is where a driver exceeds the posted speed limit and avoids being caught by police or by a speed camera. Stafford and Warr (1993) also proposed that general and specific deterrence should not be seen as two separate approaches; rather, crime rates will be influenced by both general and specific deterrence and that these deterrents should be instead viewed on a continuum. A recent article by Mears and Stafford (2024) also supports a more comprehensive theory of deterrence than the original classical deterrence theory approach. Mears and Stafford (2024) argued that deterrence is more complex than what was originally outlined in the classical deterrence theory. In their article, they provide a number of strategies for enhancing deterrence-based policies, including targeting both the costs and rewards of crime and non-crime and leveraging the interactive nature between certainty of punishment, severity, and swiftness.

1.3.3. Extended deterrence-based model

Homel's (1988) extended deterrence-based model proposes that there are four non-legal factors (sometimes referred to as informal sanctions) which may also influence engagement in risky driving behaviours. The four non-legal factors include internal loss (i.e., feelings of shame, guilt or embarrassment), physical loss (i.e., fear of physical injury, for self and others), material loss (i.e., fear of receiving a fine or demerit points) and social sanctions (e.g., social judgement, disapproval from those close to you). Some studies which have applied either the classical deterrence theory or Stafford and Warr's (1993) reconceptualised model of deterrence has also measured these non-legal factors suggested by Homel (e.g., Freeman & Rakotonirainy, 2017; Kaviani et al., 2022; Ochenasek et al., 2022; Truelove et al., 2023a).

1.4. Role of education and awareness activities in supporting enforcement

Police enforcement activities are essential in ensuring that road users comply with the road rules. Education and awareness activities may also assist in supporting police enforcement activities. Public education campaigns are one example of an initiative used in conjunction with enforcement activities to encourage safer driving behaviours (e.g., Elder et al., 2004; Megat-Johari et al., 2022; Vasudevan et al., 2009). For example, Megat-Johari et al. (2022) examined the effects of road safety messages across three timepoints: before police enforcement activities (2 weeks), during police enforcement activities (4 weeks), and after police enforcement activities (1-3 weeks). They reported that during the enforcement period, messages displayed on dynamic (variable) message signs resulted in slightly lower rates of drivers using a mobile phone compared to messages which focused on general travel time information. In addition to public education campaigns, other activities, such as activist movements may also assist with enforcement efforts. As an example, Mothers Against Drunk Driving (MADD) is one group in the United States which has changed public attitudes towards drink driving. Founded in 1980, MADD continues to increase public understanding of the dangers of drunk driving, supports enforcement activities (e.g., sobriety checkpoints), advocates for changes in legislation, and support those who have been affected by drunk driving (Fell & Voas, 2006). While it is difficult to estimate the influence of MADD on the reduction of drunk driver fatalities in the US during the 1980-1990s, it has been reported that MADD has continued to change attitudes towards drunk driving (Fell & Voas, 2006). Examples of how MADD has been reported to change attitudes towards drink driving include via advocacy, public education campaigns, and school-based education programs which are designed to educate students on the effects of alcohol and drugs, and impaired driving (Fell & Voas, 2006; Loewit-Phillips & Goldbas, 2013).

1.5. Research objectives

The purpose of this project as reported herein was to review the latest evidence of deterrence theory and conduct case studies of traffic enforcement approaches of five countries (i.e., Ireland, United Kingdom, Australia, Sweden, and Norway). Based on the findings from the systematic literature review and case studies, recommendations to optimise enforcement approaches in Ireland and how these approaches can be supported by education and awareness activities are outlined.

1.6. Report structure

The report is divided into four sections. The next section presents a systematic literature review which provides a detailed overview of deterrence theory applied to the context of traffic offending and how enforcement can best be supported by education and awareness activities considering deterrence theory. Section 3 outlines a case study approach to examine traffic enforcement approaches of five countries. Section 4 presents the key recommendations of this research based on the findings from the systematic review and case studies.

2. Systematic literature review

2.1. Introduction

The objective of this systematic review was to identify studies which have focused on deterrence theory in the context of traffic offending, and how enforcement has been supported by education and awareness activities. The review considered literature which had been published within the past 10 years. Additionally, and to ensure a comprehensive overview of deterrence theory and supporting activities in enforcement was provided, key articles and reports published prior to 2014 were also reviewed and are included below in addition to the systematic review. To address the research objective, the following two questions were used to guide the systematic review:

RQ1. How is deterrence theory applied in the context of traffic offending?

RQ2. How is enforcement best supported by education and awareness activities?

2.2. Method

2.2.1. Search strategy and databases

The search process followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRIMSA) guidelines (Page et al., 2021a,b) and was undertaken on December 20th 2024. Four databases were searched including Scopus, Embase, APA PsycINFO (via EBSCOhost), and Transportation Research International Documentation (TRID). Title, abstract, and keywords were searched in each database. The search terms were piloted prior to undertaking the main search to ensure that all relevant articles published since 2014 were captured. Appropriate Boolean operators were used to further ensure that all relevant articles were identified in the search. Table 1 presents the search terms.

Table 1. Search terms

Search terms
deterren* AND "traffic offen*"
deterren* AND "road safety"
deterren* AND "risky driv*"
deterren* AND "risky behavi*"
deterren* AND “traffic violation”
enforcement AND “road safety” AND education
enforcement AND “road safety” AND awareness
enforcement AND “road safety” AND campaign
enforcement AND “road safety” AND publicity
enforcement AND “road safety” AND “mass media”

2.2.2. Eligibility criteria

Both peer-reviewed and grey literature were considered for this review. Studies were required to i) focus on deterrence theory in the context of traffic offending or report on how enforcement is supported by education and awareness activities, ii) have been published between 2014 to present, iii) have been published in English, and iv) have been available in full text.

2.2.3. Screening

Figure 1 outlines the article screening process. Referencing software EndNote 21 was used to perform the title and duplicate screening of the identified articles and documents. SK performed the title and duplicate screening, and review of abstracts. EP then screened the full texts, which was checked by SK. To account for any studies not captured by the initial search, EP scanned the reference lists of those full text articles selected for inclusion and undertook additional searches in Google Scholar using the previously defined search terms. In total, 36 articles were identified for inclusion in the systematic review.

2.2.4. Data extraction

To extract the data, EP read each of the included studies and recorded the information in a Microsoft Excel spreadsheet. Specifically, the recorded data included information about the year of publishing, whether the article contained original research or a review of the subject, the road safety focus, research questions and research aims, applied theory or theories, participant details, variables of interest, and the main findings. Through the screening process the systematic review included studies guided by the Classical Deterrence Theory and the Reconceptualised Deterrence Theory as described by Stafford and Warr (1993). Other theoretical concepts that were included in individual studies were: Homel's (1988a) extra-legal deterrence-related variables of the fear of physical loss, material loss, and social sanctions; self-determination theory (Ryan & Deci, 2000); social cognitive theory (Bandura, 1986, 1991); theory of planned behaviour (Ajzen, 1991); and Aker's social learning theory (1977, 1990).

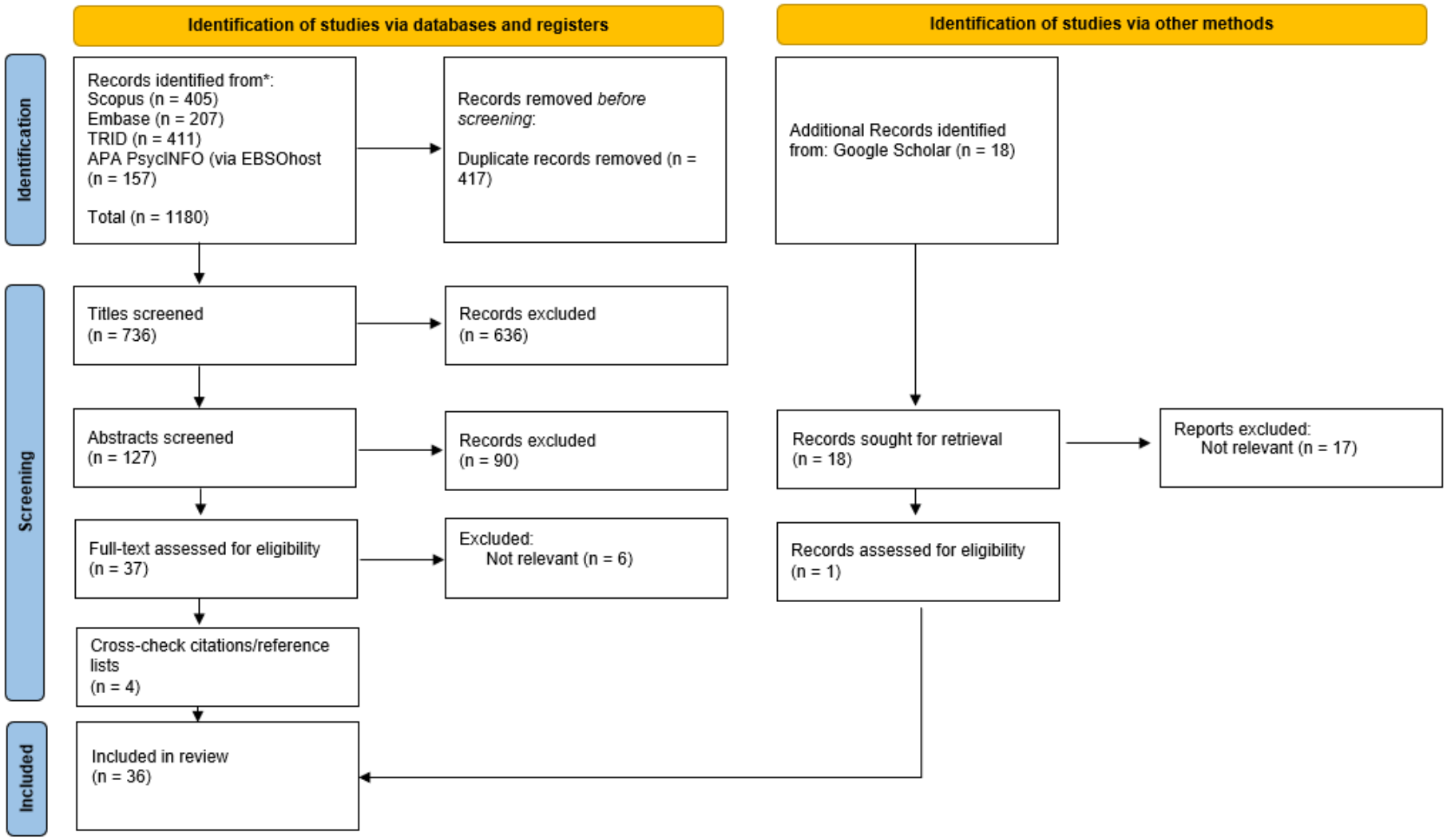


Figure 1. PRISMA flow diagram and results of its application in the current project

2.3. Results

2.3.1. Study characteristics

Of the 36 articles or reports identified within the systematic review, 28 focused on deterrence and traffic offending (RQ1) and eight focused on education and awareness activities (RQ2). For those 28 articles[1] which addressed deterrence and offending, seven articles focused on drink driving and/or random breath testing, six focused on smartphone use (distraction), five focused on drug driving and/or roadside drug tests, four focused on speeding behaviour, three focused on compliance with graduated driver licensing restrictions, and one article each focused on tailgating, street racing and stunt driving, pedestrian crossing behaviour at rail crossing, and risky behaviour from both food delivery and private motorcycle riders, and general illegal driving behaviours. Two of these 28 articles were review articles.

For those eight papers that addressed education and awareness activities, two focused on evaluating enforcement and public education campaigns, one article focused on variable message signs (VMS), one focused on examining the effects of a speed management pilot program, and one article examined the influence of text messages from police on offending behaviour. Three of these eight articles were reviews. One article reviewed other systematic reviews which had examined the effects of interventions preventing road traffic crashes, one article reviewed persuasive communication campaigns, and one report reviewed countermeasures associated with drug driving.

Most of the studies included in this systematic review originated from Australia (n = 27). The reason why most studies were conducted in Australia may be because Australia has relied upon traffic enforcement heavily and as such, this has promoted associated research on optimal enforcement. The other studies included in this review emerged from Canada (n = 1), China (n = 2), Germany (n = 1), Israel (n = 1), United States (n = 2), Vietnam (n = 1), and Zambia (n = 1).

2.3.2. RQ1. How is deterrence theory applied in the context of traffic offending?

Twenty-eight articles focused on how deterrence theory can be applied in the context of traffic offending. Most of the research identified was structured around classical deterrence theory and the central concepts of certainty of apprehension and punishment, severity of sanctions, and swiftness of sanctions. Further, some studies included in the systematic review added constructs from either Stafford and Warr's (1993) reconceptualised deterrence theory or Homel's (1988a) extended deterrence-based model. Homel's (1988a) extended deterrence-based model proposes that there are four non-legal factors (sometimes referred to as informal sanctions) which may also influence engagement in risky driving behaviours, including internal loss (i.e., feelings of shame, guilt or embarrassment), physical loss (i.e., fear of physical injury, for self and others), material loss (i.e., fear of receiving a fine or demerit points) and social sanctions (e.g., social judgement, disapproval from those close to you).

Most of the studies reported below relied upon self-reported surveys, and therefore, the deterrence variables have been operationalised as perceptions as opposed to actual behaviour. Some studies also incorporated other theories (e.g., theory of planned behaviour, Ajzen, 1991; Akers' social learning theory, 1977, 1990) to further account for variance in explaining the behaviour(s) under investigation. These findings are discussed below in accordance with each particular deterrence theory and related constructs. Further details about each study are presented in the Appendix. The focus of this section is on the original articles, with Section 2.2.6.4. outlining the findings from the two review articles.

[1] Several papers addressed more than one behaviour.

2.3.2.1. Classical deterrence theory

Classical deterrence theory consists of three key components: certainty of apprehension (and certainty of punishment), severity of sanctions, and swiftness of sanctions, and focuses on people's perceptions of these outcomes. Certainty of apprehension and punishment refers to the likelihood that an offender will be apprehended and punished for a crime. Severity of sanctions relates to the perceived severity of the penalty for committing an offence. The theory proposes that the punishment for the crime needs to be perceived as salient and appropriate (i.e., is just) to act as a deterrent. Swiftness of sanctions refers to the timing of punishment, with punishment delivered swiftly being more likely to have a deterrent effect.

2.3.2.1.1. Perceived certainty of apprehension and punishment

Most deterrence studies identified in the systematic review focused on the perceived certainty of apprehension as opposed to the perceived certainty of punishment. Perceived certainty of apprehension was found to be a significant predictor of behaviour in five studies (i.e., Freeman et al., 2020, 2021a; Hasan et al., 2023; Szogi et al., 2017; Truelove et al., 2017). For example, Hasan et al. (2023) applied both deterrence theory and Akers' social learning theory (1977, 1990) to examine factors which predicted drink and drug driving in a sample of 1,394 Australian drivers. The logistic regression showed that perceived certainty of punishment was significantly associated with drink driving, with participants who perceived punishment to be more certain, less likely to report drink driving. The findings also showed that direct experience of detection avoidance was also significantly associated with self-reported drink driving. Freeman et al. (2020) utilised deterrence theory to examine the legal and non-legal deterrents to drink driving in a sample of 733 Australian drivers. Participants completed a self-report questionnaire. Freeman et al. (2020) undertook a logic regression and found that the perceived certainty of apprehension was a significant positive predictor of self-reported future intentions to drink and drive (in addition to swiftness, severity was not significant). The odds ratio was 1.25, which the authors interpreted that for every 1 point increase on the 7-point certainty of punishment subscale, participants were 25% more likely to report future intentions to drink drive. This finding is inconsistent with the classical deterrence theory which would predict that stronger perceptions of perceived certainty of apprehension would be associated with weaker intentions to drink drive.

In Szogi et al. (2017) and Truelove et al. (2017), perceived certainty of apprehension was examined in a more refined way by separating general perceived certainty and personal perceived certainty of apprehension. General perceived certainty referred to what an individual perceives would happen to other people in a specific situation, while personal perceived certainty focuses on what would happen to them in that situation. In both studies, personal perceived certainty of apprehension was a significant negative predictor of drink driving (Szogi et al., 2017) and speeding behaviour (Truelove et al., 2017). These findings suggest that stronger perceptions of perceived certainty of apprehension were associated with lower ratings of self-reported drink driving and speeding behaviour. General perceived certainty of apprehension was not a significant predictor in either study. These findings highlight that there may exist a distinction between perceptions of personal and general certainty of apprehension.

Another study, which examined young drivers using their smartphone while driving, reported that perceived certainty of apprehension was a significant negative predictor of both initiating and responding to smartphone communications while driving (whereas neither swiftness nor severity were significant predictors; Ogden et al. 2022). These findings suggest that stronger perceptions of perceived certainty of apprehension were associated with weaker scores on initiating and responding behaviours in a typical week. However, when non-legal variables of social sanctions (defined in Ogden et al. as participants concerns about losing respect from their parents and peers) anticipated

action regret, anticipated inaction regret and injury to self/others were added into the hierarchical regression model, certainty of apprehension was no longer a significant predictor of smartphone use. These findings suggest that factors other than legal deterrents may also influence behaviour.

Other studies identified in the systematic review found no effects of perceived certainty of apprehension (e.g., Armstrong et al., 2018; Freeman & Rakotonirainy, 2017; Huang et al., 2023; Kaviani et al, 2020, 2022; Nguyen-Phuoc et al. 2024; Ochenasek et al. 2022; Truelove et al. 2019a, 2020, 2021; Watling et al., 2014). For example, Ochenasek et al. (2022) reported in a survey study focusing on the behaviour of following a vehicle too closely, that perceived certainty of apprehension was not a significant predictor of the likelihood to tailgate. This finding may be due to the belief that a driver had a small chance of being caught for tailgating. Of note, this study was undertaken in Queensland, Australia, where following a vehicle too closely (tailgating) is an offence. Similarly, Truelove et al. (2019a) reported that perceived certainty of apprehension was not a significant predictor of using Snapchat while driving in a sample of 503 young Australian drivers. However, Stafford and Warr's (1993) constructs were significant predictors of using Snapchat (see Section 2.2.6.2). Similarly, Truelove et al. (2021) reported that perceived certainty of apprehension was not a significant predictor of young drivers' engagement in exceeding the posted speed limit by 10km/hr.

In a focus group study about the Queensland Graduated Driver Licencing (GDL) restrictions (see Table 2), Truelove et al. (2019b) found that that young Queensland drivers' perceptions of certainty of apprehension varied depending on the behaviour. Specifically, young drivers reported that the GDL restrictions were difficult to enforce, particularly the requirement that novice drivers were required to display a p-plate[2]. Participants also reported that phone use while driving was infrequently enforced[3] and therefore, they were more likely to report using their phone while driving. However, regarding drink-driving, the zero alcohol limit restriction for novice drivers was associated with high levels of certainty of apprehension.

Table 2. Graduated driver licencing requirements (Queensland, Australia)

Queensland
Provisional One (P1)
Minimum age of 17 years
Peer passenger restrictions
Zero blood-alcohol concentration
Display red P plates on vehicle
No mobile phone usage (even using Bluetooth or hands-free)
High-powered restrictions
Provisional Two (P2)
Minimum age of 18 years
Zero blood-alcohol concentration
Display green P plates on vehicle
High-powered restrictions

2.3.2.1.2. Perceived severity of sanctions

There were mixed findings regarding the extent to which the severity of punishment was a significant deterrent in the studies included as part of the systematic review. Some studies reported that severity of penalties was an effective deterrent (e.g., Huang et al., 2023; Ochenasek et al., 2022; Szogi et al., 2017; Truelove et al., 2017, 2020, 2021). For example, Huang et al. (2023) reported that perceived severity of punishment was a significant negative predictor of low-range (less than

[2] https://www.qld.gov.au/transport/licensing/driver-licensing/applying/provisional/p-plates

[3] This study was undertaken prior to the introduction of the mobile phone camera in Queensland, Australia.

10km/hr over the posted speed limit), mid-range (10km/hr over but less than 20km/hr over the posted speed limit), and high range (more than 20km/hr over the posted speed limit) speeding behaviour. This finding means that stronger perceptions of the likely severity of sanctions were associated with weaker engagement in speeding behaviour. Further, Szogi et al. (2017) included two severity items in their survey to measure which deterrence variables influenced drink driving. Item 1 was, “a penalty for drink driving would cause a considerable impact on my life” and item 2 was, “a penalty for drink driving would be severe for me”. Szogi et al. (2017) found mixed support for the severity construct. Consistent with the classical deterrence theory, participants who reported the drink driving penalty to be severe, were less likely to self-report previous engagement in drink driving. However, and contrary to the tenets of the theory, Szogi also found that participants who reported that a penalty would cause considerable impact on their lives, were more likely to report previous engagement in drink driving behaviour. The authors of this study noted that one explanation for this conflicting finding may have been that participants perceived different meaning to the language used in each question (e.g., considerable impact vs. severe). Of note, within Szogi et al.’s (2017) study, most participants (949 out of 1257) reported having never engaged in drink driving.

In another study, Meirambayeva et al (2014) studied the deterrent effects of Ontario’s street racing and stunt driving legislation as implemented in 2007. They found a significant reduction in convictions for extreme speeding (>50km/h over the posted speed limit) in the male population after the new regulations were deployed. The penalties included immediate vehicle impoundment and loss of driver licence as well as a minimum fine of CAN $2000 on conviction. The researchers described vehicle impoundment as one of the most severe penalties for traffic offences, and when added to loss of licence, severely restricted the offender’s access to driving.

In contrast, other studies reported that severity of punishment was not a significant deterrent (e.g., Armstrong et al., 2018; Freeman & Rakotonirainy, 2017; Hasan et al., 2023; Kaviani et al., 2020; Nguyen-Phuoc et al., 2024; Ogden et al., 2022). For example, Ogden et al. (2022) found that severity was not a significant predictor of young drivers initiating and responding to smartphone communications while driving in a typical week. Similarly, Freeman and Rakotonirainy (2017) reported that severity was not a significant predictor of self-reported crossing rule violation. Truelove et. al. (2019b) argued that a fundamental concept of deterrence theory was that an individual had to be aware that something was illegal for deterrence to have an effect. Thus, and in the context of severity, if an individual is not aware of the punishment associated with a specific behaviour, then severity of punishment would not be a deterrent. This explanation may account for the lack of support for classical deterrence theory in the Freeman and Rakotonirainy (2017) study, which examined pedestrian railway crossings. It reported that participants lacked knowledge of the monetary fines associated with breaching crossing rules at rail crossings (e.g., crossing when the lights were flashing, ignoring warning signals, crossing when the gate was closed).

2.3.2.1.3. Perceived swiftness of sanctions

As with certainty of apprehension and severity of sanctions, there were mixed findings regarding the extent to which swiftness of punishment was a significant deterrent in the studies identified as part of the systematic review. Two studies reported that the perceived swiftness of punishment was a significant predictor of the behaviour under investigation (Freeman et al., 2020; Nguyen-Phuoc et al., 2024). However, and in both studies, the direction of the finding was inconsistent with the predictions of the classical deterrence theory. For instance, Freeman et al. (2020) found that perceived swiftness of punishment was a significant positive predictor of participants driving when they thought they were above the legal Blood Alcohol Concentration (BAC) limit. The odds ratio was 1.26, which the authors interpreted that for every 1-point increase on the 7-point scale which measured perceptions of swiftness of legal sanctions, participants were 26% more likely to have reported driving when they knew they were above the legal BAC limit. Further, Nguyen-Phuoc et al.

(2024) reported that swiftness of sanctions was a significant positive predictor of food delivery riders' intentions to engage in risky riding behaviours. This finding suggests that stronger perceptions of the likely swiftness of sanctions were associated with stronger intentions to engage in risky driving behaviours. However, for general riders[4], swiftness of sanctions was not a significant predictor of intentions to engage in risky riding behaviours. In both Freeman et al. (2020) and Nguyen-Phuoc et al. (2024) were measured by receiving a fine soon after committing an offence. An example of one item used to measure swiftness in Freeman et al. (2020) was, "*the time between getting caught for drink driving and going to court would be very short*", and in Nguyen-Phuoc et al. (2024), "*the time between getting caught by a police officer and receiving a fine would be very short*".

Other studies found no significant influence of swiftness of punishment (e.g., Armstrong et al., 2018; Freeman & Rakotonirainy, 2017; Hasan et al., 2023; Kaviani et al., 2020; Ogden et al., 2022; Szogi et al., 2017; Truelove et al., 2017, 2019a, 2020). For example, swiftness of punishment was not a significant predictor of future likelihood of drug driving in Armstrong et al. (2018). Further, three studies did not include a measure of swiftness (e.g., Huang et al., 2023; Ochenasek et al., 2022; Truelove et al., 2023b), instead only measuring two components of classical deterrence theory (i.e., certainty and severity). Collectively, the above findings may be because penalties are rarely applied swifty in a road safety context (Davey & Freeman, 2011). For example, drivers who are detected exceeding the posted speed limit via a speed camera, may be required to wait to receive the infringement notice in the mail. Therefore, to ensure that swiftness acts as a deterrent, sanctions should be provided soon after an offence occurs.

2.3.2.2. Reconceptualised model of deterrence

Stafford and Warr's (1993) reconceptualised deterrence theory postulated that direct and indirect experiences of punishment and punishment avoidance may also influence engagement in illegal driving behaviours. Stafford and Warr's reconceptualised deterrence theory acknowledges that i) avoiding detection and punishment may reinforce offending behaviour and ii) offences are not committed within a social vacuum. In the systematic review, 11 studies included constructs from the reconceptualised deterrence theory (i.e., Armstong et al., 2018; Bates et al., 2017; Freeman et al., 2021a; Hasan et al., 2023; Huang et al., 2023; Ochenasek et al., 2022; Szogi et al., 2017; Truelove et al., 2019a, 2021, 2023a,b) and one study conducted via focus groups with young Australian drivers (aged 17-25 years) explored how this cohort experienced punishment avoidance (Bates & Anderson, 2019).

The studies included in the systematic review provided some support for Stafford and Warr's (1993) reconceptualised deterrence theory. For example, Armstrong et al. (2018) reported that both direct and indirect experience of punishment avoidance were significant positive predictors of future likelihood of drug driving. This finding means that stronger perceptions of punishment avoidance and vicarious punishment avoidance were associated with more future likelihood of drug driving. Further, Hasan et al. (2023) found that direct experience of detection avoidance for both drug and drink driving were significantly and positively associated with self-reported combined drug and drink driving. That is, stronger perceptions of avoiding detection were associated with more drug and drink driving. In a study investigating tailgating, Ochenasek et al. (2022) reported that direct punishment avoidance was a significant positive predictor of following a vehicle too closely, and indirect punishment was a significant negative predictor of following a vehicle too closely. These findings suggest that stronger perceptions of punishment avoidance were associated with a stronger likelihood of following a vehicle too closely, and stronger perceptions of indirect punishment (i.e.,

[4] This study did not state if 'riders' referred to bicycle riders, motorcycle riders, or riders who use other forms of two-wheeled vehicles (e.g., mopeds).

people participants had known to have been caught and punished for tailgating) were associated with a weaker likelihood of following a vehicle too closely. In Ochenasek et al. (2022) direct punishment and indirect punishment avoidance were not significant predictors of tailgating.

Truelove et al. (2019a) reported that direct punishment, direct punishment avoidance, indirect punishment, and indirect punishment avoidance were all significant predictors of snapchat use while driving. However, the direction of these findings were not all in the anticipated direction. Specifically, participants who had previously been caught and punished for using Snapchat while driving, were also more likely to drive and use Snapchat than those who had not been caught and punished for their behaviour. These authors stated that this finding… "*can be considered an emboldening effect, in which the direct punishment variable is identifying participants who are steadfast in their phone use while driving behaviours, therefore the punishment for this behaviour occurs most often among those participants*" (p. 153). However, and consistent with the reconceptualised deterrence theory, all other findings reported in Truelove et al. (2019a) were in the predicted direction (i.e., direct and indirect experience of punishment avoidance predicted Snapchat use, while indirect punishment, in that participants who had friends who had been caught and punished, meant those drivers were less likely to report using Snapchat while driving). Overall, besides finding general support for Stafford and Warr's (1993) reconceptualised model of deterrence, these studies particularly highlight the association between punishment avoidance and self-reported illegal driving behaviour.

2.3.2.3. Homel's legal and non-legal factors

Homel (1988a) developed an extended deterrence-based model to account for other factors which may also contribute to risky driving behaviour. Originally, this model was developed to assess the impact of RBT on drink driving. The model proposes that there are four non-legal factors which may also influence engagement in risky driving behaviours, including internal loss , physical loss , material loss, and social sanctions. One or more of these constructs were examined in 10 studies identified as part of the systematic review (i.e., Freeman & Rakotonirainy, 2017, 2020; Kaviani et al., 2020, 2022; Ochenasek et al., 2022; Ogden et al., 2022; Truelove et al., 2017, 2020, 2021, 2023a).

The studies identified as part of the systematic review found some support for the constructs included as part of Homel's extended deterrence-based model. For example, Kaviani et al. (2020) examined the effect of the classical deterrence variables and three non-legal factors (i.e., social loss, physical loss, and internal loss) on illegal phone use while driving. The study involved 2,774 participants recruited from Victoria, Australia. The findings showed that while the three classical deterrence variables were not significant predictors of illegal phone use while driving, anticipated social loss, anticipated physical loss, and anticipated internal loss were all significant negative predictors of illegal phone use while driving. These findings highlight that those who had reported stronger perceptions of losing the respect of peers (anticipated social loss), fear of hurting others and oneself (anticipated physical loss), and guilt/shame (anticipated internal loss) reported less illegal phone use while driving. This study highlights that these non-legal factors may be important in deterring drivers from using their phone while driving. Similarly, Ochenasek et al. (2022) found that anticipated internal loss and anticipated physical loss predicted tailgating, suggesting that participants perceived that following a vehicle too closely would make them feel ashamed and believe that this behaviour would increase their risk of physical injury. The anticipated social sanctions variable was not a significant predictor of tailgating.

In another study, Truelove et al. (2020) reported that anticipated material loss was a significant negative predictor of self-reported speeding behaviour, reading text messages while driving, and using snapchat while driving. These findings suggest that stronger perceptions of losing points and getting fined (anticipated material loss) were associated with lower self-reported engagement in these offences. These authors also found that anticipated physical loss was a significant negative

predictor for using snapchat while driving, but not for speeding behaviour or reading text messages. This finding suggests that stronger perceptions of getting injured or hurt, or injuring another driver (anticipated physical loss) were associated with lower self-reported ratings of using snapchat while driving. Anticipated social sanctions was not a significant predictor for any of the three self-reported behaviours under investigation. Collectively, while there are some differences in the extent to which these non-legal factors were found to influence illegal driving behaviours, the studies identified within the systematic literature review highlighted the importance of targeting non-legal sanctions to prevent engagement in illegal driving behaviours. Targeting non-legal sanctions could be achieved via public education campaigns. For example, messages in campaigns could highlight the feeling of shame or guilt with receiving a traffic fine (internal loss), social judgement from others in engaging in risky and illegal driving behaviours (social loss), or the fear of being caught or receiving a fine (material loss).

2.3.2.4. Review articles

Two articles which focused on deterrence theory and traffic offending behaviour were review articles (Freeman et al., 2015; Love et al., 2024). Freeman et al. (2015) reviewed literature which had examined perceptual deterrence (i.e., people's self-reported perceptions towards deterrence) between 1950 and 2015. The review consisted of literature from both road safety and non-road safety fields. For this report, only conclusions from the road safety field are provided. The review highlighted that during the 1970s and 1980s there was a strong focus on understanding the deterrence process in road safety and this coincided with the introduction of Homel's (1988) extended deterrence-based model. However, and since the introduction of Stafford and Warr's (1993) reconceptualised model of deterrence, there has been a lack of advancement in theoretical knowledge of deterrence since the early 1990s. Freeman et al. (2015) noted that most of the literature focuses on perceptual deterrence and past involvement in illegal driving behaviours (referred to as causal ordering). Freeman et al. (2015) noted that this may be problematic given that perceptions of risk may change over time. Further, Freeman et al. (2015) reported that most of the studies had focused on recruiting participants from high income countries. This latter finding is consistent with the current systematic review, whereby most of the studies were undertaken in Australia.

Love et al. (2024) undertook a search of articles published between 1999 and 2022 that investigated the factors deterring drink driving. In total, they identified 19 articles for inclusion in a systematic review and 12 articles for inclusion in a meta-analysis. They concluded that the level of research around drink-driving and the deterrence theory-related variables (e.g., risk perceptions and experiences with offending) was limited. The concepts of perceived certainty of apprehension, perceived swiftness, and perceived severity of legal sanctions, where these were examined, had little effect on drink driving intentions. Only the perceived likelihood of apprehension had a small negative effect on drink driving intentions indicating that drink drivers may not be deterred by the prospect of legal sanctions. Furthermore, experiences with punishment (either personal or vicarious) did not impact intentions to drink and drive, either because deterrence as a concept was ineffective among the drivers under investigation or they had previously been exposed to a level of policing too low to produce a deterrent effect.[5] Punishment avoidance was reported to have a positive effect on drink driving intentions, potentially reflecting a low expectation of apprehension. The review identified that risk perceptions relating to physical and internal harm were less researched but showed a potentially stronger association with drink driving intentions than the classical and reconceptualised deterrence concepts. In the review, Love et al. (2024) reported that the theory of planned behaviour (Ajzen 1991) was a frequently applied theory in the drink-driving literature with attitudes (i.e.,

[5] The samples included in most of the articles reviewed were recruited from the general population, and contained non-alcohol uses (Love et al. 2024, p. 161-162).

favourable or unfavourable beliefs towards the behaviour), subjective norms (i.e., perceptions that important others would approve or disapprove of the behaviour), and perceived behavioural control (ease or difficulty in performing a behaviour) having medium to large effects in their influence on individuals' self-reported drink driving intentions.

2.3.3. RQ2: How is enforcement best supported by education and awareness activities?

Seven articles and one report focused on how enforcement was best supported by education and awareness activities (i.e., Bauernschuster & Rekers, 2022; Beck & Burke, 2023; Fisa et al., 2022; Guttman, 2015; Hu & Cicchino, 2023; Lu et al., 2016; Megat-Johari et al., 2022; Mulvihill et al., 2020). Five articles reported upon original research (i.e., Bauernschuster & Rekers, 2022; Beck & Burke, 2023; Hu & Cicchino, 2023; Lu et al., 2016; Megat-Johari et al., 2022), one study provided an overview of systematic reviews which had focused on the effects of interventions preventing crashes (Fisa et al., 2022), one study reviewed persuasive appeals in road safety communication campaigns (Guttman, 2015), and one report reviewed drug driving literature and countermeasures (Mulvihill et al., 2020).

Three articles focused on evaluating enforcement and public education campaigns (i.e., Beck and Burke, 2023; Bauernschuster & Rekers, 2022; Megat-Johari et al., 2022). Bauernschuster and Rekers (2022) examined the effects of a one-day speed limit police monitoring operation in Germany. Prior to the operation taking place, an public education campaign was used to highlight the negative effects of speeding behaviour and report on the country's current road toll. The public were also informed of the exact date of the police operation and the locations of the speed enforcement points via local media. The findings of the intervention revealed that there was an eight percent reduction in crashes and casualties on the day of operation. However, it was also found that there were no short or long-term effects of the speed limit police monitoring operation, with crash rates returning to baseline immediately after the one-day initiative had been implemented. The finding suggests that the eight percent reduction in crashes and casualties found on the day of operations, was likely due to police enforcement.

Megat-Johari et al. (2022) examined the effects of road safety messages across three timepoints in the United States: before police enforcement activities (2 weeks), during police enforcement activities (4 weeks) and after police enforcement activities (1-3 weeks). They reported that during the enforcement period, safety messages displayed on variable message signs resulted in lower rates of drivers using a mobile phone compared to messages which focused on general travel time information. However, unlike Bauernschuster and Rekers (2022), Megat-Johari et al. (2022) reported that mobile phone use rates remained lower after police enforcement/messages displayed, compared to before police enforcement/displayed messages. In an Australian study, Beck and Burke (2023) reported that variable message signs which displayed warning messages about speed cameras (i.e., 'speeding enforced', '24 hour speed cameras in tunnel') and messages that directed drivers to slow down (i.e., 'slow down, check your speed), decreased speed-related infringements by 38% for southbound traffic and 54% for northbound traffic compared to the 6-month period prior to the VMS. The VSM were displayed in both directions. This study did not investigate driver behaviour after the messages were turned off.

Lu et al. (2016) examined the effectiveness of text messages sent by police in China in deterring traffic violations. Participants were allocated to one of five groups: four groups which received a text message by police, and a control condition. The four messages differed in the information provided to participants, with three messages focusing on general information (e.g., one message read, "*The police of Tsingtao remind you to please drive safely for your sake and that of others*") and the final message group received a more personalised message about a recent traffic ticket, including details

such as time and location of offence, and registration number. The findings revealed that there were no significant differences in traffic offences among drivers who received one of the three general messages compared to drivers in the control (no condition) one-month after having received the text message. However, drivers who received the personalised text message committed 14% less traffic violations than those allocated to either of the two other conditions (i.e., general text message condition or control group who did not receive a text message). Based on these differences in traffic violations between those who received a personalised text message about a recent traffic ticket compared to those who received a general message or no text message at all, it could be speculated that receiving a ticket for committing a previous offence was a greater deterrent for not re-offending than receiving a text (or no) message.

Hu and Cicchino (2023) examined the effects of a rural speed management program in the United States. The program involved i) perceptually narrowing the lanes of a road where speeding was identified to be a problem through widening the painted edges of the road, ii) on-road speed feedback signs, which displayed speed of vehicle as driver approached, iii) paid public education campaigns (i.e., displayed via both billboards and social media), and iv) high-visibility police enforcement. Based on all four aspects of the program, the findings revealed that there was an overall reduction in mean speeds of 9.3%, and an 80% reduction in the odds of exceeding the posted speed limit by 10mph. It was also found that one month after the program ended, which also included removing the lane narrowing and speed feedback signs, the mean speeds remained lower than the mean speeds before the program commenced. The study reported on the total effects of the program rather than the individual effects of each component. Overall, it was concluded by the authors that programs which have multiple components are effective at reducing speeding behaviour.

Fisa et al. (2022) conduced a review of systematic reviews that focused on the effects of interventions for preventing road traffic crashes. They identified 35 review articles, published between 1999 and 2020. Fisa et al. (2022) highlighted that enforcement activities, public education campaigns, and road changes (i.e., converting intersections to roundabouts) all reduced the number of road traffic crashes. Specifically, and in terms of enforcement (11 of the total 35 reviews that were reviewed), RBTs, selective breath testing, and sobriety checkpoints were all reported to reduce alcohol-related crashes and injuries. Speed cameras and red light cameras were also reported to be effective in reducing crashes and casualties. The review also highlighted that public education campaigns (five systematic reviews of the 35 articles reviewed). One article reviewed in Fisa et al. (2022) reported that public education campaigns had reduced the number of road traffic deaths by 9%. There was mixed evidence for the effectiveness of driver education programs (four systematic reviews of the 35 articles reviewed), in that those education programs which targeted teen drivers did not decrease crashes. However, the programs were found to increase teen driver skill acquisition. Another review article reported in Fisa et al. (2022) which looked at driver re-training of older drivers reported that compared to no educational intervention curriculum, educational intervention curricula (i.e., classroom sessions, on-road education) were effective in reducing crashes.

Mulvihill et al. (2020) undertook a review of literature to understand current drug driving enforcement and public education practices in Victoria, Australia. The review consisted of those articles published on drug driving between 1995-2015, with a focus on three illicit drugs, including: amphetamine/methamphetamines, ecstasy, and cannabis. Based on the articles reviewed, the authors argue that different preventions strategies are required to target different types of drug driving offenders. For instance, they reported that both educational and enforcement approaches may not be effective in isolation for those who are drug dependent. That is, a more tailored approach which also includes treatment and rehabilitation programs may be required for repeat offenders. However, current educational and enforcement approaches may be more appropriate for recreational users. The report highlighted that there was a lack of drug driving countermeasures,

along with evaluations of these countermeasures. Overall, the authors proposed that it is important to understand the characteristics of individuals who drug drive in order to develop effective countermeasures.

2.4. Key studies published pre-2014

To provide a more comprehensive overview of deterrence theory in the context of traffic offending and how enforcement is best supported by education and awareness activities, key articles, reports, and book chapters published prior to 2014 are presented in the section that follows. These studies were, i) sought from reference lists of those studies included as part of the systematic review, ii) located via Google Scholar using the search terms presented in Table 1, or iii) suggested for inclusion by BW. Please note that not all studies published prior to 2014 are presented, rather a snapshot of some of the key findings emerging from seminal research/studies are reported.

2.4.1. Deterrence-related theoretical developments relevant to understanding traffic offending

Deterrence theory has been a cornerstone in criminological theory and criminal justice policy since the early writings of Jeremy Bentham and Cesare Beccaria in the 18th century. The theory assumes that people refrain from crime or reduce their criminal involvement because they fear punishment. For example, Homel (1988a) argued that if the punishment for drink-driving is swift, sure and tough, the rate of occurrence for this behaviour will be low. He continued, "*At the heart of the arguments for deterrence as a tool for social control is the belief that the behaviour of human beings can be modified by making them fearful of the consequences of committing illegal acts"* (Homel, 1988a, p. 22).. The following section presents 19 studies/reports and background literature published since the 1980s which addressed deterrence theory in the context of traffic offending (i.e., Bates et al., 2012; Cameron et al. 1992; Freeman et al., 2006, Freeman & Watson, 2006; Homel, 1988a,b, 1993; Nichols & Ross, 1990; Piquero & Paternoster, 1998; Piquero & Pogarsky, 2002; Ross, 1982, 1984; Staffard & Warr, 1993; Soole et al., 2013; Tay, 2005c; Vingilis, 1990; Watson, 1998, 2004; Watson et al., 2013).

Ross (1982) reported that deterrence of drink driving through law emerged from Scandinavian countries and spread through the western world where it was evaluated and found to be an effective measure in reducing alcohol related crashes. However, Ross (1982) argued, in no case had the accomplishment of deterrence been permanent, in other words, as soon as a deterrence campaign against drink driving concluded, there was a gradual return of drink driving to the previous level. Two years later, Ross (1984) noted that scholars had tried to explain the apparent contradictions in the effectiveness of classical deterrence theory by speculating that the fundamental components of deterrence; namely, certainty of apprehension, severity of sanctions, and swiftness of sanctions were interactive. This implied, for example, that severity may only be important if certainty of punishment was ensured. Other interactions such as the social and psychological characteristics of offenders, internalised standards, and peer pressure were a few of the other factors acknowledged to potentially influence effective deterrence. One of the criticisms of classical deterrence theory is that it is too narrow in scope and fails to account for the wide variety of other factors that influence social conformity (Vingilis, 1990). Several informal sanctions that have also been proposed to influence drink driving include criminal self-image (image of oneself as a criminal), group support (support received by important others), moral commitment to the law, opportunity for and ease of crime commission (e.g., ease of adolescents accessing alcohol before legal drinking age), and social stigma/labelling (Vingilis, 1990).

Extending upon the classical deterrence theory, Homel (1988a) proposed that a number of non-legal behaviours could also influence engagement in illegal drinking behaviours. Specifically, Homel

(1988a) proposed that four non-legal sanctions or social control mechanisms were of importance to deterrence, namely internal loss, physical loss, material loss, and social sanctions (see Section 2.2.6.3). The model was initially designed to examine drink driving behaviours. Five years later, Stafford and Warr (1993) proposed the reconceptualised deterrence theory. As reported in Section 2.2.6.2., this theory reconceptualised general and specific deterrence and proposes that direct and indirect experiences of punishment and punishment avoidance may also influence engagement in illegal driving behaviours. Stafford and Warr (1993) also proposed that general and specific deterrence should not be seen as two separate approaches; rather, crime rates will be influenced by both general and specific deterrence and that these deterrents should be instead viewed on a continuum. The implications of these theorical developments for understanding the influences on illegal driving behaviours are covered in the next section.

2.4.1.1. Application of theoretical deterrence models

In addition to those studies identified in the systematic review, studies published pre-2014 have also applied these theoretical deterrence models in the context of traffic offending. For example, and to test Stafford and Warr's (1993) reconceptualised deterrence theory, Piquero and Paternoster (1998) re-examined data, collected by telephone surveys, originally collected by Snortum and Berger (1989). Consistent with reconceptualised deterrence theory, they found that participants who had experienced punishment avoidance (i.e., drinking and driving without being detected) were also more likely to report intentions to drink drive in the future. However, being pulled over for a roadside breathalyser test was not found to deter reported future drink driving intentions. Further, the findings showed that indirect direct punishment was not a deterrent, in that participants reported intentions to drink drive despite knowing of others who had been detected for drink driving.

Piquero and Pogarsky (2002) further examined aspects of Stafford and Warr's (1993) reconceptualised deterrence theory in a sample of 250 university students recruited from the United States. The focus of the research was on drink driving. They reported that direct and indirect experiences of punishment avoidance related positively to self-reported drink driving behaviour. Furthermore, they found that participants who reported prior drink driving behaviour, direct experience of punishment was considered more influential than indirect experience of punishment. Contrary to Stafford and Warr's (1993) reconceptualised deterrence theory, participants who reported higher direct and indirect experience of punishment, also reported higher willingness to engage in drink driving in the future. Piquero and Pogarsky (2002) also included the construct of impulsivity and reported that those participants with higher self-reported impulsivity scores (as assessed via the Barratt Impulsivity Index) were influenced more by direct and indirect punishment avoidance, whereas those participants with lower self-reported impulsivity scores were more influenced by the experience of others.

Watson (2004) applied classical deterrence theory, Stafford and Warr's (1993) reconceptualised deterrence theory, and Akers' social learning theory (1977, 1990) to examine unlicensed driving behaviour. All participants (N=309) had been charged with either unlicensed or disqualified driving and were recruited outside of the Brisbane (Australia) Magistrates Court. Overall, the findings showed no support for classical deterrence theory, whereby perceived risk of apprehension and punishment, severity, and swiftness of punishment were not significant predictors of i) self-reported frequency of unlicenced driving trips per week or ii) self-reported intentions to drive unlicenced in the future. Punishment avoidance was a significant positive predictor of self-reported frequency of unlicenced driving trips per week. However, this variable was not a significant predictor of intentions to drive unlicenced in the future. When added to the hierarchical regression model, social learning variables of norms and attitudes were significant predictors of self-reported frequency of unlicenced driving trips per week while attitudes and anticipated punishment were significant predictors of intentions to drive unlicenced in the future. Overall, while support was found for the construct of

punishment avoidance, this study highlighted the importance of also considering social factors in explaining future intentions and frequency of driving without a licence.

Freeman et al. (2006) examined the efficacy of legal and non-legal sanctions in a population of recidivist drink drivers. Their findings showed that some drink driving offenders were impervious to the threat and application of legal sanctions. These drivers perceived legal sanctions to be severe but not necessarily swift and their recent drink driving behaviours and alcohol-use habits were predictive of re-offending. Examining the effect of non-legal sanctions showed that these drivers were not affected by peer and/or social disapproval. Further, neither legal nor non-legal sanctions significantly predicted intentions to drink-drive in future, suggesting that factors beyond alcohol consumption and legal and non-legal sanctions were significant in repeat offenders' intentions to drink-drive.

Freeman and Watson (2006) applied both classical deterrence theory and Stafford and Warr's (1993) reconceptualised theory to examine offending behaviour in a sample of recidivist drink drivers. Their findings showed certainty of apprehension was a significant negative predictor of self-reported drink driving behaviour, meaning that those who reported a higher frequency of drink driving also reported lower levels of apprehension. Direct punishment avoidance was also reported to be a significant positive predictor of both intentions to re-offend and self-reported frequency of drink driving. No other theoretical construct was significant in the combined model. The researchers offered several explanations for the findings and concluded that, as heavy alcohol use has consistently been associated with habitual offending, non-compliance may be better explained by addiction than a failure of deterrence. In other words, alcohol addiction may lead individuals to make irrational choices, such as drive when over the legal BAC limit, regardless of the legal consequences of drink driving (Yu et al., 2006). Freeman and Watson (2006) noted that additional countermeasures[6] (in addition to sanctions) may be required to address harmful drinking behaviours for individuals who are alcohol depended. More specifically, they suggested that a future approach to sentencing may require a combination of sanctions and interventions to address drink drinking.

2.4.1.2. Deterrent effects

Much of the past literature has focused on deterrence theory in the context of drink driving, specifically in relation to the impact of RBTs on behaviour. Two examples of these studies are presented herein (Homel, 1993; Tay, 2005c). The work by Homel (1993) draws upon deterrence theory to identify a best practice approach to the implementation of RBT. At the time of Homel's work, RBT had been operating for 10 years in New South Wales, Australia (introduced in December 1982). Homel (1993, p.28S) reported that, "*The aim of RBT is to create a sense of unease about drinking and driving amongst potential offenders through highly visual police enforcement which gives the impression of being unpredictable, unavoidable, and ubiquitous*". RBTs can either by stationary (i.e., RBTs which are highly visible, located on main roads, and not announced publicly) or mobile (i.e., RBTs that are less visible to drivers). Homel (1993) argues that stationary RBTs act more to deter drivers from drink driving compared to mobile RBTs. Further, he noted the importance of breathalysing all drivers who are pulled over to increase deterrence towards drink driving. Homel refers to an earlier document which he published in 1981 which had outlined the essential requirements for a successful approach to drink driving. Examples of these requirements included that funds should be made available to increase the level of police enforcement, police activity should be highly visible, publicity should aim to convince the average driver that they had a high chance of being apprehended for drink driving, and that governments should not increase the penalties

[6] No specific countermeasures were suggested by Freeman and Watson (2006), only that additional countermeasures may be required to address drinking behaviours.

associated with drink driving. This was consistent with Homel's view that certainty of penalties had a stronger deterrent impact on drink driving rather than severity of penalties. Homel (1993, p.31S) reported that, "*whatever the final verdict on the long-term effectiveness of RBT in New South Wales, there is no doubt that its initial impact was enormous*."

Tay's (2005c) study evaluated the effectiveness of RBT in Queensland, Australia. For this study, monthly crash data collected between January 1994 and October 2001 and traffic enforcement data were used to evaluate the effectiveness of RBTs. The data were analysed using both a preliminary estimation model and poisson regression model. Tay (2005c) found that the number of breath tests performed per month and the percentage of drink drivers apprehended had a significant effect in reducing the number of serious crashes each month. Overall, he concluded that investing more resources into the RBT program would increase both i) the number of RBTs which could be performed by police and ii) the number of drivers apprehended and thus, would continue to enhance both general and specific deterrence.

In addition to evaluations of RBTs, other studies have investigated the effectiveness of speed cameras in relation to their deterrent effects (e.g., Cameron et al., 1992). The speed camera program which was introduced in Victoria, Australia in April 1990 was proposed to have both specific deterrent effects (e.g., speeding fine, demerit points for those detected exceeding the posted speed limit) and general deterrent effects (e.g., knowledge about speed cameras, publicity about speed cameras). The Cameron et al. (1992) evaluation found that there was a reduction in the frequency of reported casualty crashes after the introduction of the speed camera program, with most reductions in crashes observed on arterial roads in Melbourne and 60km/h roads in rural Victoria. The pattern of results supported the conclusion that the observed effects were related to the speed camera program. The authors noted that the issuing of traffic infringement notices combined with the information campaign contributed to the positive results.

While the studies reported above focus on the effectiveness of traffic policing programs, specifically RBTs and speed cameras, the next two studies (i.e., Nichols & Ross, 1990; Watson, 1998) are examples of previous literature reviews which have explored deterrence theory within the context of penalties and sanctions. It is important to remember that traffic law enforcement consists of three components: i) the setting of road rules and regulations, ii) the policing of those rules and regulations; and iii) the application of penalties and sanctions to offenders detected breaking the rules and regulations (Bates et al., 2012). Deterrence theory has been used to inform all three steps in this process but is particularly relevant to the second and third steps.

Nichols and Ross (1990) reviewed literature which had examined legal sanctions for drink drivers. They reported that, compared to policies which are based on increasing the severity of punishment, policies which have focused on increasing the certainty and swiftness of punishment have a greater deterrent impact. However, and despite concluding that polices which are based on increasing the severity of punishment may be less of a deterrent, the review reported that sanctions which are based on certainty and swiftness of punishment (i.e., licence suspension and disqualification) appeared to be the most effective for drink drivers. . Watson (1998) built upon the work by Nichols and Ross (1990) and the principles of deterrence theory to review the effectiveness of licence sanctions, remedial programs (e.g., assessment, treatment, and rehabilitation programs), and vehicle sanctions (e.g., alcohol interlocks) in preventing drink driving behaviour. The paper reviewed studies which comprised people from both the general population and drink driving offenders. Overall, the studies reviewed provided support for licence disqualification as a general deterrent; however, it was noted that despite the effectiveness of this approach in reducing crash rates, repeat offenders who have had their licence disqualified may still continue to drive without a licence. Therefore, licence disqualification as a specific deterrent may be less effective. For repeat offenders, it was also concluded that remedial programs may reduce alcohol-specific offences and that alcohol

interlocks may also be effective when fitted to the vehicle of a repeat offender. Watson (1998) stated that a combination of both licence actions and remedial programs may be a more promising approach for repeat drink driving offenders.

2.4.2. Support of education and awareness activities

Seven articles published pre-2014 were identified to assist with addressing RQ2: How is enforcement best supported by education and awareness activities? Five articles focused on public education/mass media campaigns (Elder et al., 1994; Elliott, 1993; Tay 2005a, 2005b; Vasudevan et al., 2009) and one article reviewed the impact of Mothers Against Drunk Driving (MADD) in reducing drunk driving in the United States (Fell & Voas, 2006). The key findings from each study are reported in the section that follows.

2.4.2.1. Road safety public education campaigns

Elliott (1993) conducted a meta-analysis which reviewed 87 mass media campaigns. The duration of the campaigns ranged from four or less weeks to 20 weeks plus, and were shown across different media (e.g., television, radio, print). The review concluded that campaigns supported by a combination of publicity and enforcement were more influential than campaigns which were supported only by publicity, enforcement, or legislation (Elliott, 1993).

Elder et al. (2004) undertook a systematic review which assessed the impact of mass media campaigns in preventing alcohol-impaired driving and alcohol-related crashes. Eight studies which were published between 1975 and 1999 were included as part of the review. Three studies included in Elder et al. (2004) systematic review focused on raising awareness of enforcement activities, including the legal consequences of drink driving, with the remaining five studies focusing on the social- and health-related consequences of drink driving. For the studies which focused on raising awareness of enforcement activities, there was a short-term reduction in both drink driving and injury/fatal crashes associated with drink driving following the campaigns. However, it is worthwhile reporting that it is hard to measure the independent effects of campaigns, and other factors (e.g., highly visual enforcement activities) may have also contributed to the decline in drink driving and drink driving-related crashes during this time.

Vasudevan et al. (2009) assessed the effectiveness of public education campaigns addressing seatbelts in the Nevada, United States between 2002 and 2005. In Nevada, a secondary seat belt law applies in that a driver or passenger can only be fined for not wearing a seat belt only if they are pulled over for another driving offence. This rule applied at time of data collection and remains today. Vasudevan et al. (2009) observed that for each year assessed post the campaign, the seat belt usage rate was higher post-campaign when compared to pre-campaign. The authors concluded that media-based education and enforcement campaigns when used together can increase seat belt usage rates.

Tay (2005a) acquired data from previous studies to re-evaluate the effectiveness of anti-drink driving campaigns shown in Victoria, Australia in the 1980s and early 1990s. Tay (2005a) concluded that anti-drink driving campaigns reduced the number of serious crashes during high alcohol hours (i.e., between 6pm-6am Monday to Thursday, 4pm Friday to 6am Saturday, and 2pm Saturday to 8am Sunday). The findings also suggested that the effectiveness of these anti-drink driving campaigns was not dependent on levels of police enforcement activities (i.e., RBT) or vice versa. That is, the effects of anti-drink driving campaigns and RBT appeared to be independent of each other, meaning that both countermeasures were effective at reducing serious crashes. Tay (2005a, p. 264) further noted that these findings challenge, "*the widely held belief in the road safety arena that publicity campaigns do not work unless accompanied by enforcement needs to be re-examined in road safety research, policy, and practice*". Tay (2005b) undertook an additional study to re-evaluate the

effectiveness of both anti-drink driving and anti-speeding enforcement and publicity campaigns shown in Victoria, Australia. The focus of this study was on young male drivers aged 15-24 years old (as the intended target audience of the public education campaigns being assessed in the study). Similar to Tay (2005a), the findings showed that the effectiveness of anti-drink driving public education campaigns was independent from police enforcement activities. However, the anti-speeding campaigns and police enforcement did not have independent effects, with the campaigns operating to exert significant effects only through its interaction with enforcement. In other words, the anti-speeding public education campaigns and police enforcement work together in reducing serious crashes involving young male drivers.

Overall, while the research reported in Section 2.3.2.1. does differ in the extent to which public education campaigns contribute to reducing engagement in illegal behaviours, the findings offer support for including public education campaigns as part of road safety strategies to support deterrence (e.g., certainty of being apprehended).

2.4.2.2. Mothers against drunk driving (MADD)

One advocacy organisation which has been reported to have had an influence on drunk driving in the United States is MADD. MADD[7] was started in 1980 by a mother and friends of a young woman who was killed by a repeat drunk driver. Since the early 1980s, MADD has played a role in supporting changes to legislation, including prohibiting people under the aged of 21 years from purchasing alcohol (i.e., 1984 National Minimum Drinking Age Act) and reducing the BAC limit from 0.10 to 0.08 (from the start of the 1990s; Fell & Voas, 2006). Today, MADD continues to increase public understanding of the negative impact of drunk driving, support enforcement activities (e.g., highly visible sobriety checkpoints), and support those who have been affected by drunk driving. MADD has been acknowledged for changing peoples' attitudes towards drinking and driving in the United States (Fell & Voas, 2026). While it is unknown the extent to which MADD has prevented road-related injuries and fatalities, MADD is an example of the positive impacts that advocacy groups can have on supporting enforcement and improving road safety.

2.5. Best practice approaches to traffic enforcement

The following subsection draws upon various publications that have identified best practice approaches to traffic enforcement, including some already reviewed in the previous section. First, Watson et al. (2013) paper reviewed the impact of drink driving laws. The paper reviews the different types of approaches used to prevent drink driving including, prescribed alcohol limits, per se legislation, RBTs and sobriety checkpoints, and public education campaigns. Consistent with Homel (1993), Watson et al. (2013) reports that RBTs are more effective when they are highly visible, random, unavoidable, sustained over a period of time, and are publicised. In most countries, legal sanctions are used to prevent drink driving, including monetary fines and license actions (e.g., demerit points, licence suspension/disqualification, restricted licenses). Other legal sanctions which target high-range or repeat offenders may include remedial programs (e.g., assessment, treatment, or rehabilitation), vehicle sanctions (e.g., alcohol ignition interlocks, vehicle impoundment/immobilisation), and confinement (e.g., jail, home detention, community service orders; Watson et al., 2013).

Remedial programs may consist of assessment programs or rehabilitation programs and are designed to reform drink driving offenders. Assessment programs may be used to screen and identify those who may have a high risk of re-offending, whereas rehabilitation programs may instead consist of education and/or counselling to discourage future offending behaviour (Watson et al., 2013).

[7] https://madd.org/

There has been evidence which suggests that remedial programs may reduce drink driving offences and alcohol-related crashes (Watson et al., 2013). Alcohol ignition interlocks are one other legal sanction which could reduce future engagement in drink driving; however, these may have low uptake unless they are mandated. Watson et al. (2013) reports that alcohol ignition interlocks may need to be part of a boarder approach to be effective, as the device on its own may not produce long-term behavioural change. Further, vehicle impoundment programs may reduce reductions in both drink driving offences and other illegal driving offences. However, vehicle impoundment may have unintended costs on the offender's family (e.g., spouse) who may also use the sanctioned vehicle. Watson et al. (2013) highlights that for high-range offenders, there is a need to complement penalties (monetary fines and licence actions) with sanctions designed to constrain offending behaviour, such as alcohol ignition interlocks, vehicle impoundment, and rehabilitation programs for drink drivers. In a similar vein, consideration should be given to requiring repeat speeding offenders to have intelligent speed assistance (ISA) fitted to their vehicles upon relicensing (Watson et al, 2015).

Bates et al. (2012) reviewed evidence of the effectiveness of traffic law enforcement on drink and drug driving, speeding behaviour, red-light running, and seatbelt use. For drink driving, Bates et al. (2012) highlighted the importance of RBTs[8]. Specifically, they report that a mixture of covert (hidden) and overt (highly visible) stationary and mobile RBTs are required, as these approaches provide different deterrent functions. For example, overt stationary RBTs act as a general deterrent, whereas covert mobile operations which can occur outside of peak periods, may be more effective at detecting drink driving offenders (i.e., a specific deterrent effect). For speeding behaviour, evidence has also supported that a combination of covert and overt automated and manually operated speed cameras are required for optimal speed enforcement. Bates et al. (2012) reports literature which argues that random deployment of speed enforcement activities are needed to increase the efficacy of operations. For seatbelt use, Bates et al. (2012) reports the difficulty for police to enforce. However, and since Bates et al. (2012) article, new technology is being used in some countries (e.g., see Sections 3.2.2.4 and 3.3.2.4 for an overview of the United Kingdom and Australian approaches) to assist with enforcement activities. Bates et al. (2012, p. 103-104) concludes by noting that, "*enforcement operations need to be tailored to the specific context and driving environments, such that a 'one-size-fits-all approach' is unlikely to be effective*".

While not a lot has changed in relation to drink driving enforcement since the Bates et al. (2012) chapter was published, there has been some change in relation to camera-based technologies. This not only relates to mobile phone and seatbelt enforcement but also includes the application of average (point-to-point) speed enforcement. Soole et al. (2013) reviewed the literature on the effects of average speed enforcement on speed compliance and checks. Most of the literature included in the review was from research which had been conducted in the United Kingdom. Overall, the review highlighted that average speed cameras reduced vehicle speeds as well as fatal and serious injury crashes. In another paper, Soole et al. (2014) reviewed speed enforcement approaches across Europe, Australasia, North America, and China. Based on the findings of the review, the authors provided several recommendations for best practices for the implementation of speed enforcement operations. Consistent with their earlier review (Soole et al., 2013), Soole et al. (2014) reported that more widespread implementation of average speed cameras would produce more network-wide effects (i.e., reduce vehicle speeds and crash rates). Further, and similar to Bates et al. (2012), Soole et al. (2014) recommended using a mixture of overt and convert, and automated and manual speed enforcement operations, and tailoring these to specific situations (e.g., using automated speed cameras in areas which have high crash-risks). They also report that a perceived enforcement

[8] At the time of publication in 2012, there was less evidence regarding the effectiveness of roadside drug testing.

presence was critical to the success of speed enforcement. Further, Soole et al. (2014) notes that speed enforcement operations should be accompanied by public education campaigns to increase the effectiveness of police operations.

Sakashita et al. (2021) recently published a guide to the use of penalties to improve road safety. In their document, they reviewed both the advantages and disadvantages of the different types of penalties (e.g., fines, demerit points, licence suspension and disqualification) and applied the classical deterrence theory to discuss how to increase the effectiveness of these penalties. In regard to perceived certainty of punishment, Sakashita et al. (2021) report that it is important to ensure that penalties are not avoidable. This comment is consistent with the findings reported earlier in the systematic literature review about the negative implications of punishment avoidance. To optimise the severity of penalties, Sakashita et al. (2021) highlight that costs of offending need to outweigh any benefits of offending. They provide several strategies of how this can be achieved, including matching fines with income (as currently occurs in Sweden) and ensuring that drivers receive an immediate licence suspension for serious driving offences (as currently occurs in Sweden, Norway, and Australia; see Section 3 for more information). For swiftness of punishment, Sakashita et al. (2021) report that penalties should be applied swifty. However, they also acknowledged that this is challenging to achieve in road safety. Again, immediate licence suspension for serious driving offences was one suggestion of how penalties could be swiftly applied. It was also noted within their document that most penalties to improve road safety are designed to modify behaviour at a population level, and that it is difficult to determine the specific (isolated) effects of each individual penalty.

As reported by Homel (1993), it is important that police enforcement is highly visible and gives the impression of being unpredictable, unavoidable, and ubiquitous. Recently, research has shown that some drivers are using social media and other technologies, such as navigation applications, to monitor police enforcement activities (e.g., Oviedo-Trespalacios & Watson, 2021; Truelove et al., 2025). Truelove et al. (2025) conducted a focus group study with 58 licenced Australian drivers and found that some participants reported using navigation systems (e.g., Google maps to monitor camera locations and Waze to monitor police enforcement locations) to notify them of police enforcement activities. Further, some participants reported that navigation systems may reduce their chance of being caught for engaging in illegal driving behaviours, such as exceeding the posted speed limit or using a handheld mobile phone while driving (i.e., punishment avoidance). Further, and as reported by Oviedo-Trespalacios and Watson (2021), knowledge of police enforcement locations may also reduce drivers' perceived risk of apprehension.

2.6. Summary of systematic literature review

The objective of the systematic review was to identify studies which have focused on deterrence theory in the context of traffic offending, and how traffic enforcement has been supported by education and awareness activities. The review included articles which had focused on the three key deterrence theories: i) classical deterrence theory, ii) Stafford and Warr's (1993) reconceptualised deterrence theory, and iii) Homel's (1988a) extended deterrence model. The three theories are summarised below. The key points for the systematic review are also presented below, in accordance with each of our two research questions.

2.6.1. Summary of deterrence theory

Classical deterrence theory consists of three key components: certainty of apprehension (and certainty of punishment), severity of sanctions, and swiftness of sanctions, and focuses on people's perceptions of these outcomes. Certainty of apprehension and punishment refers to the likelihood that an offender will be apprehended and punished for a crime. Severity of sanctions relates to the

perceived severity of the penalty for committing an offence. The theory proposes that the punishment for the crime needs to be perceived as salient and appropriate (i.e., is just) to act as a deterrent. Swiftness of sanctions refers to the timing of punishment, with punishment delivered swiftly being more likely to have a deterrent effect.

Stafford and Warr's (1993) reconceptualised deterrence theory proposes that there are four ways in which punishment impacts deterrence, including: i) direct experience of punishment, ii) indirect (vicarious) experience of punishment, iii) direct experience of punishment avoidance, and iv) indirect (vicarious) experience of punishment avoidance. Direct experience refers to the individual themselves having had the experience (e.g., receiving a speeding fine) where indirect experience relates to knowing of someone who has the experience (e.g., family/friend receiving a speeding fine). Punishment refers to whether an individual is caught and punished (i.e., punishment) or commits a crime, or is not caught and punished (i.e., punishment avoidance). An example of punishment avoidance is where a driver may exceed the posted speed limit and avoids being caught by police or by a speed camera

Homel's (1988a) extended deterrence-based model proposes that there are four non-legal factors (sometimes referred to as informal sanctions) which may also influence engagement in risky driving behaviours. The four non-legal factors include internal loss (i.e., feelings of shame, guilt or embarrassment), physical loss (i.e., fear of physical injury, for self and others), material loss (i.e., fear of receiving a fine or demerit points) and social sanctions (e.g., social judgement, disapproval from those close to you).

2.6.2. RQ1. How is deterrence theory applied in the context of traffic offending?

- Most of the studies included in the systematic review focused on classical deterrence theory and its concepts of certainty of apprehension, severity of sanctions, and swiftness of sanctions. In the studies, there was relatively more focus on certainty of apprehension as opposed to perceived certainty of punishment. Some studies also included constructs from Stafford and Warr's (1993) reconceptualised deterrence theory and/or Homel's (1988a) extended deterrence-based model to further identify which predictors explained the most variance in the behaviour/s under investigation.

- Research was mixed in the extent to which constructs within classical deterrence theory explained the behaviour/s under investigation. There was some support for the important influence of certainty of apprehension and certainty of punishment. Specifically, traffic enforcement approaches should increase drivers' perceived risk of apprehension and certainty of punishment.

- There was support for ensuring that sanctions are sufficiently severe, with less support for the concept of swiftness. However, a measure of swiftness was not included in most studies reported in the systematic review and therefore, it was difficult to determine the impact of this construct from this review. While swiftness of punishment has been examined in other contexts (e.g., theft, burglary, and violence), similar to studies which have applied the classical deterrence theory in a road safety context there have been mixed findings on the effect of swiftness of behaviour (Abramovaite et al., 2023). For example, and we note it is an example from outside of the road safety context in the absence of many examples with which to draw upon that have examined swiftness, Abramovaite et al. (2023) reported that swiftness of punishment was associated with a reduction in theft offences, but was not associated with reducing burglary or violence offences. Based on the available evidence, it has been argued that traffic penalties need to be strictly and swiftly applied; and include immediate mandatory license loss for repeat offenders and increased penalties for repeat offences (Watson et al.,

2013). In addition, there is a need to complement these penalties with other sanctions designed to constrain offending behaviour, such as alcohol ignition interlocks, vehicle impoundment, and rehabilitation programs for drink drivers (Watson et al, 2013). In a similar vein, consideration should be given to requiring repeat speeding offenders to have ISA fitted to their vehicles upon relicensing (Watson et al, 2015).

- Direct and indirect experience of punishment and punishment avoidance were shown in some studies to be significant predictors of engagement in illegal driving behaviours. Direct experience of punishment avoidance was identified as an important factor in illegal driving behaviours including using a handheld phone while driving, drug driving and tailgating. As a result, it is important that traffic policing is conducted in a manner that is difficult to avoid and counters the evasion strategies used by drivers. This includes the need to address the use of social media by drivers to communicate the locations and times when police are conducting enforcement operations (Oviedo-Trespalacios & Watson, 2021; Truelove et al., 2025).

- Non-legal sanctions (i.e., anticipated internal loss, anticipated physical loss, anticipated material loss, and anticipated social sanctions) were also shown in some studies to be significant predictors of various illegal driving behaviours. Most of the research investigating these constructs had focused on anticipated internal, physical, and material loss as opposed to social sanctions. The findings highlighted the importance of considering these non-legal sanctions to assist with gaining a greater understanding of why road users may engage in risky driving behaviours.

- The studies reported within the systematic review addressed a number of behaviours, including; drink driving, drug driving, speeding behaviour, tailgating, mobile phone use, street racing, risky motorcycle behaviour, and crossing behaviour at railways. No recent research was identified which applied deterrence theory to understand factors contributing to the non-use of seat belts or the incorrect use of seatbelts. However, this may become a topic of interest in the future as smart cameras designed to detect seatbelt non-compliance become more widely used.

- Most of the studies included in the systematic review comprised participants completing a self-report questionnaire. Further, many of these studies reported used a convenience sample (e.g., university students) as opposed to restricting the sample to those who had previously reported engagement in the specific illegal behaviour/s under investigation or repeat offenders. Therefore, deterrent effects may be different for those who report engaging in repeat driving offences.

- It was identified in several studies that road users need to be aware of the sanctions for deterrence to have an effect. As noted above, Truelove et. al. (2019b) argued that a fundamental concept of deterrence theory was that an individual had to be aware that something was illegal for deterrence to have an effect. Thus, and in the context of severity, if an individual is not aware of the punishment associated with a specific behaviour, then severity of punishment would not be a deterrent.

- Most of the historical literature relating to the role of deterrence in road safety focused on drink driving and the impact of RBT on this behaviour. This research identified that licence suspension/disqualification is an effective general deterrent for drink driving. For RBTs, the evidence suggested that, "*The aim of RBT is to create a sense of unease about drinking and*

driving amongst potential offenders through highly visible police enforcement which gives the impression of being unpredictable, unavoidable, and ubiquitous" (Homel, 1993, p. 28S).

2.6.3. RQ2. How is enforcement best supported by education and awareness activities?

- Most of the studies identified in the review focused on examining the effects of public education campaigns alongside police enforcement strategies.

- The studies highlighted mixed findings regarding the role and effectiveness of public education campaigns relative to the implementation of enforcement. For instance, Tay (2005a) reported that anti-drink driving campaigns affected drink driving crashes independently of, and were not dependent on, the levels of enforcement activities. However, Tay (2005b) found that anti-speeding campaigns did not function independently (from enforcement) in reducing speeding-related crashes. Similarly, in his seminal meta-analysis of road safety public education campaigns, Elliott (1993) concluded that public education campaigns works most strongly when used to signpost and/or support other initiatives (e.g., enforcement).

- Fisa et al. (2022) reviewed 35 systematic reviews which had examined the effects of interventions for preventing road crashes. Five of those articles reviewed had focused on public awareness strategies and four articles had focused on driver education programs. Overall, there was some support that public education advertisements reduction the number of road traffic deaths, and driver education programs increasing teen driver skill acquisition. However, these education programs were not found to decrease road crashes.

- Mulvihill et al. (2020) highlighted that different prevention strategies are required to target different types of drug driving offenders. More specifically, they reported that while current approaches may be appropriate for recreational users, a more tailored approach which also includes treatment and rehabilitation programs may be required for repeat offenders.

- While the studies reviewed support the use of road safety public education campaigns, most studies acknowledged that it is very difficult to measure the independent effects of such campaigns given that such initiatives are continually operating concurrently with other initiatives (e.g., police enforcement activities, changes in legislation).

3. Case studies of enforcement approaches

Case studies of traffic enforcement approaches in five countries were conducted. These countries included i) Ireland, ii) United Kingdom, iii) Australia, iv) Norway, and v) Sweden. These countries are leaders in global-best practices in road safety and have implemented various enforcement countermeasures and supporting public education and awareness activities to discourage risky driving behaviours. Table 3 provides an overview of the population, road fatality rate, and road safety legislation for each country of interest. The subsequent sections include the following information for each country:

- General overview of the traffic enforcement system,
- Approaches to enforcement regarding speeding behaviour, use of mobile devices, drink and drug driving, and non-and incorrect seat belt use,
- Road policing statistics including the number of enforcement checks and detected offences from 2014-2023, and trends for detected offences between 2020-2023, and
- Key traffic enforcement and offence related metrics.

For Norway and Sweden, information about enforcement checks and detected offences were sourced from the Police Authorities. For all other countries, information was sourced from the public domain (e.g., Government and Police websites, reports, journal articles, and conference proceedings).

Table 3. Population, fatality rate, and road safety legislation for Ireland, United Kingdom, Australia, Norway, and Sweden

	Ireland	United Kingdom	Australia	Norway	Sweden
Demographics					
Population (million) (2023)	5.28	68.35	26.66	5.52	10.54
Position ranking of best performing countries					
Fatality rate per 100,000 population (2022)	3.06	2.61	4.54	2.1	2.1
Fatality rate per 10,000 vehicles (2022)	0.5*	0.43	0.57	0.27	0.35
Speed limits**					
Urban area	50km/hr	48km/hr 32km/hr (Wales)	50km/hr	50km/hr	50km/hr
Motorways	120km/hr	112km/hr	100-110km/hr	100km/hr	120km/hr
Allowed BAC levels					
General population	0.05	0.08 0.05 (Scotland)	0.05	0.02	0.02
Novice drivers	0.02	0.02	0.00	0.02	0.02
Professional drivers	0.02	0.02	0.00/0.02***	0.02	0.02
Seat belt requirements					
Drivers	Yes	Yes	Yes	Yes	Yes
Front seat passenger	Yes	Yes	Yes	Yes	Yes
Rear passenger	Yes	Yes	Yes	Yes	Yes
Mobile phone use					
Hand-held phone use allowed	No	No	No	No	No
Hands-free phone use allowed	Yes	Yes	Yes	Yes	Yes
Novice driver restrictions	No	No	Yes	No	No

* 2020 latest figure available ** Unless there are speed signs showing otherwise

*** New South Wales and the Australian Capital Territory adopt an enforcement threshold of 0.02 BAC for professional drivers. All other Australian states and territories have a zero BAC.

3.1. Ireland

3.1.1. General overview of the traffic enforcement system

In Ireland, the Department of Transport is responsible for transport policy and An Garda Síochána are responsible for monitoring, detecting, and enforcing road safety legislation. According to the An Garda Síochána (2025), "*the main objective of the Garda National Roads Policing Bureau (GNRPB) is to increase public confidence in safety on Irish roads by:*

- *Reducing the number of deaths and serious injuries on our roads,*
- *Improving driver behaviour and attitudes through education and awareness campaigns, and*
- *Denying criminal use of the Irish road network*[9]"

As of 31st December 2024, there were 14,058 Gardaí (2,488 detectives, 11,570 uniforms)[10], and as of 31st October 2024, there were 623 Roads Policing Gardaí in the roads policing unit[11]. Recently, the An Garda Síochána has instructed that all uniformed Gardai are required to conduct a mandatory of 30 minutes of road safety policing per shift[12]. The number of Roads Policing Gardaí has been declining since 2009[13]. Based on these figures, approximately 4.4% of Gardaí are dedicated to road policing.

3.1.2. Approaches to enforcement

This section provides an overview of Ireland's approach to enforcement for speeding, mobile device use, intoxicated or impaired driving (i.e., drink and drug driving), and non-use of seat belts. The Road Traffic Act sets out driving offences. In Ireland, drivers who are caught performing these illegal behaviours receive a monetary fine and penalty points and, in some cases, disqualification from driving, or imprisonment. Drivers may be disqualified from driving if they receive 12 penalty points within a 3-year period. Learner drivers are disqualified from driving if they receive 7 penalty points (applies for first 2-years of licensure). Drivers can also be charged for multiple traffic offences at the same time. Recently, amendments were made to Road Traffic Bill 2023 so that, "*drivers who pay fixed charges for multiple offences committed at the same time will receive two sets of penalty points, which will be the highest or joint highest for the offences committed"*[14]. Table 4 provides a brief overview of the current penalties associated with these five traffic offences.

[9] https://www.garda.ie/en/roads-policing/roads-policing-unit/

[10] https://www.garda.ie/en/about-us/our-departments/human-resources-and-people-development/garda-hr-directorate/garda-numbers-by-division-and-station-breakdown.html

[11] https://www.oireachtas.ie/en/debates/question/2025-01-22/1015/

[12] https://www.rsa.ie/news-events/news/details/2024/04/12/chair-of-rsa-welcomes-immediate-deployment-of-garda-roads-policing

[13] https://www.irishtimes.com/crime-law/2024/05/16/numbers-in-garda-roads-policing-units-falls-to-lowest-level-since-2017-says-drew-harris/

[14] https://www.gov.ie/en/press-release/8644d-cabinet-approves-publication-of-road-traffic-bill-2023/

Table 4. Ireland traffic penalties

	Speeding	Mobile phone	Drink driving	Drug driving	Driving a car or goods vehicle without wearing a safety belt
Ireland	€160 if paid in 28 days of offence €240 if paid after 28 days of offence €320 third payment option 3 penalty points on payment 5 penalty points on conviction	€120 if paid in 28 days of offence €180 if paid after 28 days of offence €240 third payment option 3 penalty points on payment 5 penalty points on conviction	Experienced Drivers (first offence): BAC .05-.08: €200 fine, 3 months disqualification. BAC .08+: €400 fine, 6 months disqualification Other drivers (first offence): BAC .021-.08: €200 fine, 3 months disqualification Maximum penalty is €5,000 and up to 6 months imprisonment	All offences carry period of disqualification. Maximum penalty is €5,000 and up to 6 months imprisonment	€120 if paid in 28 days of offence €180 if paid after 28 days of offence €240 third payment option 3 penalty points on payment 5 penalty points on conviction

Note. Information for speeding, mobile phones, and seatbelt retrieved 10/02/2025 from https://www.rsa.ie/services/licensed-drivers/penalty-points/types-of-offences. Penalties correct as of 27th October 2022 and fines are provided in Euros. Penalties for drink driving and drug driving offences retrieved 10/02/2025 from https://www.citizensinformation.ie/en/travel-and-recreation/motoring/driving-offences/drink-driving-offences-in-ireland/ and correct as on 10th June 2024.

3.1.2.1. Speeding

It is illegal to exceed the posted speed limit in Ireland. The Gardaí uses a range of speed detection devices to enforce speed limits, including:

- *"Handheld and tripod mounted laser guns*
- *Vehicle mounted Puma speed detection equipment (both marked and unmarked vehicles)*
- *Van mounted automatic speed detection radars (Garda operated)*
- *Van mounted Go-Safe vans (civilian operated)"*[15]

The operation of the Go-Safe cameras commenced on 15th November 2010. These cameras operate in areas where crashes have previously occurred. Average speed cameras are also operational in Ireland and were first introduced in 2017.

3.1.2.2. Mobile phone use

In Ireland, it is illegal to hold a handheld phone or have the phone resting on one's person. A driver may only use a handheld phone in case of an emergency. At present, the Gardaí enforces this law by conducting on-spot checks. Smart cameras which can detect drivers using a handheld mobile phone or not wearing a seatbelt will be part of a new Government initiative[16].

[15] https://www.garda.ie/en/roads-policing/road-safety/safety-camera-network.html
[16] https://www.irishexaminer.com/news/arid-41509154.html

3.1.2.3. Impaired or intoxicated driving

In Ireland, the Blood Alcohol Concentration (BAC) limit is 0.05 for full licence holders (lowered from 0.08 in 2010). The BAC limit for provisional, learner, and novice drivers is currently 0.02. It is also illegal to drive under the influence of illegal and prescriptions drugs.

For drink driving, mandatory alcohol testing (MAT) was first introduced in July 2006. The Gardaí can only undertake MAT at authorised checkpoints approved by a Garda Inspector. At these checkpoints, the Gardaí can take a roadside breath sample within suspicion of alcohol consumption. Further, the Gardaí can breathalyse a driver if they believe that the driver is intoxicated, has been involved in a crash, or committed a road offence[17]. The Gardaí will also test a driver for alcohol in an event of a car crash where they or someone else has been injured and requires medical attention. MAT for drivers involved in a car crash has been in place since 2011. For drug driving, and under the Road Traffic Acts, the Gardaí can conduct preliminary drug tests at the roadside or in Garda station. Since 31st May 2024, the Gardaí must test a driver for drugs at the roadside if they have been involved in a serious collision.

3.1.2.4. Non-use of seat belts

Ireland first introduced seat belt legislation in February 1979. Registered vehicles were required to have front seat belts fitted from June 1971 and rear seat belts fitted from 1992.

Drivers and passengers of conventional vehicles must wear a seat belt if one is fitted. All buses which carry children must be fitted with seat belts; however, this requirement may not apply to public bus services[18]. There are some exemptions for not wearing seat belts (e.g., those who have a signed medical certificate from a registered medical practitioner for non-use associated with some medical condition/ailment, members of the Defence Force while performing their duties). It is also a requirement that children (height: under 150 centimetres; weight: less than 36 kilograms) have an appropriate child restraint unless they are travelling in a taxi. The Gardaí enforces this law by conducting on-spot checks. Smart cameras which can detect seatbelt non-compliance will be part of a new Government strategy.

3.1.3. Road policing statistics

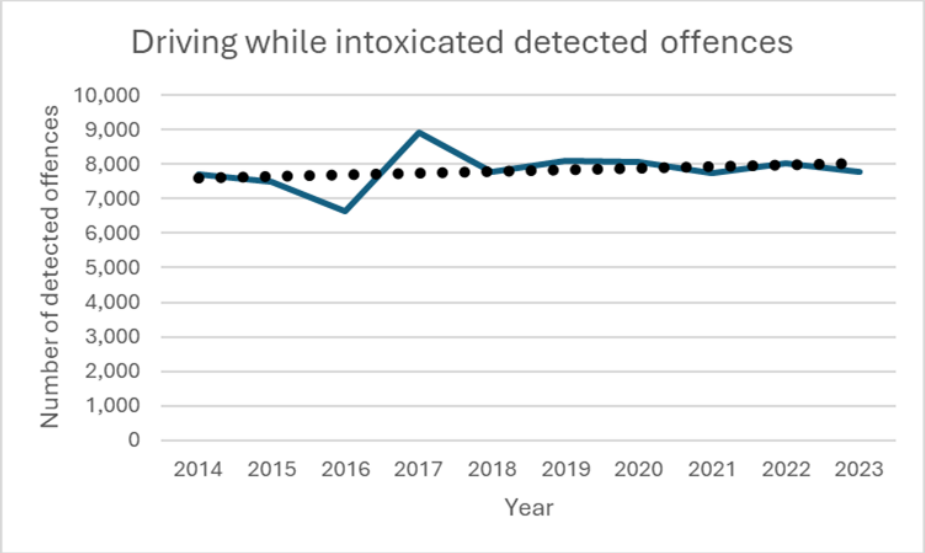
Table 5 and Figure 2 presents the road policing statistics for Ireland between 2014-2023. No statistical analyses were undertaken on these data, rather this subsection reports on what was found and whether there were any increases or decreases in road policing statistics over the last decade. The number of fatalities in 2023 was the highest number of reported traffic deaths since 2014. While not presented in the table, the number of fatalities in 2024 was slightly lower at 175 deaths. For enforcement checks, the number of breath tests undertaken each year has decreased since 2014 and 2015 (no figures were provided online for between 2016-2019). However, and since 2021, the number of breath tests undertaken in 2022 and 2023 has started to increase. For offences, the trendline for fixed charged notices for seat belts, speeding, and mobile phones has been decreasing since 2014. The trend for detected offences associated with driving while intoxicated has slightly increased/remained steady since 2014.

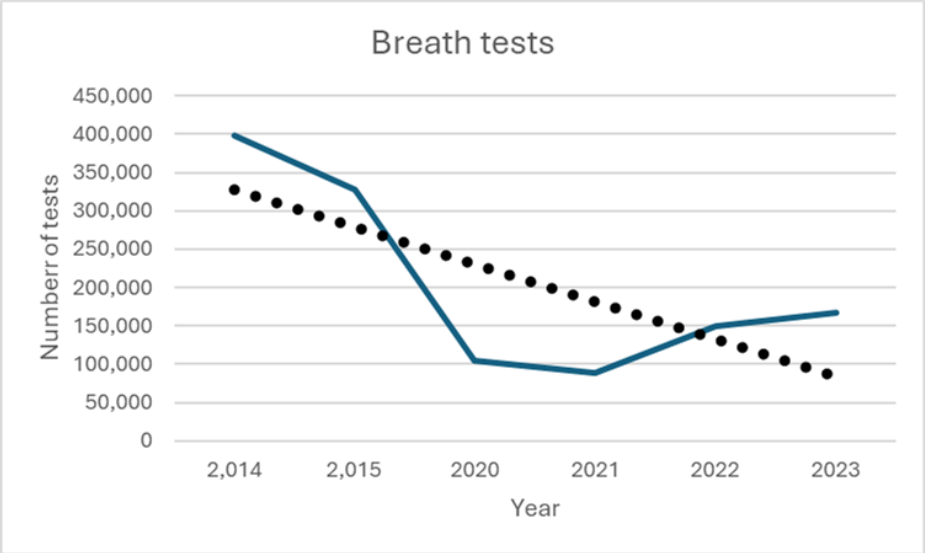
[17] https://www.citizensinformation.ie/en/travel-and-recreation/motoring/driving-offences/drink-driving-offences-in-ireland/
[18] https://www.citizensinformation.ie/en/travel-and-recreation/roads-and-safety/seatbelts-when-motoring-in-ireland/

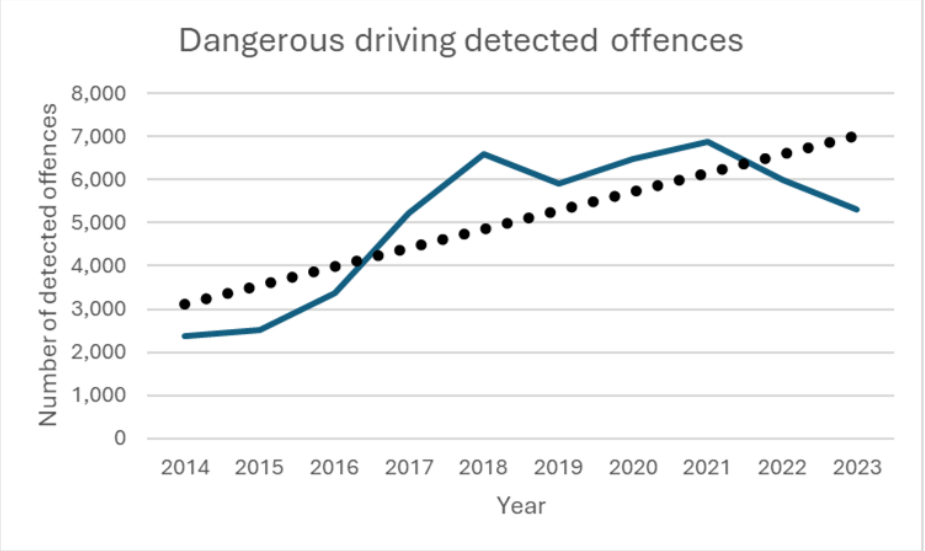
Table 5. Road policing statistics for Ireland between 2014-2023

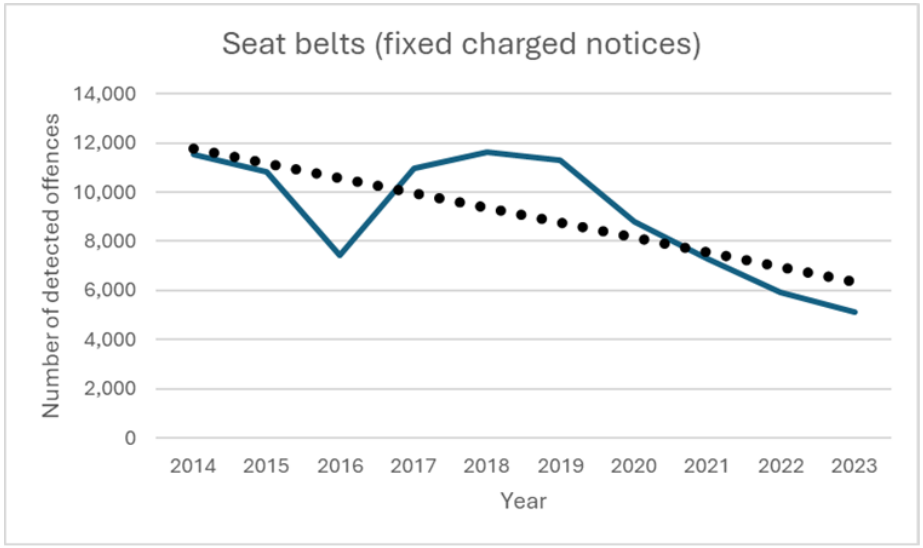
	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Population (million)	4.65	4.69	4.76	4.79	4.86	4.92	4.98	5.01	5.15	5.28
Fatalities	192	162	182	154	134	140	141	132	152	180
Fatalities (per million population)	41.3	34.6	38.2	32.1	27.6	28.4	28.3	26.3	29.5	34.1
Driving while intoxicated	7,697	7,481	6,628**	8,920	7,764	8,111	8,069	7,761	8,015	7,771
MIT checkpoints	78,012	77,348	-	-	-	63,966	38,259	43,318	49,943	46,150
Breath tests	397,513*	327,450*	-	-	-	-	104,803	88,825	149,938	166,478
Detention of vehicles (Section 41 RTA)	20,265	22,046	23,935**	33,890	30,473	30,232	29,809	23,722	21,821	22,967
Dangerous driving	2,384	2,516	3,368**	5,215	6,598	5,909	6,490	6,879	5,988	5,310
Seatbelts (fixed charged notices)	11,513	10,831	7,431**	10,977	11,637	11,305	8,779	7,276	5,921	5,129***
Mobile phones (fixed charged notices)	30,524	28,771	21,174**	28,295	31,174	28,952	24,478	23,846	18,612	17,954***
Speeding (fixed charged notices)	223,191	217,888	127,844**	147,648	136,122	136,797	181,263	179,882	165,716	143,178***

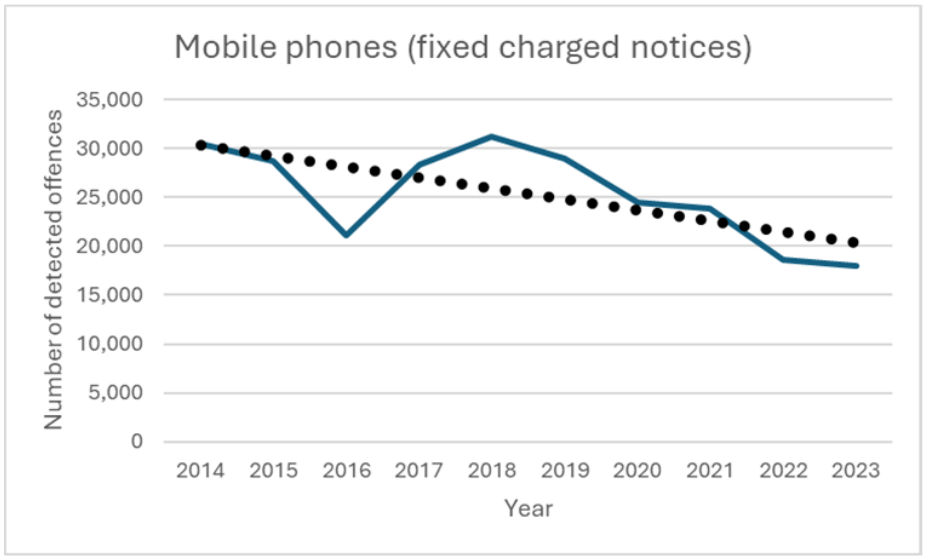
Note. Some figures may be subject to change. * These figures are under review and subject to an audit. ** Data missing for 2 or 3 months. *** Does not include December 2023 data. Retrieved 31/01/2025 from the An Garda Síochána website: https://www.garda.ie/en/roads-policing/statistics/previous-years-roads-policing-statistics/. While monthly statistics are available, data are presented annually to be consistent with the other case studies reported in this report. Population data were provided by the RSA. Population data for 2016 and 2022 was sourced from the CSO Centre, with data for other years sourced from the CSO population estimates. Fatality figures for the years 2021 onwards are provisional and subject to change.


Driving while intoxicated detected offences
Number of detected offences
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year


Breath tests
Numberr of tests
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2,014
2,015
2020
2021
2022
2023
Year


Dangerous driving detected offences
Number of detected offences
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year





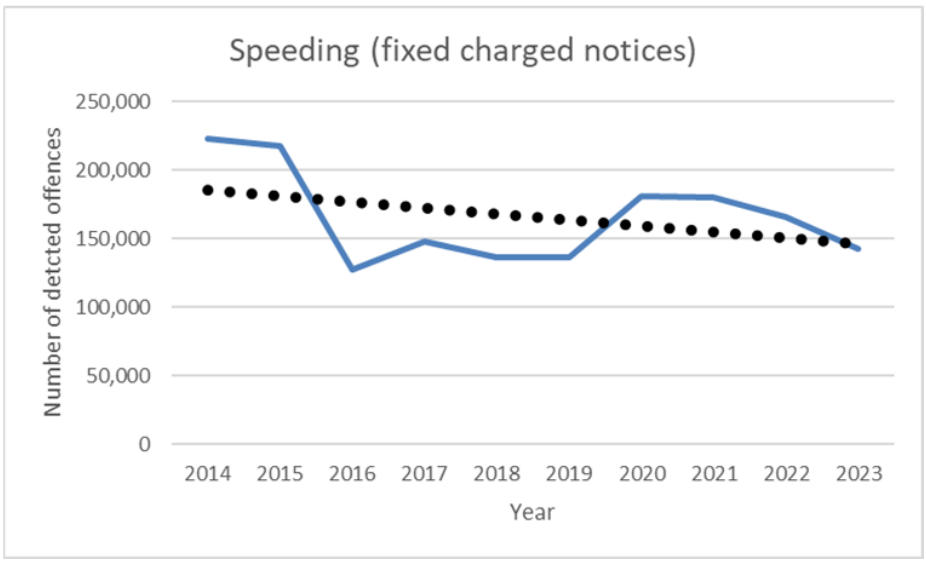


Figure 2. Trends in road policing statistics (Ireland 2014-2023)

Notes: Blue lines represent total number of tests/detected offences and dotted black lines represent trends.

3.1.4. Key enforcement and offence related metrics

The Garda Síochána Analysis Service (GSAS) complies and releases provisional road policing statistics on a monthly basis[19]. Statistics which specifically relate to traffic enforcement are available each year from 2008. Prior to 2008, only yearly injury and fatality statistics are available online. Ireland's Government Road Safety Strategy (current: 2021-2023, and previous versions) also highlights the importance of road safety enforcement in achieving Vision Zero.

[19] https://www.garda.ie/en/information-centre/statistics/road-policing-statistics-2022.html

3.2. United Kingdom

3.2.1. General overview of the traffic enforcement system

The United Kingdom consists of England, Wales, Scotland, and Northern Ireland. In the United Kingdom, police are responsible for traffic enforcement and the Road Traffic Act 1988[20] governs road safety and applies to all vehicles and drivers on public roads. The Highway Code[21] and the Official Highway Code for Northern Ireland outlines the road rules for motorists, cyclists, and pedestrians. Information available online presents data for the United Kingdom based on three jurisdictions: i) England and Wales, ii) Scotland, and iii) Northern Ireland. Table 6 presents information about police numbers for each of these jurisdictions.

Table 6. Traffic enforcement for the United Kingdom

Country	Responsibility for policing	Police officer numbers	Police numbers dedicated to road policing
England and Wales	Home Office	147,746 full-time equivalent (March 2024)	Road policing covered by 43 local police forces 3% of total police force are dedicated to road policing
Scotland	Home Office	16,425 (October 2024)	Police Scottland 3.5% of total police force are dedicated to road policing
Northern Ireland	Department of Justice	6,309 (December 2024)	Police Service of Northern Ireland Numbers dedicated to road policing were not available

Notes. Statistics were accessed from the following websites on 6/02/25: https://www.gov.uk/government/statistics/police-workforce-england-and-wales-31-march-2024/police-workforce-england-and-wales-31-march-2024; https://www.hmics.scot/news/police-scotland-urged-to-review-its-commitment-to-road-policing/; Road Policing Unit | PSNI; https://www.brake.org.uk/get-involved/take-action/mybrake/knowledge-centre/roads-policing#:~:text=Enforcing%20the%20rules%20of%20the%20road%20and%20improving%20safety&text=Roads%20policing%20is%20the%20primary,policing%20in%20the%20UK%20works

3.2.2. Approaches to enforcement

This section provides an overview of the United Kingdom's approaches to enforcement for speeding, mobile device use, intoxicated or impaired driving (i.e., drink and drug driving), and non-use of seat belts. In the United Kingdom, drivers who are caught performing these illegal behaviours receive a monetary fine and penalty points[22] and, in some cases disqualification from driving, or imprisonment. Drivers can be charged for multiple offences committed at the same time. However, the court may decide if the offences should be considered as separate or the same offence. If the court decides the offences are separate, then the driver may receive penalty points for each offence. Data available online are consistent across all countries in the United Kingdom. Table 7 provides a brief overview of the current penalties associated with the various traffic offences.

[20] https://www.legislation.gov.uk/ukpga/1988/52/contents

[21] https://www.gov.uk/browse/driving/highway-code-road-safety

[22] A drivers may be disqualified from driving if they receive 12 or more penalty points within a 3-year period. New drivers (within 2 years of receiving their licence) are allowed up to 6 penalty points.

Table 7. United Kingdom traffic penalties

	Speeding	Mobile phone	Drink driving (first offence)	Drug driving (first offence)	Non-use of seatbelts or incorrect use
United Kingdom	Minimum penalty £100 fine and 3 penalty points. The amount of fine depends on what speed the driver was exceeding the speed limit by.	£200 fine Up to 6 penalty points Lose licence if passed driving test in last 2 years	Driving or attempting to drive while above legal limit may result in 6-month imprisonment, an unlimited fine, a ban for driving for at least 1 year (3 years if convicted twice in 10 years) Penalty points	If convicted, a driver may receive a minimum 1 year driving ban, an unlimited fine, up to 6 months in prison, a criminal record. Penalty points	Up to £500 fine 3 penalty points (passengers over 14 years may also receive fine and points if they are not wearing a seat belt)

Note. All fines are provided in Pounds and are correct as of 6/02/25. Information was retrieved from https://www.gov.uk/browse/driving/penalty-points-fines-bans; https://www.gov.uk/using-mobile-phones-when-driving-the-law#:~:text=Penalties,in%20the%20last%202%20years; https://www.police.uk/advice/advice-and-information/rs/road-safety/seatbelts/

3.2.2.1. Speeding

It is illegal to exceed the posted speed limit in the United Kingdom. Like other countries, speed cameras are typically used to enforce speed limits. Speed cameras used include fixed and mobile speed cameras, average speed cameras, variable speed cameras, and bi-directional cameras. The first speed camera installed in Great Britain was in West London in 1992[23]. A cost-benefit analysis revealed that 3 years after the installation of speed cameras in Great Britain, crashes at speed camera sites fell by 28%, and that average speeds were reduced by 4.2mph (Hooke et al., 1996). These findings demonstrate the safety benefits of speed cameras.

In Northern Ireland, while the police are responsible for enforcing the traffic laws, the Northen Ireland Road Safety Partnership are responsible for the safety camera scheme. This partnership was established in July 2003 and originally referred to as the Ireland Safety Camera Scheme[24]. The road safety partnership includes representatives from different government departments as well as the police service and the courts and tribunal service. Specifically, the partnership aims to change the public's attitudes towards speeding behaviour and reduce the number of casualties through education and by detecting speeding behaviour. The Northern Ireland Road Safety Partnership reported that, in 2023, there were three fixed speed cameras sites, six fixed red-light cameras sites, and three average speed cameras sites. Further, there were 11 speed camera vehicles which were operational at various sites around Northern Ireland (Northern Ireland Statistics and Research Agency, 2024). The police service of Northern Ireland also detects speeding behaviour and enforces speed limits. These statistics were not available for Great Britain.

3.2.2.2. Mobile phone use

In the United Kingdom, it is illegal to hold and use a phone, a tablet, satellite-navigation system, or any other device which can send or retrieve data while driving. This law applies to drivers while driving, stopped at traffic lights, and when queuing in traffic. Drivers are allowed to use hands-free devices, providing these devices are not touched by the driver at any time. Mobile phone and seat-

[23] https://www.rospa.com/getmedia/4b1dc15b-b396-4bd6-8d4d-1dd80d093db0/Speed-Cameras-factsheet-Oct-23.pdf
[24] https://www.psni.police.uk/safety-and-support/roads-and-driving/northern-ireland-road-safety-partnership#:~:text=The%20Northern%20Ireland%20Road%20Safety,Ireland%20Courts%20and%20Tribunal%20Service

belt detection cameras were first introduced in 2021. Similar to other countries, the trial phase involved motorists receiving warning letters (no fine or penalty points). Now, motorists receive a fine and penalty points if caught using their phone while driving from these cameras.

3.2.2.3. Impaired or intoxicated driving

The BAC limit differs in the United Kingdom, with the legal BAC limit in England, Wales, and Northern Ireland at 0.08 and the BAC limit in Scotland slightly lower at 0.05. It is also illegal to drive under the influence of drugs and the law does not distinguish between illegal drugs and prescription drugs.

Breath testing is used to deter drink driving in the United Kingdom. However, and in England, Wales, and Scotland, while police can randomly stop a vehicle at any time, they can only conduct a breath test if they suspect that a driver has been drinking or is under the influence of drugs. Breath tests may also be conducted by police if a driver has been in a crash or committed a traffic offence. In Northern Ireland, and since November 25th 2016, police can conduct random breath tests at vehicle checkpoints. Prior to this date, police were also required to only conduct breath tests if they suspected that a driver was under the influence of alcohol or drugs. For drug driving, if police think that a driver is under the influence of drugs, they can ask a driver to do a field impairment test (e.g., asking a driver to walk in a straight line). Police also have access to roadside drug tests which screen for cannabis and cocaine. If the test is positive, the driver will be taken to the police station for further testing (i.e., a blood or urine test).

3.2.2.4. Non-use of seat belts

In the United Kingdom, seatbelts were first made compulsory for drivers and front seat passengers in January 1983. Rear seatbelts were made compulsory for adults in 1991 and children in 1989. Drivers and passengers of conventional vehicles must wear a seat belt if one is fitted in the seat. As outlined in the legislation, a person does not have to wear a seatbelt if they are: “a driver who is reversing, or supervising a learner driver who is reversing; in a vehicle being used by police, fire, and rescue services; a passenger in a trade vehicle and are investigating a fault; driving goods vehicle on deliveries that is travelling no more than 50 metres between stops; a licensed taxi driver who is looking for customers either by being hailed in the street or waiting at a taxi rank (known as ‘plying for hire’); a licensed taxi driver or a driver or a private hire vehicle who is carrying passengers”[25]. Some medical exemptions may also apply however a driver will need to obtain a Certificate of Exemption from Compulsory Seat Belt Wearing from a registered medical doctor. Seat belt non-compliance is enforced via the recently introduced detection cameras and on-road police.

3.2.3. Road policing statistics

The number of enforcement checks are reported for i) England and Wales (combined), ii) Scotland, and iii) Northern Ireland.

3.2.3.1. England and Wales

Table 8 presents the road policing statistics for England and Wales, with fatalities reported for Great Britian (i.e., England, Wales, and Scotland). The number of breath tests and trends have increased since 2020; however, these numbers remain lower than the number of breath tests undertaken by police prior to the COVID-19 pandemic. As reported by the United Kingdom Home Office[26], there are seasonal variations in breath test checks. Specifically, and to coincide with the annual national

[25] https://www.gov.uk/seat-belts-law/when-you-dont-need-to-wear-a-seat-belt

[26] https://www.gov.uk/government/statistics/police-powers-and-procedures-roads-policing-to-december-2023/police-powers-and-procedures-roads-policing-to-december-2023#:~:text=In%202023%2C%205%20breath%20tests,the%20same%20for%20recent%20years

Christmas drink and drug driving campaigns, more breath tests were undertaken by police in December 2022 and December 2023 compared with all other calendar months in 2022 and 2023.

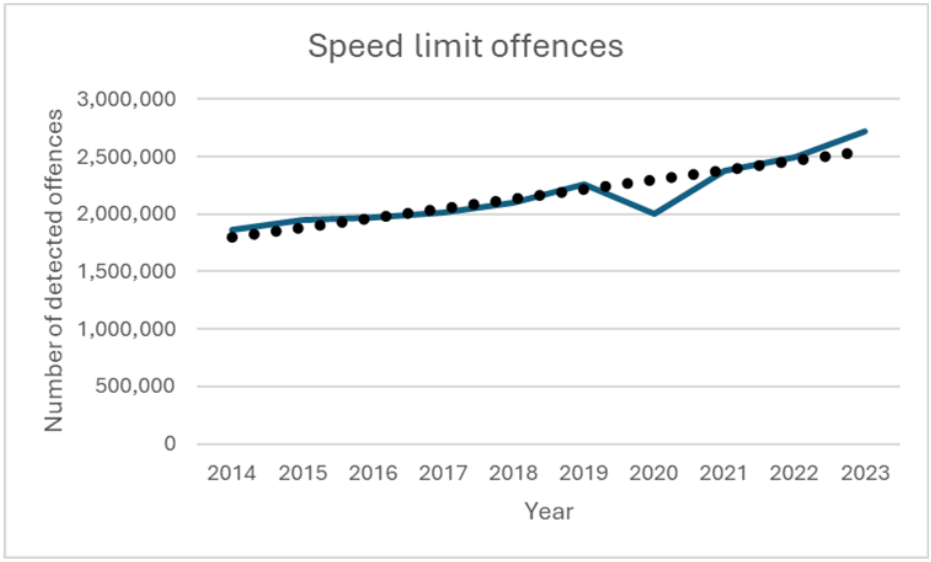
For detected offences, Table 8 also shows that there has been an increase in the number of speed limit offences between 2014 and 2019 and again from 2021 to 2023. The trend in detected speed offences has also slightly increased since 2014 (see Figure 3). For mobile phone offences, there was a decrease in the number of offences between 2014 and 2020. However, between 2021 and 2022 there was a larger increase in the number of offences which could be due to the change in the law of using a mobile phone while driving. The new law changed the meaning of 'using' a phone to cover using "*any device which is capable of interactive communication even if that functionality is not enabled at the time*"[27]. The trends in detected mobile phone offences have been increasing since 2020 (see Figure 3). For seatbelt offences, there was a decrease in the number of detected offences between 2014 and 2016, with these detected offences increasing between 2018 and 2021, and then remaining steading since 2021.

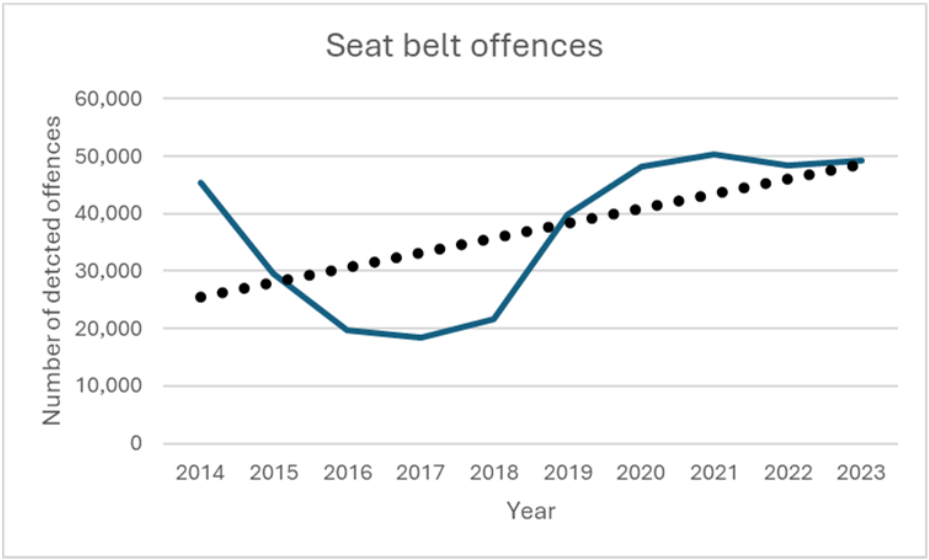
[27] https://commonslibrary.parliament.uk/changes-in-the-law-on-driving-while-using-a-mobile-phone/

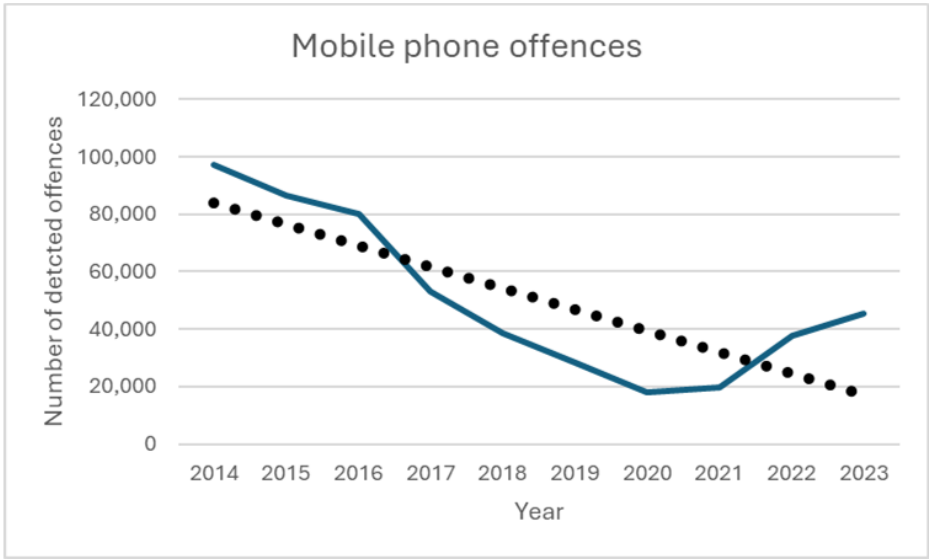
Table 8. Road policing statistics for England and Wales between 2014-2023

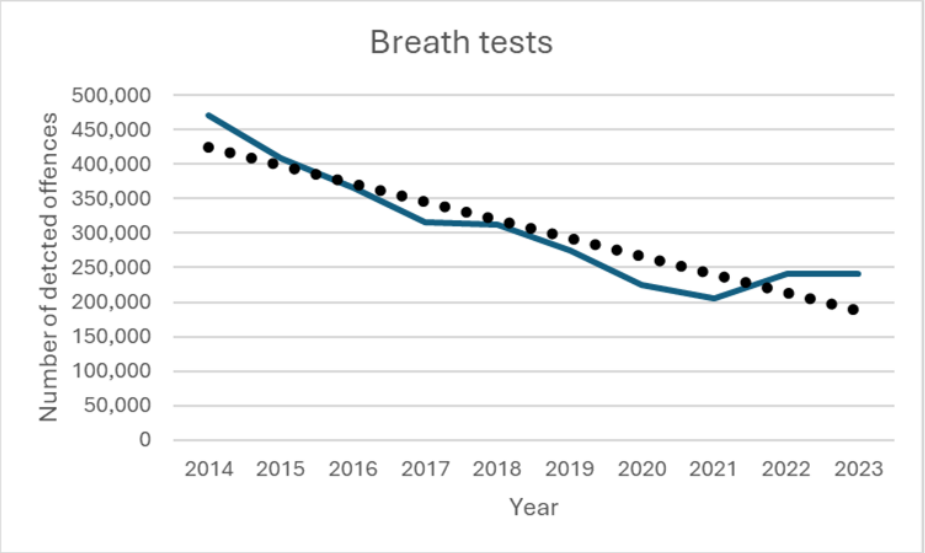
	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Great Britian										
Population (million)	64.60	65.12	65.61	66.06	66.46	66.84	67.08	67.03	67.79	68.35
Fatalities	1,775	1,730	1,792	1,793	1,784	1,752	1,460	1,558	1,711	1,624
Fatalities (per million population)	27.5	26.6	27.3	27.1	26.7	26.21	21.8	23.2	25.2	23.8
England and Wales										
Speed limit offences	1,863,317	1,944,978	1,970,207	2,013,830	2,101,647	2,253,948	2,006,382	2,371,813	2,495,584	2,714,945
Seat belt offences	45,324	29,646	19,629	18,467	21,577	39,745	48,189	50,364	48,301	49,146
Use of handheld phone while driving	97,385	86,371	79,929	52,993	38,545	28,321	17,873	19,614	37,882	45,638
Number of breath tests	470,954	409,111	366,053	315,072	311,716	274,425	225,521	205,703	241,021	240,322/ 276,914*
Positive or refused tests	48,841	45,842	44,587	41,387	45,149	44,377	37,757	34,647	39,810	38,061

Note. breath tests, some figures may be estimates in the period between 2014-2016. Statistics access 31/01/2025: https://www.gov.uk/government/statistics/police-powers-and-procedures-roads-policing-to-december-2023#documents *Tables: bt_03 2023 yearly trend and bt_04 monthly trends provide different total statistics; Fatality data accessed 31/01/2025: https://www.gov.uk/government/statistical-data-sets/reported-road-accidents-vehicles-and-casualties-tables-for-great-britain#road-user-type-ras02 Information about population million was accessed 28/03/2025 from https://datatopics.worldbank.org/world-development-indicators/. Calculations for fatalities (per million population) were than calculated by dividing total number of deaths by the total population, then multiplying by 1 million.


Speed limit offences
Number of detected offences
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year


Seat belt offences
Number of detcted offences
60,000
50,000
40,000
30,000
20,000
10,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year


Mobile phone offences
Number of detcted offences
120,000
100,000
80,000
60,000
40,000
20,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year



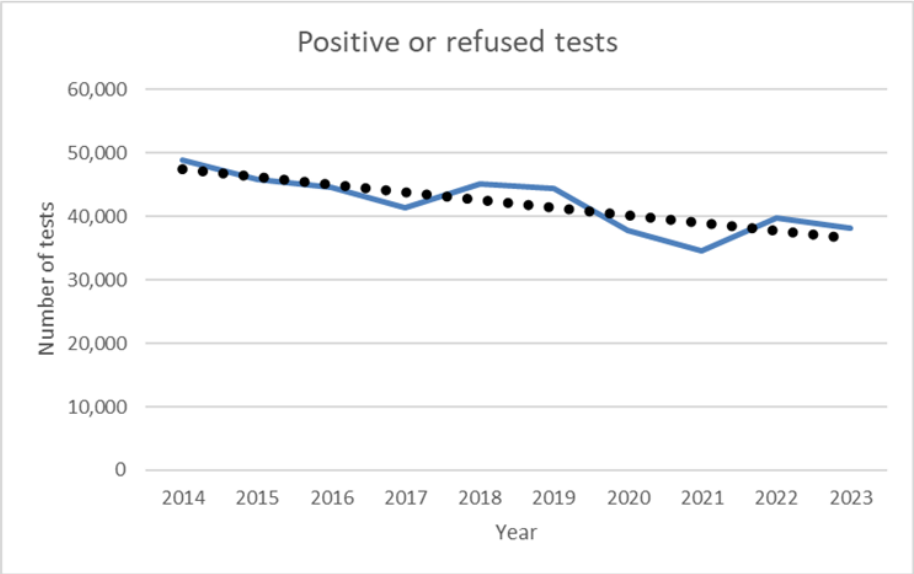


Figure 3. Trends in road policing statistics (England and Wales 2014-2023)

Notes: Blue lines represent total number of tests/detected offences and dotted black lines represent trends.

3.2.3.2. Scotland

Tables 9 and 10 present the road policing statistics for Scotland. In Scotland between 2023-24, road traffic offences account for 65% of all offences in this country. Overall, road traffic offences have increased 3% between 2022-23 to 2023-24. However, since 2014-2015 the number of road traffic offences have decreased by 43%[28]. In 2023-24, speeding behaviour accounted for 13% of all road traffic offences, dangerous and careless driving accounted for 12% of all traffic offences, driving under the influence accounted for 7%, mobile phone offences accounted for 3%, and seat-belt offences accounted for 2% of all road traffic offences. Figure 4 presents the trends in data between 2014-15 to 2023-24. As shown, trends in detected dangerous and careless driving, speeding offences, mobile phone offences and seat belt offences have decreased since 2014-15. However, in since 2021-22, mobile phone offences have started to increase. Trends for offences for driving under the influence have increased since 2014-15, with the number of detected offences remaining stable since 2021-22.

[28] https://www.gov.scot/publications/recorded-crime-scotland-2023-24/pages/13/

Table 9. Road policing statistics for Scotland between 2014-2023

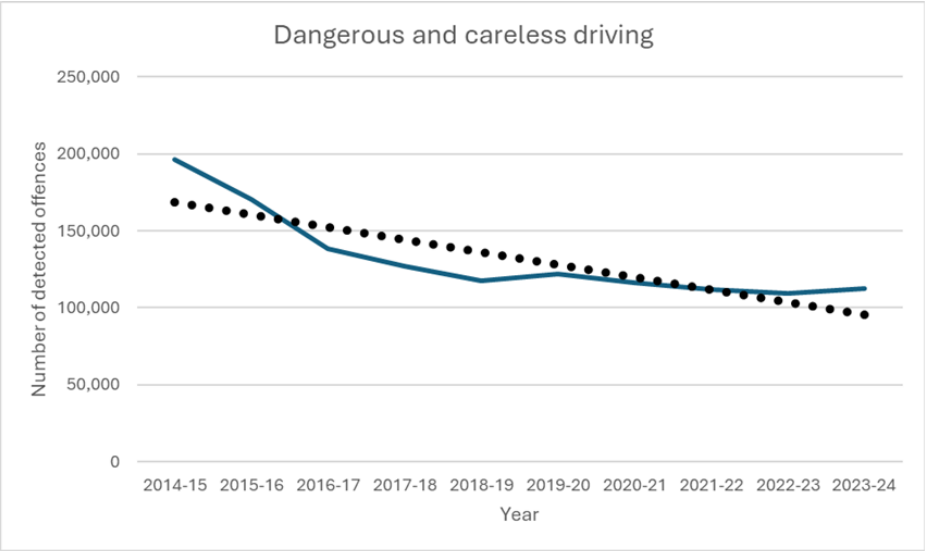
	Year									
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Total traffic offences*	196,185	170,462	138,308	127,177	117,245	122,043	116,197	111,987	109,320	112,417
Dangerous and careless driving	10,773	12,057	11,693	10,722	10,989	11,246	11,771	12,919	12,614	13,140
Speeding offences	60,926	54,419	34,371	29,223	27,368	28,758	22,963	22,472	17,767	15,064
Driving under the influence	5,218	5,458	5,917	5,863	5,847	6,597	8,097	7,773	7,815	8,041
Mobile phone offence	17,978	10,085	6,709	3,173	2,895	2,450	1,629	1,541	2,958	3,538
Seat belt offence	15,619	8,059	4,502	3,134	2,921	2,800	1,632	1,759	1,930	2,254

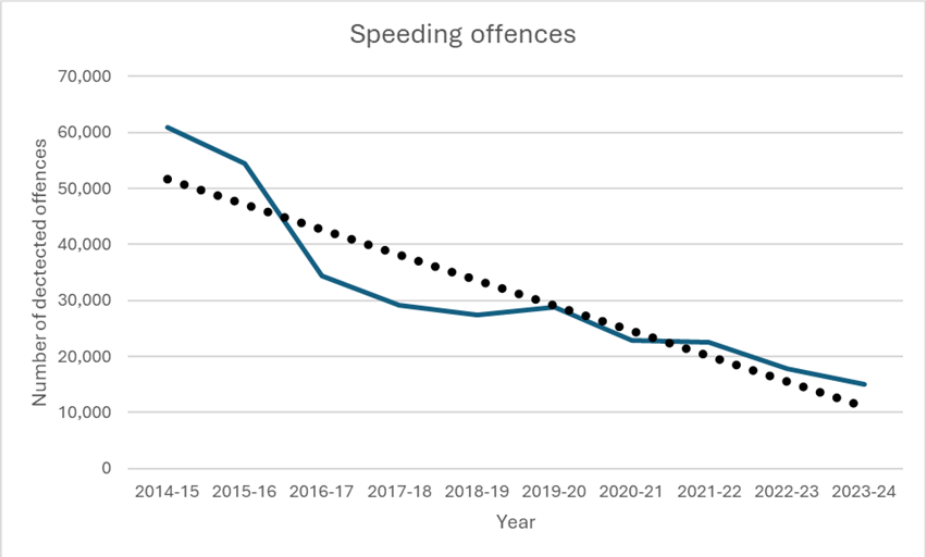
Note. * Not all traffic offences are reported in this table. These figures do not include any offences recorded as a result of the Scottish Safety Camera Program. Data relating to the number of speed offences detected by the Scottish Safety Camera Programme were not available online. Data retrieved 31/01/2025 from https://www.gov.scot/publications/recorded-crime-scotland-2023-24/documents/

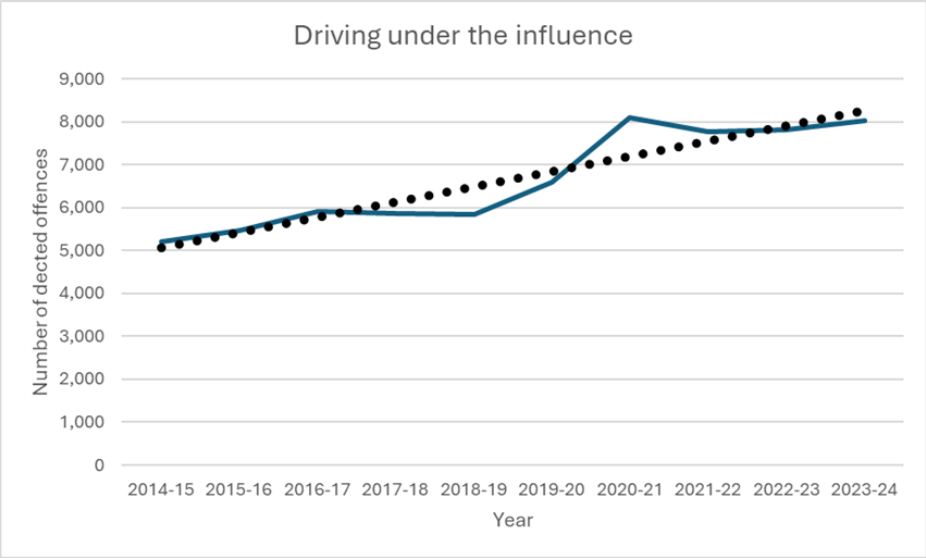
Table 10. Breath tests and drug wipes for Scotland between 2022-2023

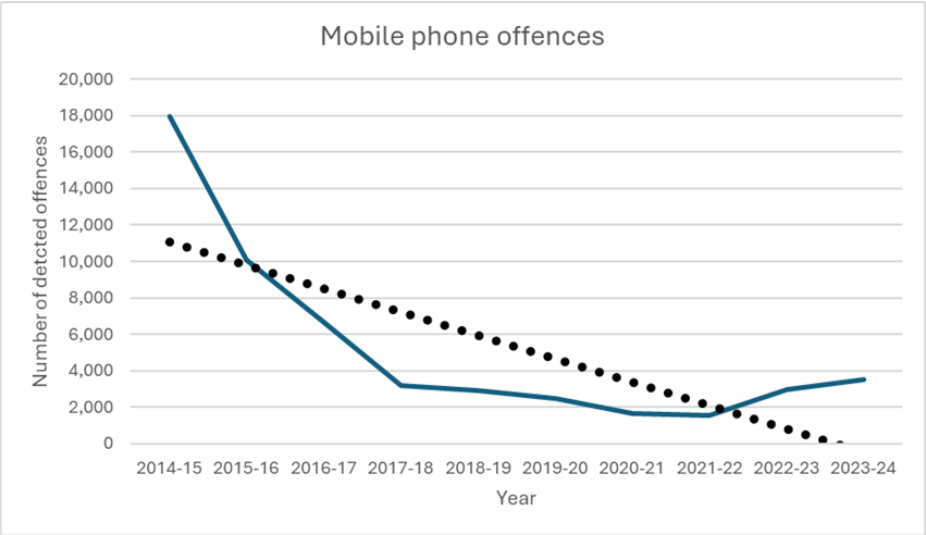
	2022	2023
Breath tests	2,568	3,219
Drug wipes	481	481

Note. The number of breath tests and drug wipes are not recorded in official documents available online. These figures were identified from a police article located on 7/02/2025 from https://www.scotland.police.uk/what-s-happening/news/2022/august/offenders-targeted-as-part-of-drink-and-drug-drive-campaign/


Dangerous and careless driving
250,000
200,000
150,000
100,000
50,000
0
Number of detected offences
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Year


Speeding offences
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Number of dectected offences
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Year


Driving under the influence
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Number of dected offences
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Year



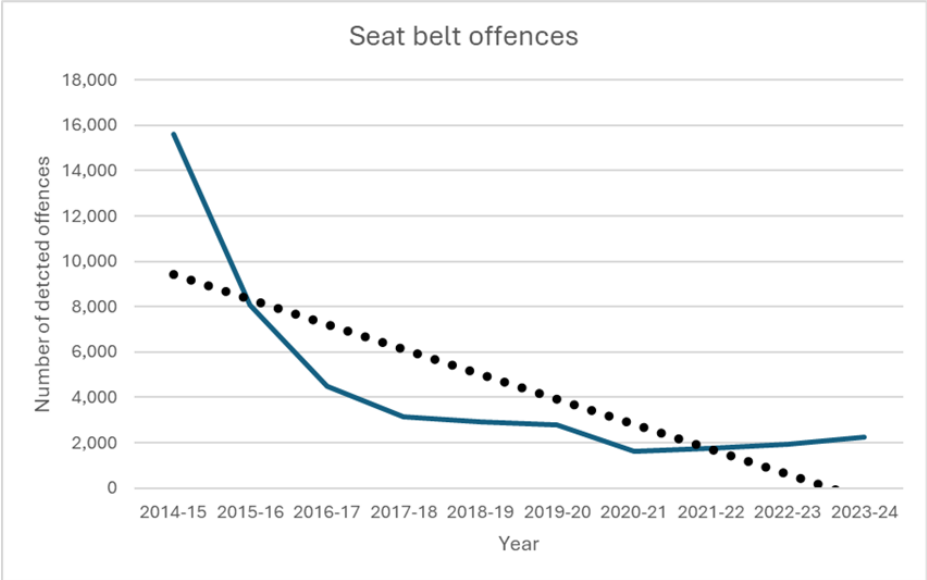


Figure 4. Trends in road policing statistics (Scotland 2014-2023)

Notes: Blue lines represent total number of tests/detected offences and dotted black lines represent trends.

3.2.3.3. Northern Ireland

Table 11 presents the road policing statistics for Northern Ireland between 2014-2023, Table 12 presents the number of fatalities, and Table 13 presents the number of speeding offences detected by the Northern Ireland Road Safety Partnership. Table 11 shows that compared to 2022, there was a decrease in the number of detections for all reported behaviours. The number of careless driving offences has decreased from 7,922 in 2014 to 4,666 in 2023, with the number of mobile phone offences decreasing from 7,126 in 2014 to 1,298 in 2023. Figure 5 highlights that the trends for detected driving offences have slightly increased between 2020-2023. However, the trends for detected mobile phone use have decreased.

The highest number of preliminary breath tests were reported for 2017, which coincides with changes in police being able to conduct random breath tests at vehicle checkpoints. Since 2017, preliminary breath tests have decreased from 43,712 in 2017 to 31,988 in 2023. Trends in preliminary breath tests show a slight increase between 2020 and 2023, although have remained relatively consistent since 2014. The total number of speeding offences detected by the Road Safety Partnership in 2023 was the highest number of detections ever recorded in a calendar year (see Table 13). Mobile speed cameras have detected the most speeding offences across all calendar years, accounting for 93% of all detections in 2023. Trends in detection via speed cameras are increasing, whereas trends in detection via police are slightly decreasing (see Figure 5).

Table 11. Road policing statistics for Northern Ireland between 2014-2023

	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Careless driving offences	7,922	8,942	7,207	5,059	4,658	4,484	3,939	4,445	4,576	4,666
Drink or drug driving offences	2,789	2,813	3,125	3,038	2,941	3,198	3,106	2,955	3,102	2,978
Mobile phone offences	7,126	6,739	5,926	4,826	4,553	3,750	3,468	2,465	1,777	1,298
Seat belt offences	-	-	-	-	-	-	-	-	723	714
Speeding offences	10,208	8,785	6,881	6,967	8,308	7,622	9,035	6,769	7,127	5,551
Preliminary breath tests	29,005	27,446	34,420	43,712	35,994	39,489	28,971	33,472	34,611	31,398
Positive or failed to provide	3,252	3,386	3,675	3,940	3,767	3,746	3,409	3,516	3,818	3,763

Note. Retrieved 31/01/2025 from https://www.psni.police.uk/sites/default/files/2024-03/Motoring%20Offences%202023%20Annual%20Report.pdf; https://www.psni.police.uk/sites/default/files/2024-05/Preliminary%20Breath%20Tests%20NI%202023.pdf. These statistics report offences detected by police in Northern Ireland. It does not include any detections by the Northern Ireland Road Safety Partnership.

Table 12. Fatalities for Northern Ireland between 2014/15 to 2023/24

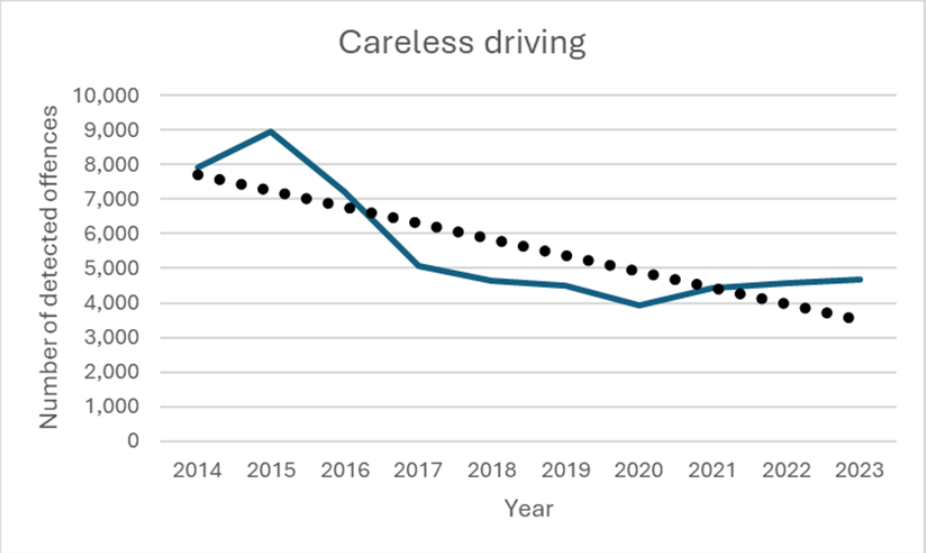
	Year									
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Fatalities	76	75	65	61	61	56	53	45	61	73

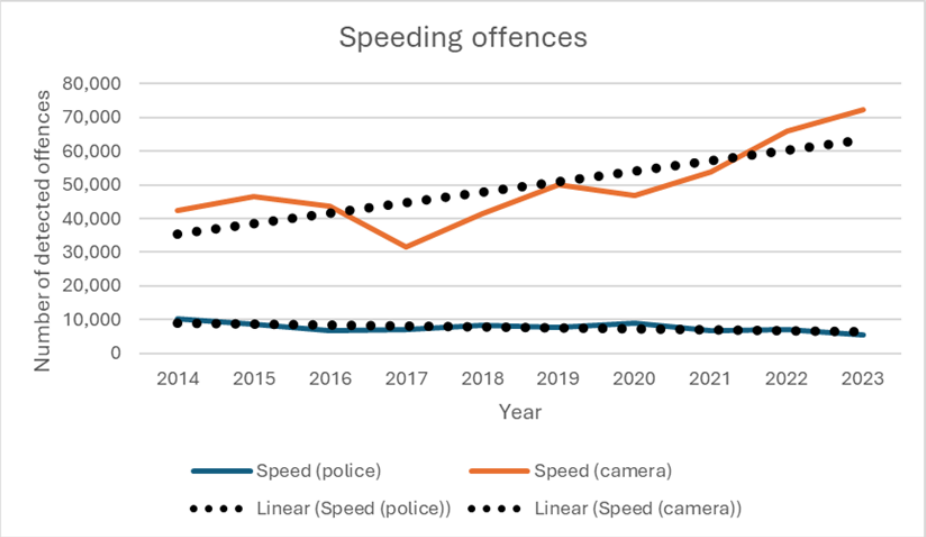
Note. Retrieved 31/01/2025 from https://www.psni.police.uk/about-us/our-publications-and-reports/official-statistics/road-traffic-collision-statistics

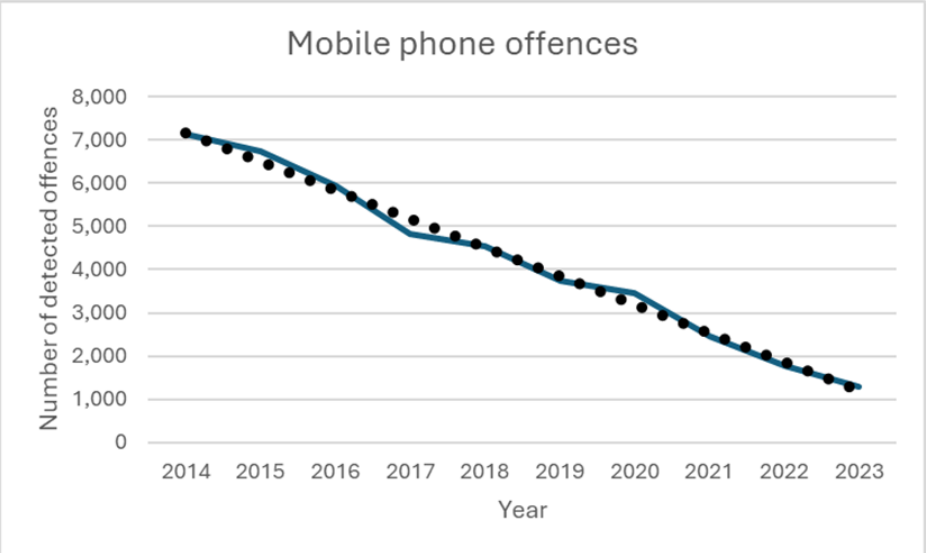
Table 13. Number of speeding offences detected by the Northern Ireland Road Safety Partnership between 2014-2023

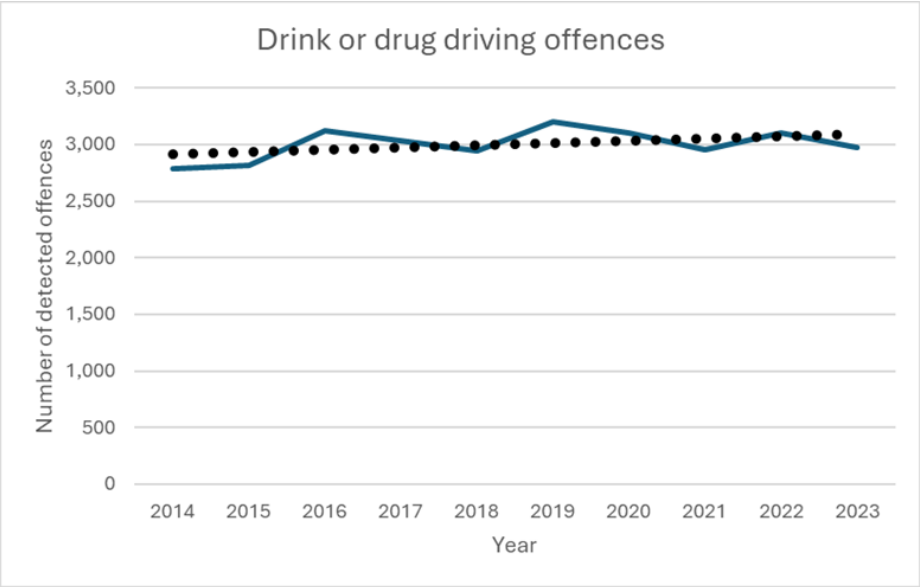
	Year									
Camera type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Mobile speed camera	30,012	34,692	34,308	22,700*	31,538	41,233	41,012	47,997	60,174	67,227
Fixed speed camera	11,484	10,318	8,100	7,669	5,970	5,035	3,188	3,276	3,351	2,967
Average speed camera	265	900	936	707	3,461	3,044	2,095	2,239	1,932	1,721
Red light running camera	668	590	314	357	448	568	436	458	517	439
Total	42,429	46,500	43,658	31,433	41,417	49,880	46,731	53,970	65,974	72,354

Note. Retrieved 31/01/2025 from https://www.nisra.gov.uk/statistics/ni-road-safety-partnership/ni-road-safety-partnership-statistics. * Fewer deployments of mobile vans in 2017 due to staffing resources, which resulted in a lower number of offences detected


Careless driving
Number of detected offences
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year


Speeding offences
Number of detected offences
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year
Speed (police)
Speed (camera)
Linear (Speed (police))
Linear (Speed (camera))


Mobile phone offences
Number of detected offences
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year



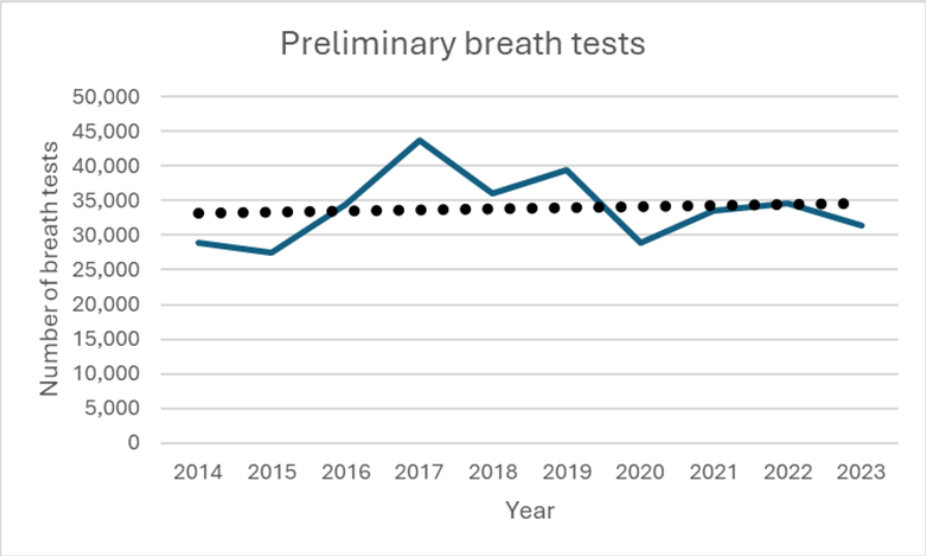


Figure 5. Trends in road policing statistics (Northern Ireland 2014-2023)

Notes: Blue and orange lines represent total number of tests/detected offences and dotted black lines represent trends.

3.2.4. Key enforcement and offence related metrics

GOV.UK publishes official statistics for England and Wales. In addition to the statistics presented earlier, rates per 1,000 population are provided for breath tests separately for England and Wales. In England in 2023, the rate was 4 per 1,000 population for breath tests which was lower than in Wales which was 11 per 1,000 population for breath tests. Metrics per population for other enforcement activities and offences were unable to be located from official sources online.

In Scotland, the Scottish Government releases yearly accredited official statistics on crimes and offences, including road policing statistics[29]. As part of these annual reports, data are reported separately for each relevant traffic offence, alongside data per 10,000 population for road traffic offences. These additional statistics have been included in reports since 2020-21. The national rate for road traffic offences for the last four years in Scotland are: 213/10,000 population in 2020-21, 205/10,000 population in 2021-22, 201/10,000 population in 2022-23, and 206/10,000 population in

[29] https://www.gov.scot/publications/recorded-crime-scotland-2023-24/

2023-24. Scotland's Road Safety Framework to 2030 covers the importance of increasing police enforcement of the road rules.

The Police Service of Northern Ireland motoring offence statistics are used to monitor traffic offences[30]. These statistics are independently reviewed by the Office of Statistics and comply with the Code of Practice for Statistics. Data are reported separately for each relevant traffic offence. Figure 6 from the 2025 report on motoring offence statistics for Northern Ireland presents the rate of motoring offences per 10,000 population. Specific metrics were not provided for preliminary breath tests. The Road Safety Strategy for Northern Ireland to 2030 also highlights the importance of police enforcement.

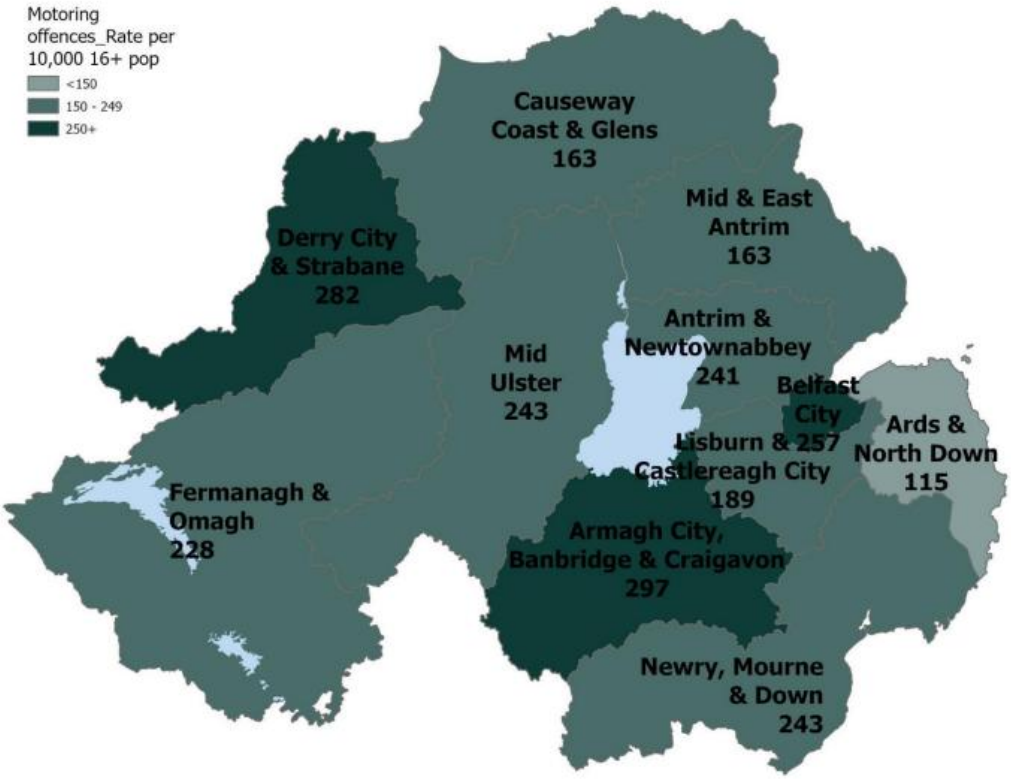


Figure 6. Rate of motoring offences per 10,000 population aged 16+ years by policing district (1st December 2023 to 30th November 2024)

[30] https://www.psni.police.uk/about-us/our-publications-and-reports/official-statistics/motoring-offence-statistics

3.3. Australia

3.3.1. General overview of the traffic enforcement system

Australia consists of five States (i.e., New South Wales, Queensland, Victoria, Tasmania, South Australia, and Western Australia) and two Territories (i.e., Northern Territory and the Australian Capital Territory). Police in each of the various states and territories are responsible for enforcing traffic laws. The Australian Road Rules form the basis of the traffic laws for each State and Territory. The overarching objectives of the Australian Road Rules[31] are to:

a) Provide uniform rules across Australia for all road users, and

b) Specify behaviour for all road users that supports the safe and efficient use of roads in Australia.

While there are some differences between the traffic laws in each Australian State and Territory, most jurisdictions have adopted the Australian Road Rules. Table 14 presents information of the police agency who is responsible for enforcing traffic laws and the relevant government department in each Australian jurisdiction. Where available, the total number of police officers for each jurisdiction is provided in Table 14. Unfortunately, it was not possible to determine the number of those police officers who focus on traffic/road policing in each jurisdiction from the reviewed informational sources.

Table 14. Traffic enforcement for Australian jurisdictions

State/Territory	Police Agency	Government department
New South Wales	The New South Wales Police Force, through the Traffic Highway and Patrol Command Police: 10,485 (as of 30th June 2024)	Transport for NSW (TfNSW)
Queensland	Queensland Police Service Police: 12,341 (as of 30th June 2024)	Department of Transport and Main Roads (TMR)
Vicotria	Victoria Police Police: 16,059 (as of 29th June 2024)	Transport Victoria
Tasmania	Tasmania Police Police: 1,486 (2023)	Department of State Growth; The Department of Police, Fire, and Emergency Management
South Australia	South Australia Police Police: data not available	Department for Infrastructure and Transport
Western Australia	Western Australia Police Force Police: data not available	Department of Transport
Northern Territory	Northern Territory Police Force Police: 1,649 (as of 30th March 2024)	Department of Infrastructure Planning and Logistics
Australian Capital Territory	ACT Policing/Australian Federal Police Police: data not available	Transport Canberra and City Services

[31] Information about the Australian Road Rules can be found: https://pcc.gov.au/uniform_legislation_official_versions.html

3.3.2. Approaches to enforcement

This section provides an overview of the Australian approaches to enforcement for speeding, mobile device use, intoxicated or impaired driving (i.e., drink and drug driving), and non-use of seat belts. In Australia, drivers who are caught performing these illegal behaviours receive a monetary fine and demerit points and, in some cases, licence disqualification/suspension, a court appearance, or imprisonment. Drivers who hold an open licence can accrue up to 12 points, with demerit points expire three years from date of offence. For novice drivers, demerit points range between 4 to 8 depending on residence. Novice drivers who accumulate more than the allowed points within a set time period will receive a suspension. For example, in Queensland novice drivers (i.e., learner and all provisional license holders) have a limit of 4 demerit points, with demerit points expiring 12 months from date of offence. If a novice driver is detected using a handheld mobile phone (i.e., an offence with 4 demerit points) then their licence will be suspended for 3-months. Further, double demerit points may apply in some Australian States and Territories for a second offence within 1-year of a previous offence. Double demerit points also apply in some Australian jurisdictions during holiday periods. In other jurisdictions, such as Queensland, double demerit points apply to repeat offenders. In Australia, drivers can be charged for separate multiple offences committed at the same time. Cumulative disqualifications (i.e., serve one disqualification period after the other) may also apply for a driver who is convicted and disqualified for two or more drink or drug driving offences, or a drink and drug driving offence at the same time as driving without a valid licence.

Table 15 provides a brief overview of the current penalties associated with the various traffic offences across Australian state and territories. As Table 15 highlights, offence penalties differ across the Australian jurisdictions.

Table 15. Australian traffic penalties

State/Territory	Speeding	Mobile phone	Drink driving (first offence)	Drug driving (first offence)	Non-use of seatbelts or incorrect use
New South Wales	Range: $137/1 point exceed speed limit by 10km/hr or under to $2,967/ 7 points if exceed speed limit by more than 45km in a school zone.	$410/ $544 if detected in school zone 5 demerit points	Low range: $682, licence disqualification 3-6 months. Mid-range (0.08-0.15): Max $2,200, licence disqualification 6+ months, potential for prison term. High-range (above 0.15) Max $3,300, license disqualification 10+ months, potential prison term.	$682-$2,200, 3 months licence suspension, 3-6 months disqualification.	$410 3 demerit points
Queensland	Range: $287/1 point less than 11km over speed limit to $1,653/8 points/6-month suspension more than 40km/hr over speed limit	$1,209 4 demerit points	Low range: $2,258, 1-9 months licence disqualification, potential imprisonment Mid-range: $3,226, 3-12 months licence disqualification, potential imprisonment High-range: $4,516, min 6 months licence disqualification, potential imprisonment.	Fine up to $2,258, 1-9 months disqualification, potential prison imprisonment	$1,209 4 demerit points
Victoria	Range: $247/1 point exceed	$593	Low: receive fine, licence cancelled,	Fine: 12 penalty units*, licence	$395

State/Territory	Speeding	Mobile phone	Drink driving (first offence)	Drug driving (first offence)	Non-use of seatbelts or incorrect use
	speed by less than 10km to $988/3 points/12 months licence suspension for 45km or more.	4 demerit points	disqualified between 3-6 months, complete a drink driver behaviour change program, have an alcohol interlock, zero BAC for next 3 years. Mid: receive fine, licence cancelled, disqualified between 10-14 months, complete a drink driver behaviour change program, have an alcohol interlock, zero BAC for next 3 years. High: receive fine, licence cancelled, disqualified between 15-24 months, complete a drink driver behaviour change program, have an alcohol interlock, zero BAC for next 3 years.	suspended for 12 months, need to complete a drug driver behaviour change program, zero BAC for next 3 years, court may record conviction	3 demerit points
Tasmania	Range: $101/2 points exceed speed by less than 10km to $1,161.50/6 points/ 4 months licence suspension for 45km or more	$404 3 points	Low: Fine 2-10 penalty units, 3-12 months disqualification Mid: Fine 4-20 penalty units, 6-18 disqualification High: Fine 5-30 penalty units, 12-36 months disqualification. Potential for imprisonment for all offences.	Maximum fine $1,680, 3-12 months disqualification, potential for imprisonment	$404 3 points
South Australia	Range: $202/2 points by less than 10km to $1895/ 9 points/ 6-months licence suspension for 45km or more	$556 3 demerit points	Low: $849/4 points Mid: court-imposed penalty/5 points High: court-imposed penalty/6 points	$849 4 points	1 person: $435/3 points More than 1 person: $514/5 points
Western Australia	Range: $100/zero points not more than 9km to $1,200/7 points for more than 40/km	Up to $1000 4 points	Low: infringement, $1000, plus court penalty, 3-5 points. Mid: $750 to $2,250 court penalty, 6 to 9 months+ disqualification High: $1,700-$3,750 court penalty, 10 months disqualification	$1,250 (max) 3 points	$550 4 points
Northern Territory	Range: $150/1 point for up to 15km to $1000/6	$500 3 points	Low: $400/3 points/3 months (min) licence disqualification/potential prison term	$400 or court ordered fine of 5 penalty units	$500 3 points

State/Territory	Speeding	Mobile phone	Drink driving (first offence)	Drug driving (first offence)	Non-use of seatbelts or incorrect use
	points for over 45km		Mid: 7.5 penalty unit fine/6 months licence disqualification/ potential prison term High: 10 penalty units fine/ 12 months licence disqualification/ potential prison term	Maximum term of imprisonment: 3 months	
Australian Capital Territory	Range: $307/1 point for less than 15km to $2,136/6 points if exceed speed by 45km+ in school zone	$514 3 points Use for messaging, social media, apps, or internet: $632/2 points	Low: maximum 25 penalty units; 3 months (min) disqualification Mid: maximum 50 penalty units; 6 months (min) disqualification High: maximum 75 penalty units; 9 months (min) disqualification	Maximum 25 penalty units; 3 months min disqualification	$353 3 points

Note. All fines are provided in Australian dollar. Penalties are correct as of 18/12/24. * Penalty units are standard amounts of money used to calculate penalty. A driver who is convicted of a high-risk driving drink driving offence and their licence is disqualified are required to participate in their State/Territory alcohol interlock program.

3.3.2.1. Speeding

In Australia, it is illegal to exceed the posted speed limit. However, jurisdictions use different enforcement thresholds above which drivers need to be travelling to receive an offence notice. These enforcement thresholds are not publicised by the police, so it is not possible to report them in a systematic way. In some Australian States and Territories there are also additional restrictions for learner licence holders. For example, and in New South Wales, learner and P1 drivers who hold a New South Wales learner licence cannot drive faster than 90km/h, even on roads with a higher speed limit. In Australia, the tolerance threshold police implement in speed detection is not made available to the public.

Speed cameras are typically used to enforce speed limits. Speed cameras were first introduced on a trial basis in Victoria in 1985. This trial consisted of overt mobile speed cameras which were situated at high frequency crash sites (Delaney et al., 2005). Covert speed cameras were later introduced in Victoria in 1989, which operated from unmarked cars (Delaney et al., 2005). Today, both overt and covert mobile as well as fixed cameras operate in all Australian States and Territories. Average speed cameras are also operational in Queensland, New South Wales[32], Australian Capital Territory, Victoria, South Australia, and Western Australia. Average speed cameras are also currently being trialled in Tasmania. Other camera types implemented within Australian jurisdictions include combined red light and speed cameras (i.e., cameras which capture motorists who are both exceeding the posted speed limit and/or running a red light) and cameras on portable trailers (i.e., cameras which can be moved around and operated at sites including road work zones and school zones).

[32]Average speed cameras are in use for heavy vehicles, with a trial currently underway to track all vehicles.

3.3.2.2. Mobile phone use

In Australia, it is illegal to hold a handheld phone or have the phone resting on any part of your body (e.g., lap) while driving, stopped in traffic, or stopped at traffic lights. Fully licensed drivers[33] are permitted to use a handsfree device while driving.

Mobile phone detection cameras were first trialled in New South Wales on 1st December 2019. During this time, drivers only received a warning notice if they were caught driving with a handheld phone. These mobile phone detection cameras became fully operational on 1st March 2020, with drivers receiving a monetary fine and five demerit points. In July 2021, Queensland was the first Australian State to introduce combined mobile phone and seatbelt detection cameras. As in New South Wales, these cameras only issued drivers with a warning notice when they were first introduced as part of an amnesty period extending a number of months, with penalties (monetary fines and demerit points) issued to drivers from 1st November 2021. Mobile phone and seatbelt cameras target drivers who are using a handheld phone as well as drivers and front seat passengers who are not wearing seatbelts. These cameras have since been introduced into other Australian jurisdictions including, New South Wales, Victoria, South Australia, and the Australian Capital Territory. In addition to mobile phone cameras, police may also issue drivers with a ticket for using a handheld phone (however, detecting mobile phone use via this method of detection has long been recognised as a relatively challenging to implement).

3.3.2.3. Impaired or intoxicated driving

In Australia, the BAC limit is 0.05 for full licence holders. Restrictions apply for professional drivers (see Table 3), and novice drivers must have a zero BAC limit. It is also illegal to drive under the influence of drugs.

Random breath testing (RBT) is used in Australia to deter motorists from drink driving. In Australia, police can stop any driver at any time to conduct an RBT. RBT was first introduced in Victoria in 1976, followed by the remaining States and Territories in the early to late 1980s (Homel, 1988b). In 1990, highly visible roadside breath testing sites (typically referred to as 'booze buses') were introduced in conjunction with public education campaigns to support the random roadside breath test program. Again, this approach first occurred in Victoria and was then adapted to varying degrees in other jurisdictions. Roadside breath testing sites, either the highly visible booze buses or less visible police checks, are the key approaches to drink driving enforcement in Australia.

Roadside drug testing (RDT) is used in Australia to detect drivers who are driving under the influence of illicit substances. RDT was first introduced in Victoria in 2004. RDT enables police to detect the presence of specific drugs (e.g., cannabis, methylamphetamine, ecstasy) with a swab taken of saliva from a driver's tongue. Prior to RDT, a driver could only be tested for drug driving through a blood sample taken at a hospital. However, and compared to RBTs, roadside drug testing tends to be more targeted (i.e., police suspect that a driver may be under the influence of an illicit substance).

3.3.2.4. Non-use of seat belts

In Australia, seat belts were first made compulsory in Victoria in 1970. Within two years, seat belts were compulsory in all other Australian States and Territories (McDermott & Hough, 1979). However, this law did not initially apply to children who were less than 8 years of age (McDermott & Hough, 1979).

[33]There are restrictions for learner and provisional licence holders. Handsfree use of mobile phones may also attract penalties if a driver is not in proper control of their vehicle.

Drivers and passengers of passenger vehicles must wear a seat belt. Seat belts must also be worn correctly, and one belt not used to restrain more than one person. In some vehicles, such as public buses, seatbelts must be worn if they are present (i.e., not all buses are fitted with seat belts) although this change is coming with it mandatory for all new buses by the end of 2025 to have seatbelts fitted and retrofitted to older buses by the following year. There are some exemptions for not wearing seat belts (e.g., those who have a signed medical certificate from a registered medical practitioner). In Australia, police are responsible for enforcing seat belt use. Enforcement measures include mobile phone and seat belt detection cameras (see Section 3.3.2.2), and on-road police who enforce seat belt use while driving on the road.

3.3.3. Road policing statistics

The Department of Infrastructure, Transport, Regional Development, Communications and the Arts within the Australia Government collects annual enforcement numbers for RBTs, drug tests, as well as infringements issued via camera or police detection of mobile phone use, speeding, or non- or incorrect use of seatbelts. Figure 7 provides example screen-shots taken from the Australian Government Road Safety Enforcement Dashboard. Table 16 presents the number of fatalities, random breath tests, drug tests, and infringements issues for mobile phone use, speeding, and the non-use/incorrect use of seatbelts in Australia between 2014 to 2023.

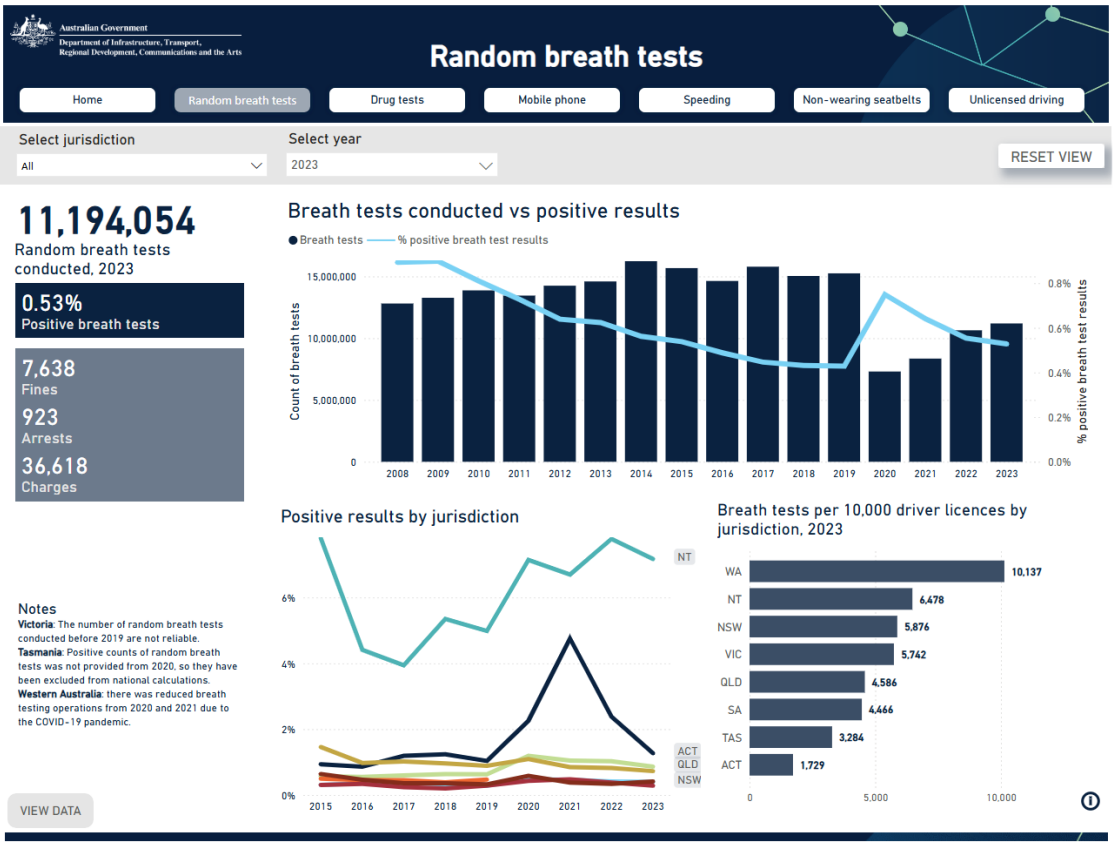


Figure 7. Example of road safety enforcement data provided on the Australian Government Road Safety Enforcement Dashboard

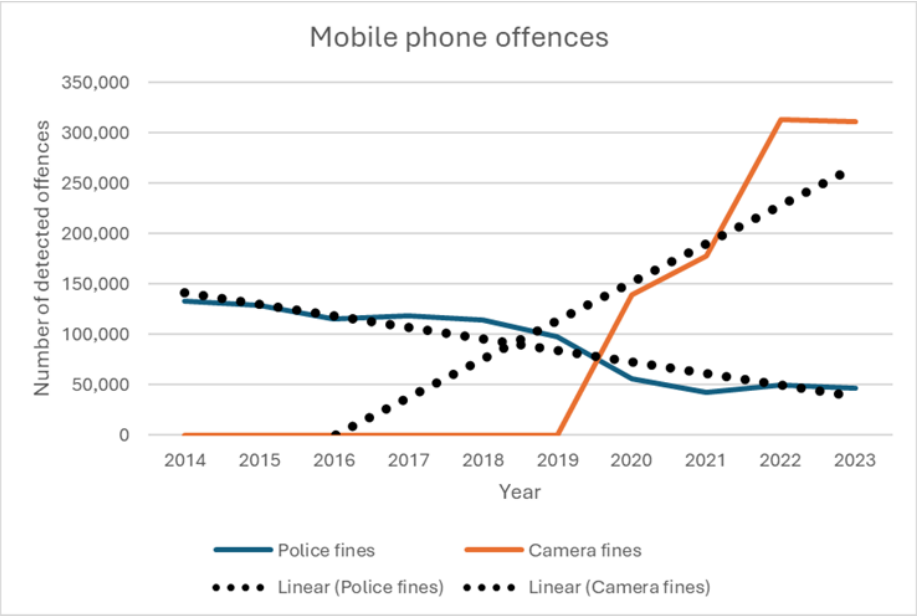
Table 16. Road policing statistics for Australia between 2014-2023

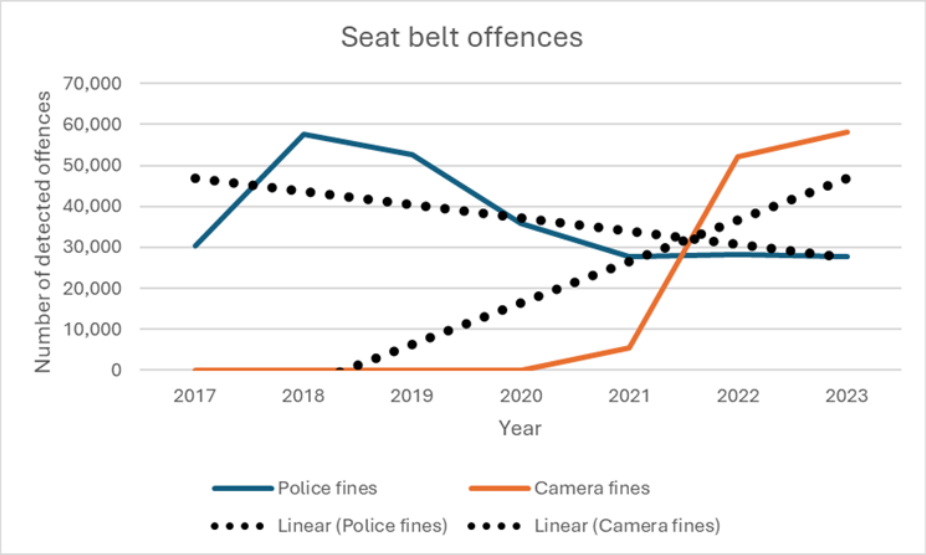
	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Population (million)	23.48	23.82	24.19	24.59	24.96	25.33	25.65	25.69	26.01	26.66
Fatalities	1,150	1,206	1,294	1,223	1,135	1,186	1,097	1,129	1,194	1,272
Fatalities (per million population)	49.0	45.0	53.5	49.0	45.5	46.8	42.8	43.9	45.9	47.7
RBTs (total)*	12,394,158	12,608,152	11,576,631	11,555,567	11,489,937	15,248,047	7,304,543	8,350,363	10,639,333	11,194,054
Proportion of positive RBTs	0.64%	0.60%	0.53%	0.52%	0.50%	0.43%	0.75%	0.64%	0.55%	0.53%
Drug tests (total)	186,204	298,133	325,598	368,600	392,352	507,315	322,609	393,728	458,133	471,217
Proportion of positive drug tests	8.7%	11.8%	11.9%	10.8%	12.3%	9.6%	14.5%	12.6%	10.2%	11.4%
Mobile phone fines										
Total	132,619	128,385	114,981	117,909	113,981	97,367	195,151	221,080	362,342	358,162
Police fines	132,619	128,385	114,981	117,909	113,981	97,367	56,304	42,784	49,397	46,599
Camera fines	-	-	-	-	-	-	138,847	178,296	312,945	311,563
Speeding fines										
Total	3,669,800	3,797,740	3,265,399	3,691,401	4,279,816	3,696,730	3,773,473	4,867,138	4,551,342	4,236,133
Police fines	-	-	-	361,752	524,096	485,840	483,108	409,356	490,898	543,699
Camera fines	3,669,800	3,797,740	3,265,399	3,329,649	3,755,720	3,210,890	3,290,365	4,457,782	4,060,444	3,692,430
Non-wearing seatbelt fines										
Total	N/A	N/A	N/A	30,263	57,554	52,749	35,910	33,193	80,470	85,768
Police fines	-	-	-	30,235	57,539	52,742	35905	27,842	28,389	27,696
Camera fines	-	-	-	28	15	7	5	5,351	52,081	58,072

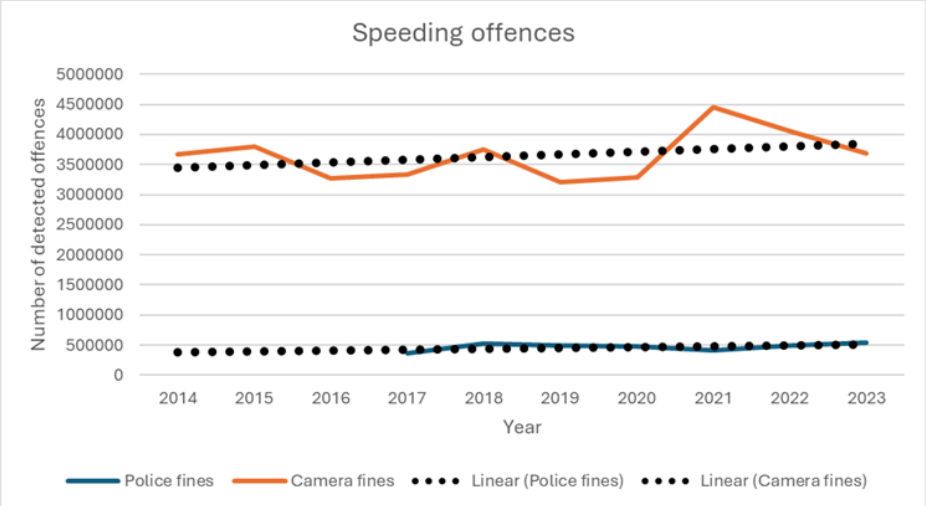
Please note that data are subject to revision. This information was current as of 24/01/2025 and accessed via the Road Safety Enforcement Dashboard: https://www.bitre.gov.au/publications/2024/road-safety-enforcement-data. Statistics were not available for non-wearing seatbelt fines and police fines for speeding behaviour between 2014-2016. Some State and Territory data are not available for all cells and therefore, are excluded from national calculations presented above. The number of random breath tests conducted before 2019 in Victoria are not reliable and therefore data from this state are not reported national calculations for 2014-2018. Information about population million was accessed 28/03/2025 from https://datatopics.worldbank.org/world-development-indicators/. Calculations for fatalities (per million population) were than calculated by dividing total number of deaths by the total population, then multiplying by 1 million.

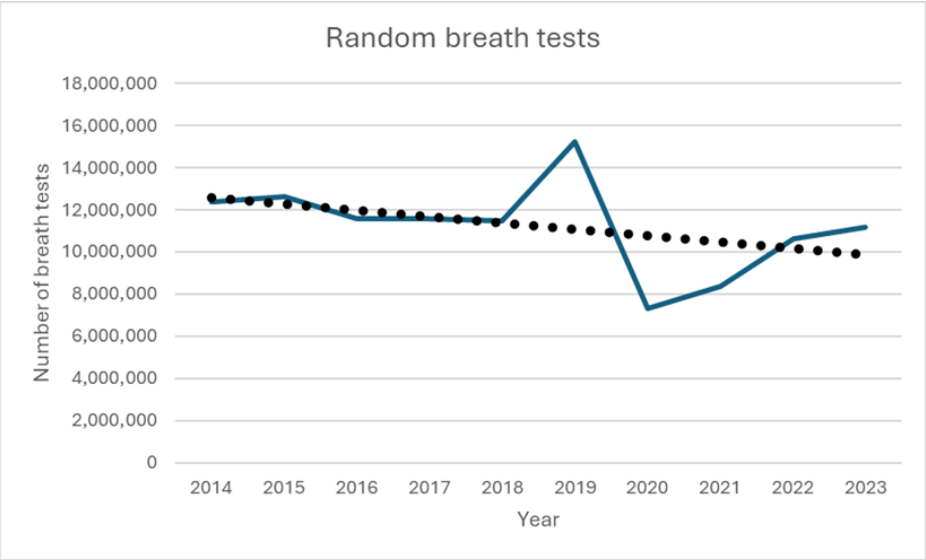
For RBTs, the number of breath tests conducted has decreased since 2020. In 2019, there were 15,248,047 tests conducted compared to 7,304,543 tests conducted in 2019. This reduction was due to police being allocated elsewhere due to emergence of the COVID-19 pandemic. Table 16 shows that the number of breath tests has increased between 2020 and 2023. Figure 8 shows that the trend in the number of breath tests has increased between 2020 and 2023. There was a drop in the number of drug tests between 2019 to 2020 also due to COVID-19, however the number of drug tests has been increasing since 2020, along with the trend (see Figure 8).

For mobile phone use, camera infringements have been recorded since 2020. Since 2020, the number of infringements issues by camera detection has increased yearly from 2020 to 2022. Across this same period, police issued infringements have been steadily decreasing, with a decrease in trends (see Figure 8). A similar pattern emerges with speeding infringements whereby camera issued infringements have been slightly increasing; however, the number of camera infringements for speeding detection decreased between 2022 and 2023. The number of police issued speeding infringements has remained consistent between 2018 to 2023. Figure 8 shows that trends for police issued speeding offences have remained stable since 2017. With the introduction of seat belt non-use and incorrect use detection cameras, the number of infringements issued for such behaviours have increased substantially from 2020 (5 fines) to 2023 (58,072 fines). While trends show that the number of police issued seat belt non-use infringements has been decreasing since 2018.


Mobile phone offences
Number of detected offences
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Police fines
Camera fines
Linear (Police fines)
Linear (Camera fines)


Seat belt offences
Number of detected offences
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2017
2018
2019
2020
2021
2022
2023
Year
Police fines
Camera fines
Linear (Police fines)
Linear (Camera fines)


Speeding offences
Number of detected offences
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Police fines
Camera fines
Linear (Police fines)
Linear (Camera fines)



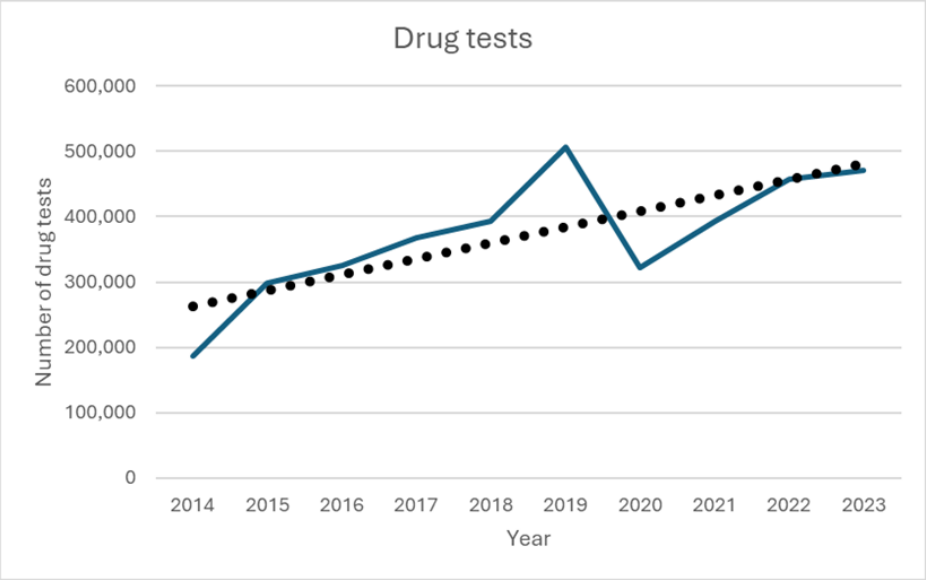


Figure 8. Trends in road policing statistics (Australia 2014-2023)

Notes: Blue and orange lines represent total number of tests/detected offences and dotted black lines represent trends.

3.3.4. Key enforcement and offence related metrics

Data per 10,000 driver licences on issue are used to track the number of random breath and drug tests, as well as for the number of mobile phone use, speeding, and seatbelt non-use/incorrect use infringements issued (Australian Government, 2024). This information is provided separately for each Australian State and Territory. Tables 17 and 18 outlines the statistics per 10,000 driver licences on issue for each jurisdiction in 2023. The statistics presented in Table 17 show that, in 2023, Western Australia conducted the highest number of RBTs per 10,000 licences followed by the Northern Territory. South Australia conducted the highest number of drug tests per 10,000 licences, followed by Victoria. Table 18 shows that there were more mobile phone use infringements issued in New South Wales per 10,000 licences on issue, followed by Queensland. For speeding, Western Australia recorded the highest number of speeding infringements issued per 10,000 licences on issue, followed by the Northen Territory. Queensland had the highest number of infringements issued for non-use or incorrect use of seatbelts as well as for driving while unlicenced per 10,000 licences. This may be likely because mobile phone detection cameras in Queensland also capture front seat passengers who are not wearing seatbelts. The Australian Government and relevant State and Territory infrastructure and transport ministers also report annually on progress towards the agreed

upon targets outlined in the National Road Safety Strategy 2021-30 and National Road Safety Action Plan 2023-25 (see Commonwealth of Australia, 2024). Beyond this, each state and territory also has its own road safety strategy and action plan.

Table 17. Breath test and drug tests per 10,000 driver licences on issue by Australian jurisdictions in 2023

State/Territory	Breath tests per 10,000 driver licences	Drug tests per 10,000 driver licences
New South Wales	5,876	267
Queensland	4,586	143
Victoria	3,024	294
Tasmania	3,284	117
South Australia	4,466	392
Western Australia	10,137	231
Northern Territory	6,478	Data not available
Australia Capital Territory	1,729	31

Note. NSW, QLD, TAS, NT, ACT licences are estimated.

Table 18. Fines per 10,000 driver licences on issue by Australian jurisdictions in 2023

State/Territory	Mobile phone fines	Speeding fines	Non-wearing seatbelt fines	Unlicensed driving fines
New South Wales	361	1,474	17	13
Queensland	201	2,151	94	69
Vicotria	97	2,555	60	18
Tasmania	58	1,551	49	6
South Australia	43	1,519	22	53
Western Australia	18	4,062	9	10
Northern Territory	12	2,605	47	22
Australian Capital Territory	9	2,129	2	8

Note. NSW, QLD, TAS, NT, ACT licences are estimated.

3.4. Norway

3.4.1. General overview of the traffic enforcement system

The Department of Public Roads, Urban Mobility and Traffic Safety is responsible for the Norwegian Roads Administration and the Norwegian Road Supervisory Authority. The department consists of three sections, including the public roads section, section for traffic safety, and urban transport section. The public roads section is responsible for traffic safety and administration of the Road Traffic Act[34]. Traffic Police (Utrykningspolitiet) are responsible for the enforcement of traffic laws.

3.4.2. Approaches to enforcement

This section provides an overview of Norway's approaches to enforcement for speeding, mobile device use, drunk driving, drug driving, and non-use of seat belts. Norway's penalty point system was introduced in 2004. Drivers receive penalty points (referred to as dots) and fines for speeding behaviour, priority, overtaking, red-light violations, too short headways, driving on a painted median barrier, and inadequate securing of a child under 15 years of age (Sagberg & Sundfør, 2019). Dots are removed after 3-years from signing for the fine or receiving final judgement in case. If a driver receives eight dots in a 3-year period, they will lose their driver licence for 6-months[35]. Drivers receive a warning letter when they have incurred 4 or more dots. If a driver is stopped for multiple offences, then they will occur the penalty points for all other offences[36]. Conditional prison sentences, imprisonment, and/or licence suspensions may also apply for more serious offences. Table 19 provides an overview of traffic penalties for speeding, mobile phones, drink and drug driving, and seat belts in Norway.

Table 19. Norway traffic penalties

	Speeding	**Mobile phone**	**Drink driving**	**Drug driving**	**Non-use of seatbelts or incorrect use**
Norway	Speeding 11-15km/hr where the speed limit is 60km/hr or less: 2 dots Speeding 16km/hr+ where the speed limit is 60km/hr or less: 3 dots Speeding 16-20km/hr where the speed limit is 70km/hr or more: 2 dots Speeding 21km/hr+ where the speed limit is 70km/hr or more: 3 dots Fine depends on speeding offence	Violation of mobile use ban: 3 dots 7,450 kr (as of March 2022)	Fine is depended upon gross salary. Driving ban and criminal record depending on amount of alcohol in system. Example: for BACs of .20-.49, the fine is equivalent to 1.5 times gross monthly salary. For BACs of .50-1.19, includes a fine, conditional prison sentence, and licence suspension	Fine is depended upon gross salary. Driving ban and criminal record depending on amount of drugs in system.	Failure to secure passengers under 15 years: 2 dots, 3,520kr Driving without a seatbelt up to 1,500kr

[34] https://www.regjeringen.no/en/dep/sd/organisation/departments/department-for-public-roads-and-traffic-/id635327/#:~:text=The%20Road%20Section%20is%20responsible,of%20The%20Norwegian%20Roads%20Administration.

[35] https://www.vegvesen.no/forerkort/har-forerkort/prikker/

[36] https://www.vegvesen.no/en/driving-licences/driving-licence-holders/penalty-points/#:~:text=If%20you%20are%20stopped%20for,you%20receive%20the%20sum%20total

	Speeding	Mobile phone	Drink driving	Drug driving	Non-use of seatbelts or incorrect use
	License confiscation may also occur for exceeding posted speed limit		(Christophersen et al., 2020). Alcohol interlocks are required for some categories of professional drivers		

Note. Traffic penalties for full licence holders. Drivers who hold a probationary licence (first 2 years of driving) receive double points for each offence (Sagberg & Sundfør, 2019). Fines are reported in Krona (kr). Information retrieved 26/02/2025 from https://www.vegvesen.no/forerkort/har-forerkort/prikker/; https://www.thelocal.no/20220302/norway-increases-fine-for-being-caught-using-a-phone-while-driving; https://trafikksiden.motocross.io/informasjon/spesial/straff_fartsovertredelser_EN.html

3.4.2.1. Speeding

It is illegal to exceed the posted speed limit in Norway, with police officers and speed cameras used to enforce speed limits. Specifically, the police are responsible for carrying out manual speed checks and the Norwegian Public Roads Administration is responsible for the operation of speed cameras[37]. Police are responsible for following up speed offences detected via these cameras. There are two common types of speed cameras which operate in Norway: spot (fixed) cameras, and average speed cameras. Fixed cameras were first introduced in Norway in 1988, with section control speed cameras introduced in 2009 (Elvik, 2025). The number of section control cameras in Norway continue to grow, with 24 cameras in 2015 increasing to 123 cameras in 2021 (ETSC, 2022).

3.4.2.2. Mobile phone use

Since May 2013, it has been illegal to use a handheld mobile phone while driving in Norway. Police enforce the use of handheld phones by issuing on the spot fines. Using a phone via a headset while driving is permitted.

3.4.2.3. Impaired or intoxicated driving

Norway was the first country in the world to introduce a limit on drink driving in 1936 (Christophersen et al., 2020). The BAC limit was first introduced as .05 and later lowered to .02 in 2001. There is some current discussion around further reducing the BAC limit to .01[38]. In Norway, police can randomly test any driver for alcohol. Norway also has systematic breath testing, whereby a driver is tested for alcohol if they are stopped by police.

For drug driving, Norway introduced legislative limits for driving under the influence of drugs in February 2012. Consistent with the BAC limits for alcohol, corresponding BAC limits were established for 20 drugs[39]. Examples of drugs and limits include amphetamine (41, impairment limit comparable to .02 BAC) and cocaine (24, impairment limit comparable to .02 BAC). Individuals with valid prescriptions for medicinal drugs are exempt. Previous research has shown that the number of apprehended drugged drivers increased by 20% between 2010 and 2013 (Vindenes et al., 2014), highlighting the impact of these legislative limits. Eight more drugs were added to the legislative limits

[37] https://www.vegvesen.no/fag/fokusomrader/trafikksikkerhet/automatisk-trafikkontroll/#:~:text=The%20Norwegian%20Public%20Roads%20Administration%20is%20responsible%20for%20establishing%20and,the%20police%20criminal%20case%20registry.

[38] https://etsc.eu/issues/drink-driving/drink-driving-in-norway/

[39] https://www.regjeringen.no/globalassets/upload/sd/vedlegg/brosjyrer/sd_ruspavirket_kjoring_net.pdf

in 2016 (Christophersen et al., 2020). In Norway, police can randomly test any driver for alcohol and/or drugs.

3.4.2.4. Non-use of seat belts

In Norway, seat belts were first made compulsory in front seats in 1975, and rear seats in conventional vehicles in 1985[40]. Children restraints are compulsory for children under 135cm in height. For buses equipped with seat belts, it is also requirement for passengers to wear a seat belt. Visual inspection by police is the primary method of seat belt enforcement. Seat belt inspections of bus passengers are also conducted by the Norwegian Public Roads Administration (Høye & Vaa, 2010).

3.4.3. Road policing statistics

Table 20 and Figure 10 presents the road policing statistics for Norway between 2014-2023. The number of police officers dedicated to traffic services during this period was 284 (National Road Policing service). These statistics were provided by the Utrykningspolitiet on 27/02/2025. Table 20 shows that number of alcohol breathalyser tests conducted by police was over 600,000 in 2019. However, and like many other countries, there was a decrease in the number of alcohol breathalyser tests in 2020 and 2021 as traffic police were sent to assist at the borders during COVID. The number alcohol breathalyser tests started to increase each year since 2022, with 547,384 tests undertaken in 2024.

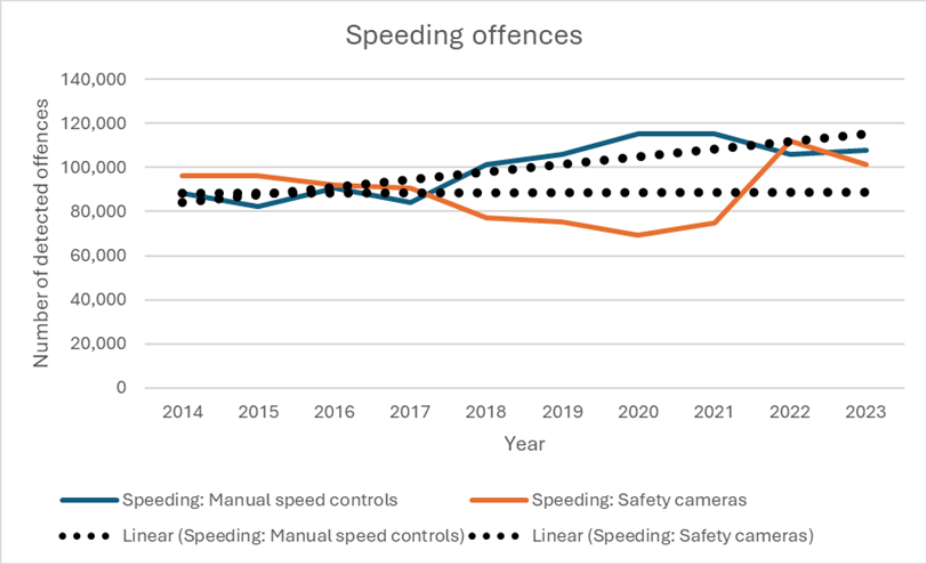
There was an increase of 36,916 detected speed offences via safety cameras between 2021 and 2022. However, the number of manual speed control offences slightly decreased between 2020 (115,397) and 2023 (107,833). Figure 10 shows that the trend for detected manual speed controls has increased since 2014, with the trend for detected speed offences captured via safety cameras remaining steady. The number of detected mobile phone offences has continued to decrease since 2020, while there was a large decrease in the number of detected seatbelt offences between 2017 and 2018. Figure 10 shows that trends for mobile phone offences and seatbelt offences have been decreasing since 2018. Detected drunk and drug driving offences were slightly higher for 2022 and 2023, with Figure 10 showing an increasing trendline for drunk driving offences since 2014.

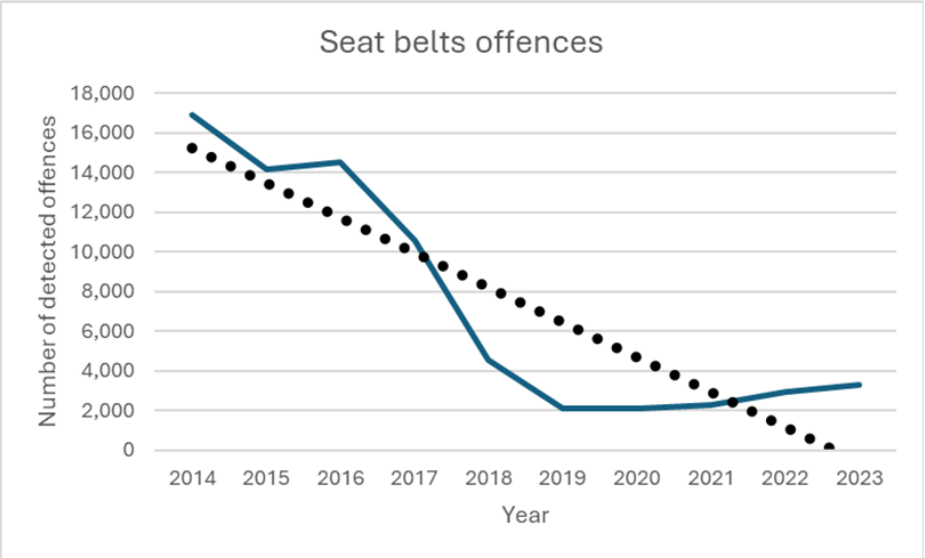
[40] https://www.itf-oecd.org/sites/default/files/norway-road-safety.pdf

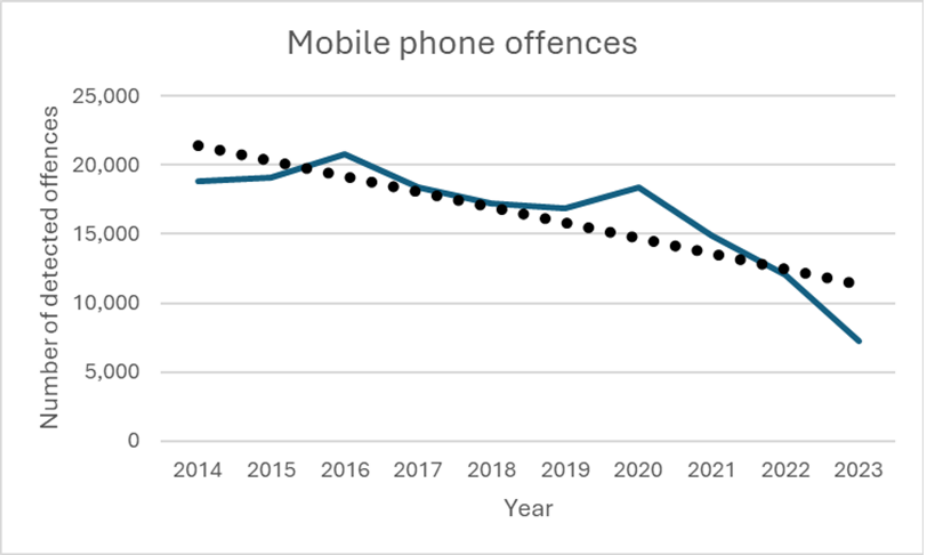
Table 20. Road policing statistics for Norway between 2014-2023

	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Population (million)	5.14	5.19	5.24	5.28	5.31	5.35	5.38	5.41	5.46	5.52
Fatalities	147	117	135	106	108	108	93	80	116	110
Fatalities (per million population)	28.6	22.5	25.8	20.1	20.3	20.2	17.3	14.8	21.2	19.9
Alcohol breathalyser tests*	635,275	546,641	485,614	492,418	528,532	643,809	183,230	91,942	432,737	515,303
Speeding – manual speed controls	88,347	82,322	90,522	84,139	101,136	106,098	115,397	115,470	105,871	107,833
Speeding – safety cameras	96,317	96,114	91,948	90,851	77,424	75,223	69,314	75,043	111,959	101,182
Use of mobile phones	18,861	19,051	20,799	18,368	17,206	16,895	18,350	14,875	12,020	7,194
Non/incorrect seat belts	16,917	14,161	14,504	10,594	4,552	2,087	2,110	2,269	2,913	3,295
Drunk/drug driving*	9,215	9,484	9,655	9,349	9,537	9,729	10,267	9,750	11,818	11,618
Alcohol (breath)	1,761	2,040	1,932	1,755	1,682	1,689	1,236	1,222	2,108	2,015
Alcohol (blood)	3,045	2,677	2,486	2,190	2,310	2,295	2,125	1,931	2,143	1,964
Alcohol and drugs	914	919	780	732	782	892	940	834	977	1,015
Drugs	3,648	3,837	4,338	4,304	4,546	4,674	5,519	5,277	5,956	5,787

Notes. Traffic offence data and the number of alcohol breathalyser tests were provided by Utrykningspolitiet (Police) via email on 27/02/2025. *Number of alcohol breathalyser tests conducted by the National Road Policing service. Figures are not available separately from police reports on drug and drunk driving. Below presents the information provided by Utrykningspolitiet from blood tests and evidential breath tests. Information about population million was accessed 28/03/2025 from https://datatopics.worldbank.org/world-development-indicators/. Calculations for fatalities (per million population) were than calculated by dividing total number of deaths by the total population, then multiplying by 1 million


Speeding offences
Number of detected offences
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Speeding: Manual speed controls
Speeding: Safety cameras
Linear (Speeding: Manual speed controls)
Linear (Speeding: Safety cameras)


Seat belts offences
Number of detected offences
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year


Mobile phone offences
Number of detected offences
25,000
20,000
15,000
10,000
5,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

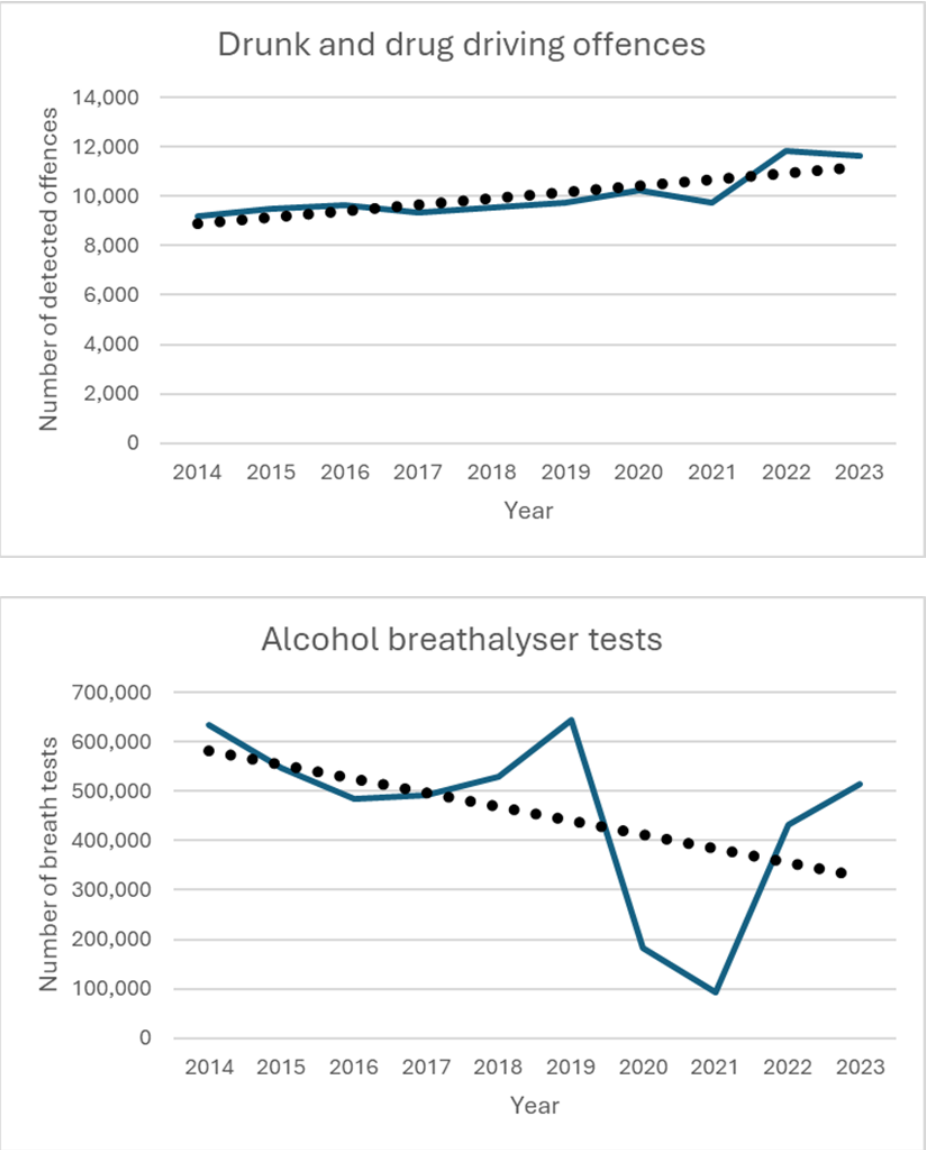


Figure 9. Trends in road policing statistics (Norway 2014-2023)

Notes: Blue and orange lines represent total number of tests/detected offences and dotted black lines represent trends.

3.4.4. Key enforcement and offence related metrics

Statistics Norway is the national statistical institute of Norway[41]. Statistics Norway reports the official statistics, including those relating to traffic offences. Traffic offences are reported per 1,000 population. In 2023, the number of traffic offences reported to police was 43,975, which equates to 8 per 1,000 population. The 2024 statistics were not available at time of writing. Norway's National Plan of Action for Road Safety 2022-2025 highlights that Vision Zero has been the basis for road safety in Norway since 2001.

[41] https://www.ssb.no/en/sosiale-forhold-og-kriminalitet/kriminalitet-og-rettsvesen/statistikk/anmeldte-lovbrudd-og-ofre

3.5. Sweden

3.5.1. General overview of the traffic enforcement system

The Swedish Transport Agency is responsible for the regulation of the transport sector[42], while the Swedish Transport Administration is responsible for infrastructure planning and maintenance of roads[43]. Traffic laws may also be developed by municipal and county councils. The Swedish Police Authority is responsible for the enforcement of traffic laws. All police officers in Sweden work with all types of offences and therefore, information on how many police officers work with traffic offences cannot be provided.

3.5.2. Approaches to enforcement

This section provides an overview of Sweden's approaches to enforcement for speeding, mobile device use, drunk driving, drug driving, and non-use of seat belts. In Sweden, drivers may be fined and, in some cases, receive a criminal conviction for a traffic offence. Drivers may also be fined for multiple traffic offences and will receive a fine for each traffic offence. For multiple traffic violations, the person will also be reported, and this will then be investigated. Police may also confiscate a driver licence for serious traffic violations. The Swedish Transport Agency may also revoke a driver licence for behaviours such as gross reckless behaviour, repeat traffic violations, failing to stop at a traffic crash, and if found guilty of a serious crime[44]. There is no penalty point system in Sweden; however, drivers who reoffend within a 2-year period may receive more severe penalties, such as licence suspension. Table 21 provides a brief overview of the current penalties associated with these five traffic offences.

Table 21. Sweden traffic penalties

	Speeding	**Mobile phone**	**Drink driving**	**Drug driving**	**Non-use of seatbelts or incorrect use**
Sweden	Speed limit 50km/hr or lower: 1-10km/hr: 2,000kr 11-15km/hr: 2,400kr 16-20km/hr: 2,800kr 21-25km/hr: 3,200kr 26-30km/hr: 3,600kr 30+km/hr: 4,000kr 36km/hr+ case referred to the prosecutor Speed limit 50km/hr or higher: 1-10km/hr: 1,500kr 11-15km/hr: 2,000kr 16-20km/hr: 2,400kr 21-25km/hr: 2,800kr	1,500kr	Fine or prison sentence of up to 6 months. Fine is aligned with a driver's income. Potential licence suspension (a convicted driver may be able to opt to participate in the alcohol interlock program rather than have their licence suspended).	Fine or prison sentence. Fine is aligned with a driver's income. Licence suspension.	Failure to wear a safety belt (driver or passenger who has turned 15 years): 1,500kr Failure as a driver to ensure that a passenger under the age of 15 years is wearing a seat belt: 2,500kr

[42] https://www.government.se/government-agencies/swedish-transport-agency/#:~:text=Sweden%20is%20governed-,Swedish%20Transport%20Agency,producing%20regulations%20and%20ensuring%20compliance.
[43] https://www.government.se/government-agencies/swedish-transport-administration/
[44] https://korkortonline.se/en/facts/loss-of-driving-licence/

	Speeding	Mobile phone	Drink driving	Drug driving	Non-use of seatbelts or incorrect use
	26-30km/hr: 3,200kr 31-35km/hr: 3,600kr 35+km/hr: 4,000kr 51km/hr+ case is referred to the prosecutor. Current debate if speeding fines should be aligned with a driver's income.				

Note. All fines are reported in Krona (kr). Information retrieved 17/02/2025 from https://korkortonline.se/en/facts/fines/; https://polisen.se/en/laws-and-regulations/traffic-violations/; https://inelo.com/what-are-the-fines-for-speeding-in-sweden/#:~:text=In%20Sweden%2C%20holding%20a%20phone,a%20fine%20of%20SEK%201500.

3.5.2.1. Speeding

In Sweden, it is considered an offence to exceed the posted speed limit. Speed limits in Sweden range from 30km/hr to 120km/hr. However, it is recommended that drivers drive to the weather/road conditions. Police officers and traffic cameras are used to enforce speed limits in Sweden, with speeding offences recorded by the speed cameras assessed by the Automatic Traffic Safety Inspection section of the Swedish Police[45]. The automatic traffic safety system is managed by the Swedish Transport Administration and the Swedish Police Authority, in collaboration with the Swedish Prosecution Authority[46].

Trials of speed cameras commenced in Sweden in the late 1980s and early 1990s; however, the Swedish Government did not adopt a speed camera program until 2006 (Belin et al., 2010). In Sweden, spot cameras are typically used measure the speed of passing vehicles. These cameras are located on various stretches of roads, approximately 5kms in distance apart (Vadeby & Howard, 2024). A recent before-and-after review of 361 speed measurement spots across a 20-year period revealed that spot speed cameras maintained long-term speed compliance and were estimated to reduce road fatalities by 38.6% (Vadeby & Howard, 2024). Sweden has a large camera network, with approximately 2,480 traffic cameras existing on Swedish roads in 2023[47].

3.5.2.2. Mobile phone use

In Sweden, it is illegal to hold a handheld phone while driving. This rule was introduced in February 2018, with police able to issue on-spot fines for drivers who use a handheld phone while driving. Prior to 2018, amendments were made to the Swedish Traffic Regulation in which drivers were only able to use their phone or another communication device (e.g., GPS) if it did not negatively interfere with their ability to operate the vehicle[48]. Similar to the other countries reported within this report, using a hands-free device is permitted.

[45] https://polisen.se/en/laws-and-regulations/traffic-violations/
[46] https://trafikverket.diva-portal.org/smash/record.jsf?pid=diva2%3A1901203&dswid=-2768
[47] https://trafikverket.diva-portal.org/smash/get/diva2:1901203/FULLTEXT01.pdf
[48] https://www.loc.gov/item/global-legal-monitor/2013-12-13/sweden-charges-brought-under-new-provision-on-driving-while-using-cellphones/

3.5.2.3. Impaired or intoxicated driving

In Sweden, the BAC limit is 0.02 for all drivers. This revised BAC limit was lowered from 0.08 to 0.02 in 1990. Police enforce drink driving via RBTs at targeted alcohol check points. Police are also able to breathalyse any driver who they may have stopped for any other offence (e.g., speeding behaviour). If a driver is over the BAC limit of 0.02 then they are taken to the police station for a further confirmatory test.

It is illegal to drive under the influence of drugs in Sweden. Since 1999, there is a zero-tolerance approach in that no trace of drugs or narcotics are permitted (Jones, 2005). Prescription drugs are exempt if a driver is using these in accordance with their doctor's prescription. Roadside drug testing is used by police to detect drivers who are driving under the influence of illicit substances.

3.5.2.4. Non-use of seat belts

In Sweden, seat belts were first made compulsory in 1975 in front seats and 1986 for passengers in rear seats of conventional vehicles[49]. Since 1988, children under 135cms tall are required to use a child restraint, with a recommendation that children remain in a booster seat (or similar) until 12 years of age. Temporary travel by taxi on a short journey is the only exemption for a child under 135cms not to use an appropriate car seat[50]. In Sweden, police are responsible for enforcing seat belt use.

3.5.3. Road policing statistics

Table 22 and Figure 11 presents the road policing statistics for Sweden from 2014-2023. These statistics were provided by the Police Authority on 12/02/2025. Since 2020, the number of alcohol breathalyser tests have increased from 439,537 (2020) to over 1.2 million (2023). The number of alcohol breathalyser tests in 2023 are consistent with those undertaken in 2019 prior to the COVID-19 pandemic. During the COVID-19 pandemic, breath testing checkpoints were suspended to assist with reducing the spread of COVID. However, police still performed tests if there was a reasonable suspicion that a driver was under the influence of alcohol. As such, number of tests conducted in 2020 and 2021 are lower compared to previous years.

The number of detected speeding violations conducted via manual monitoring was lower in 2023 compared to both 2014 and 2020-2021. Detected speeding violations conducted via automatic monitoring showed an increase in 2021 and 2022 (since 2014), however the number of detected violations conducted via automatic monitoring was lower in 2023 when compared to 2022. Figure 11 shows that the trend in speeding violations detected via manual speed controls has slightly decreased since 2014, with the trend in speeding violations detected via safety cameras slightly increasing since 2014. The trend for the number of detected mobile phone offences has increased since 2014, with the trend for seat belt offences decreasing in the same time period. Detected drunk driving offences had increased in 2023 when compared to 2020-2022; however, the number of detected drunk driving offences was lower in 2023 when compared to detected drunk driving offences recorded prior to the COVID-19 pandemic. The trend for drug driving offences has slightly increased/ remained steady since 2014.

[49] https://www.itf-oecd.org/sites/default/files/sweden-road-safety.pdf

[50] https://www.1177.se/globalassets/1177/regional/jonkoping/media/dokument/barn--gravid/sakerhet-i-bilen/100558_ak-sakert_i_bilen_engelska_20160713_liten.pdf

Table 22. Road policing statistics for Sweden between 2014-2023

	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Population (million)	9.70	9.80	9.92	10.06	10.18	10.28	10.35	10.42	10.49	10.54
Fatalities	270	259	270	252	324	221	204	210	227	229
Fatalities (per million population)	27.8	26.4	27.2	25.0	31.8	21.5	19.7	20.2	21.6	21.7
Alcohol breathalyser tests*	2,012,185	1,430,960	1,204,706	1,170,286	1,188,297	1,312,152	439,537	395,465	924,719	1,263,057
Speeding violation manual monitoring	213,403	171,947	144,265	139,643	139,183	88,785	142,738	163,210	125,532	127,767
Speeding violation automatic monitoring	72,024	80,694	74,446	78,339	81,223	80,844	83,098	99,402	93,986	78,579
Reported crime regarding speeding violation**	5,547	7,064	5,937	5,836	5,361	5,819	7,334	7,749	6,329	5,055
Use of mobile phone***	-	-	-	-	1,777	9,119	14,853	18,289	15,285	16,065
Non/incorrect use of seat belts	20,142	14,390	10,046	6,866	7,105	7,792	8,610	9,203	8,026	8,981
Drunk driving	12,744	12,565	11,552	11,298	11,188	11,558	8,558	7,804	9,774	9,973
Drug driving	11,429	12,603	12,071	13,312	13,806	14,117	16,141	14,176	12,050	12,040

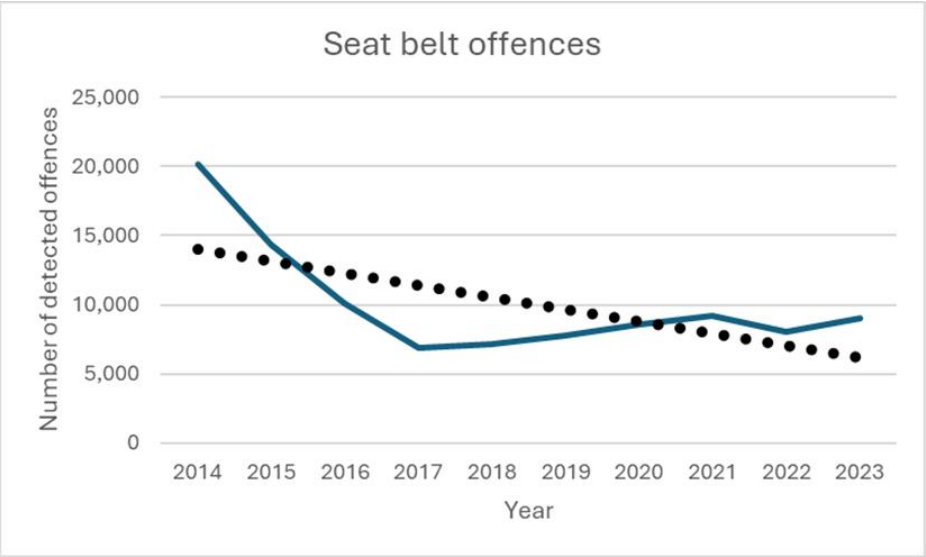
Notes. Traffic offence data and the number of alcohol breathalyser tests were provided by The Police Authority via email on 12/02/2025. The database with traffic fines if continuously updated and therefore numbers may differ at different withdrawal times. Fatality statistics were retrieved 12/02/2025 from https://www.trafa.se/en/road-traffic/road-traffic-injuries/

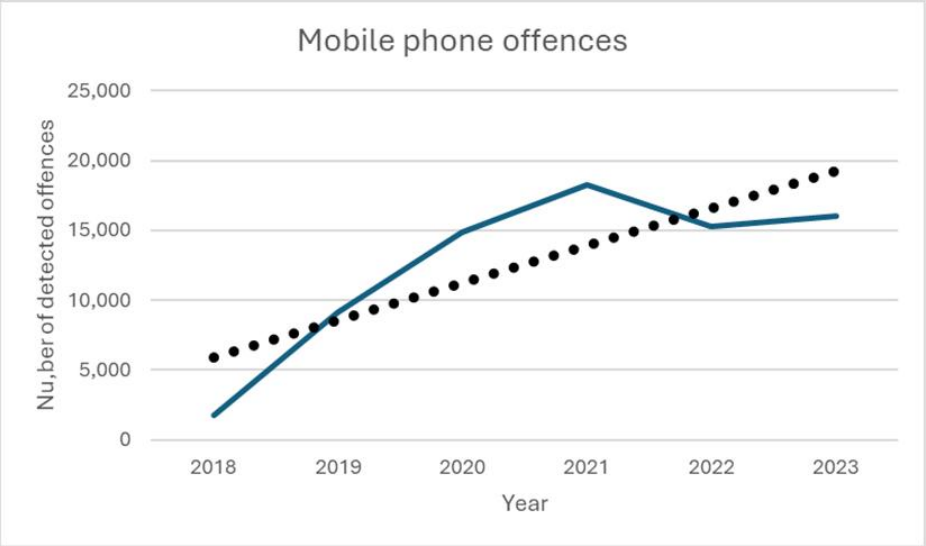
* During the pandemic, random alcohol breath tests were stopped. They were only conducted when there was a suspicion of drunk driving.

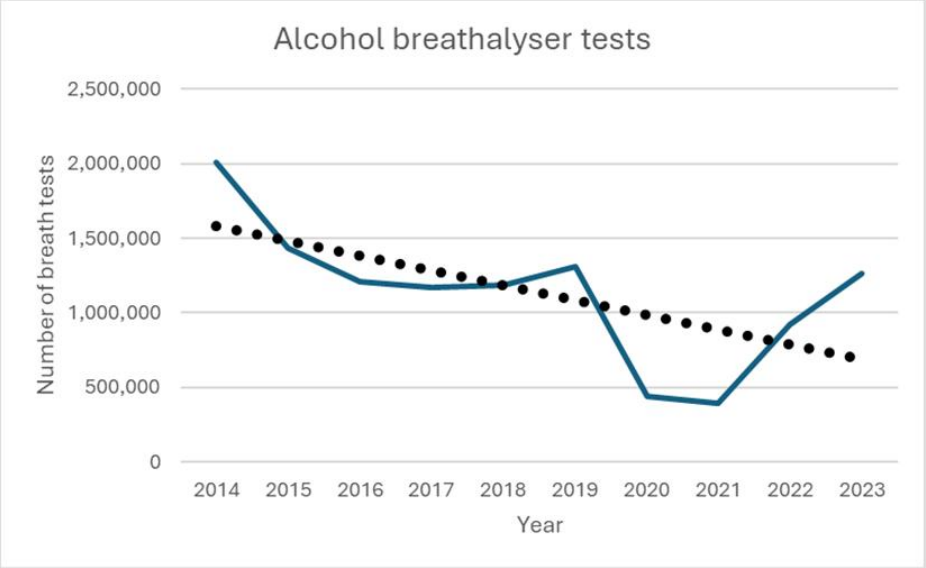
** Sweden distinguish between misdemeanours and crime. If a misdemeanour has been committed, the person usually receives a fine on the spot. If it is a more serious crime, or if a person does not what to accept the fine, a report of crime is instead made, and an investigation is started.

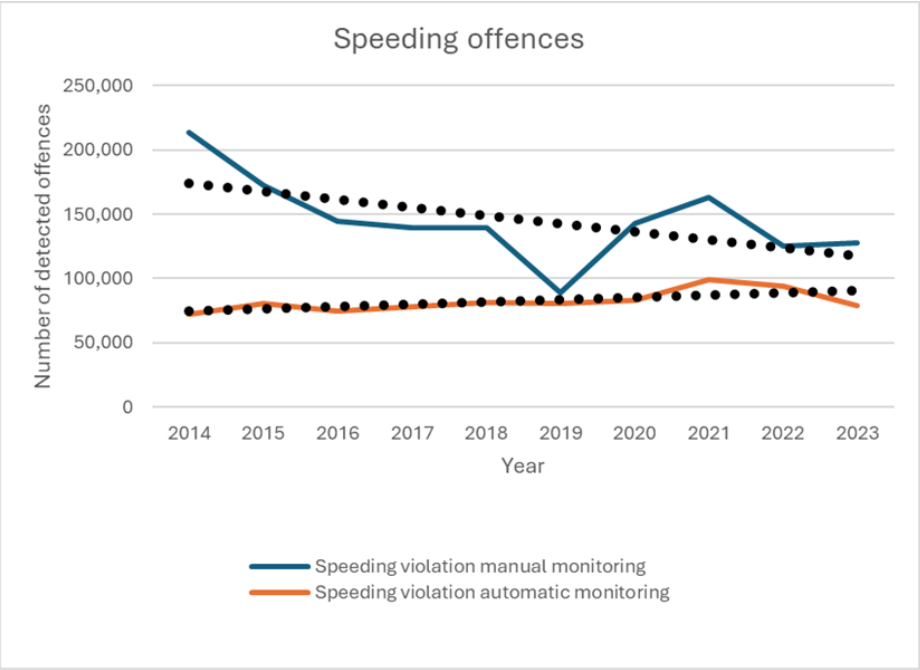
*** Use of mobile phone when driving became illegal 01/02/2018.

Information about population million was accessed 28/03/2025 from https://datatopics.worldbank.org/world-development-indicators/. Calculations for fatalities (per million population) were than calculated by dividing total number of deaths by the total population, then multiplying by 1 million.


Seat belt offences
Number of detected offences
25,000
20,000
15,000
10,000
5,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year


Mobile phone offences
Nu,ber of detected offences
25,000
20,000
15,000
10,000
5,000
0
2018
2019
2020
2021
2022
2023
Year


Alcohol breathalyser tests
Number of breath tests
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year



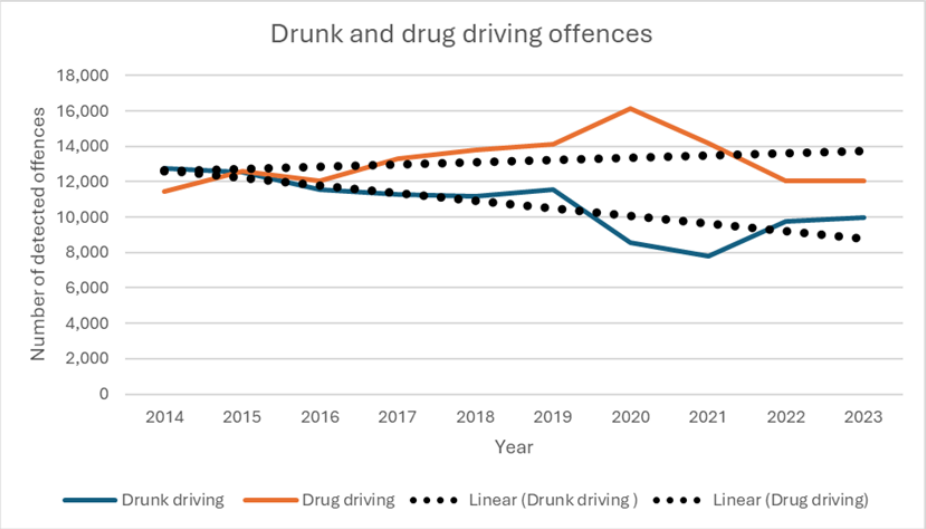


Figure 10. Trends in road policing statistics (Sweden 2014-2023)

Notes: Blue and orange lines represent total number of tests/detected offences and dotted black lines represent trends.

3.5.4. Key enforcement and offence related metrics

Road safety in Sweden is based on the strategic principle of Vison Zero, with targets used to track progress towards achieving this goal. The police enforcement statistics are important part in tracking progress to achieve Vision Zero. As an example, and for drink driving, "*The target for sobriety of the roads is for at least 99.9 per cent of the total traffic volume to have sober drivers by 2030*" (Swedish Transport Administration, 2023a p.51). In Sweden, police checkpoints are used to track progress towards achieving this target for sobriety. These reports by the Swedish Transportation Administration provide examples of past key enforcement and offence related metrics to track progress towards Vision Zero. Further, Sweden's Road Safety Action Plan 2022-2025 highlights both the Swedish Administration and the Police Authority's plan for continual monitoring of offence related metrics, and the role they play in reducing risky driving behaviours (Swedish Transport Authority, 2023b).

3.6. Summary of case studies

Case studies of traffic enforcement approaches in five countries were conducted. These countries included i) Ireland, ii) United Kingdom, iii) Australia, iv) Norway, and v) Sweden. The following section summaries the types of approaches undertaken in each country to enforce key road rules, the penalties used in each country, and the key enforcement activities/outcomes per licenced vehicle.

Table 23 presents the enforcement approaches used in each country to address speeding behaviour, handheld mobile phone use, drink and drug driving, and non-use and incorrect use of seat belts.

- *Speeding behaviour*: Across all jurisdictions police enforce speed limits via speed cameras and manual police operations (i.e., using radar and laser guns).
- *Handheld mobile phones and seatbelts:* Across all jurisdictions police manually monitor use of handheld phones and non-use/incorrect use of seatbelts. In some parts of the United Kingdom and Australia, cameras are also used to detect mobile phone use and non-use/ incorrect use of seatbelts. In Ireland, cameras to detect handheld mobile phone use and non-use of seatbelts will be part of a new Government strategy.
- *Drink driving*: Mandatory alcohol testing is used in Ireland, with random breath testing used in Northern Ireland, Australia, Sweden, and Norway. In England, Wales, and Scotland, police can only conduct a test if they suspect a driver has been drinking. In Norway, systematic breath testing is used in that a driver is tested for alcohol if they are stopped by police. Similarly, in Sweden, police can breathalyse a driver if they are stopped for another offence.
- *Drug driving*: Dug tests at roadsides are used to monitor drug driving, though different approaches are used across the five jurisdictions. For instance, in Norway random drug testing is employed, while a more targeted approach is used in Australia. In Ireland, the Gardaí can conduct preliminary drug tests at the roadside and must test a driver for drugs if they have been involved in a serious collision.

Table 23. Summary of enforcement approaches

Country	Speeding	Mobile phone	Drink driving	Drug driving	Non-use of seatbelts or incorrect use
Ireland	Police (radar/laser guns) Speed cameras	On-spot checks Cameras part of new Government strategy	Mandatory alcohol testing Breathalyser test if believe driver is intoxicated Test driver involved in crash where they or someone else injured or needs medical attention	Preliminary drug tests at roadside Drug test for driver involved in a serious crash	On-spot checks Cameras part of new Government strategy
United Kingdom	Police (radar/laser guns) Speed cameras	On-spot checks Mobile phone and seat belt cameras introduced in some parts of the UK	Breathalyser tests – Northern Ireland conducts random breath tests, in England, Wales, and Scotland police can only conduct test if they suspect a driver has been drinking	Drug tests – Northern Ireland conducts random tests, in England, Wales, and Scotland police can only conduct test if they suspect a driver is under influence of drugs	Manual police operations Mobile phone and seat belt cameras introduced in some parts of the UK
Australia	Police (radar/laser guns) Speed cameras	Manual police operations Some states and territories have mobile phone and seat belt cameras	Random breath testing	Targeted roadside drug testing	Manual police operations Some states and territories have mobile phone and seat belt cameras
Norway	Police (radar/laser guns) Speed cameras	Manual police operations	Random breath testing Systematic breath testing (i.e., each time driver is stopped by traffic police, they will be checked for drink driving).	Random drug testing	Manual police operations
Sweden	Police (laser guns) Speed cameras	Manual police operations	Random breath testing Breathalyse drivers stopped for other offences	Roadside drug testing	Manual police operations

Table 24 presents an overview of the typical traffic penalties for full licence holders. As presented in Table 24, all jurisdictions impose monetary fines for speeding behaviour, using a handheld phone while driving, drink and drug driving, and non-use/incorrect use of seatbelts. However, the amount of the monetary fine for each offence does differ both across jurisdictions and within jurisdictions (i.e., there are different monetary fines for the same offences in countries within the UK and across different states and territories in Australia). Further, and for Sweden, the amount of the fine is aligned with the driver's income (i.e., those with a higher income receive a higher monetary fine). Except for Sweden, all jurisdictions have a penalty point system for traffic offences. If a driver accumulates a certain number of points within a specific timeframe (e.g., 12 penalty points within 3-years) then they will receive an automatic licence suspension. Table 24 also shows that there are more severe penalties for drink and drug driving compared to the other listed traffic offences across all five jurisdictions.

Table 24. Summary of the typical traffic penalties for full licence holders

Country	Speeding	Mobile phone	Drink driving	Drug driving	Non-use of seatbelts or incorrect use
Ireland	Fine Points	Fine Points	Fine Licence suspension Imprisonment	Fine Licence suspension Imprisonment	Fine Points
United Kingdom	Fine Points	Fine Points	Fine Points License suspension Imprisonment	Fine Points License suspension Imprisonment	Fine Points
Australia	Fine Points Licence suspension (high speed offences)	Fine Points	Fine Licence suspension Imprisonment	Fine Points Licence suspension Imprisonment	Fine Points
Norway	Fine Points Licence suspension (high speed offences)	Fine Points	Fine Points Licence suspension Imprisonment	Fine Points License suspension Imprisonment	Fine Points
Sweden	Fine Referred to prosecutor (exceed speed by 36km/hr+ in 50km/hr or lower zone; 51km/hr+ in 50km/hr+ zone)	Fine	Fine Licence suspension Imprisonment	Fine Licence suspension Imprisonment	Fine

Note. Typical traffic penalties are reported for full licence holders. Some additional restrictions may also apply for those on a novice or professional driver licence (e.g., licence suspension). Across all jurisdictions, licence suspension and imprisonment may occur for severe cases and/or repeat offenders.

Table 25 presents an overview of the number of traffic offences and alcohol breathalyser tests conducted per number of licensed/registered vehicles. As shown in Table 25, Australia had the highest number of speeding offences detected per licensed vehicle, followed England and Wales, Northern Ireland, and then Ireland. Both Australia and Ireland recorded a higher number of mobile phone offences detected per licensed vehicle compared to the other jurisdictions. The total number of drink and/or drug driving offences ranged from 0.0% to 0.5% for all countries. Similarly, seatbelt offences also ranged from 0.1% to 0.4%. For alcohol breathalyser tests, Australia also recorded the highest number of tests performed per licensed vehicle, followed by Sweden, then Ireland. Scottland recorded the lowest number of alcohol breathalyser tests per licensed vehicle.

Table 25. Key enforcement activities (per licensed vehicle) 2023

	Total number of traffic offences and breath tests for 2023 (ratio; percentage per licensed vehicle)							
Country	**Approx. number (million) of licenced vehicles per country**	**Speeding**	**Mobile phone**	**Driving while intoxicated**	**Drink driving**	**Drug driving**	**Breath tests (alcohol)**	**Non-use of seatbelts or incorrect use**
Ireland	2.91	143,178 (0.05; 4.9%)	17,954 (0.01; 0.6%)	7,771 (0.00; 0.3%)	-	-	166,478 (0.06; 5.7%)	5,129 (0.00; 0.2%)
England and Wales	37.3	2,714,945 (0.07; 7.3%)	45,638 (0.00; 0.1%)	38,061** (0.00; 0.1%)	-	-	276,914 (0.01; 0.7%)	49,146 (0.00; 0.1%)
Scotland*	3.09	15,064 (0.00; 0.5%)	3,538 (0.00; 0.1%)	15,064 (0.00; 0.5%)	-	-	3,219 (0.00; 0.01%)	2,254 (0.00; 0.1%)
Northern Ireland	1.27	77,905 (0.06; 6.1%)	1,298 (0.00; 0.1%)	2,978 (0.00; 0.2%)	-	-	31,398 (0.02; 2.5%)	714 (0.00; 0.1%)
Australia	21.16	4,236,133 (0.20; 20.0%)	358,162 (0.02; 1.7%)	-	7,638 (0.00; 0.0%)	13,784 (0.00; 0.1%)	11,194,054 (0.52; 52.9%)	85,768 (0.00; 0.4%)
Norway	5.40	209,015 (0.04; 3.9%)	7,194 (0.00; 0.1%)	-	3,979 (0.00; 0.1%)	6,802** (0.00; 0.1%)	51,303 (0.01; 1.0%)	3,295 (0.00; 0.1%)
Sweden	7.40	206,346 (0.03; 2.8%)	16,065 (0.00; 0.2%)	-	9,973 (0.00; 0.1%)	12,040** (0.00; 0.2%)	1,263,057 (0.17; 17.1%)	8,981 (0.00; 0.1%)

Note. * 2023-24 for Scotland. ** Positive or refused tests *** Alcohol and drugs. Numbers of traffic offences were totalled (e.g., offences for speeding captured by speed cameras, offences for speeding captured by police).

4. Discussion and recommendations

The findings from the systematic review and case studies strongly support the vital role that police enforcement plays in improving road safety. Police enforcement is one of the most effective countermeasures to reduce illegal and risky on-road behaviours. This section draws upon the findings from the systematic review and case studies of the enforcement approaches of five countries. Based on the findings from the review and case studies, we identify 13 key recommendations to optimise enforcement approaches in Ireland, and how these approaches can be best supported by public education campaigns.

4.1. Deterrence theory

4.1.1. Theoretical models of deterrence

The review consisted of studies which were guided by one or more theoretical models of deterrence, including i) classical deterrence theory, ii) Stafford and Warr's (1993) reconceptualised deterrence theory, and iii) Homel's (1988a) extended deterrence-based model. Classical deterrence theory consists of three key components: certainty of apprehension (and certainty of punishment), severity of sanctions, and swiftness of sanctions, and focuses on people's perceptions of these outcomes. Certainty of apprehension and punishment refers to the likelihood that an offender will be apprehended and punished for a crime. Severity of sanctions relates to the perceived severity of the penalty for committing an offence. The theory proposes that the punishment for the crime needs to be perceived as salient and appropriate (i.e., is just) to act as a deterrent. Swiftness of sanctions refers to the timing of punishment, with punishment delivered swiftly being more likely to have a deterrent effect. Most of the studies in the systematic review focused on classical deterrence theory.

Stafford and Warr's (1993) reconceptualised deterrence theory proposes that there are four ways in which punishment impacts deterrence, including: i) direct experience of punishment, ii) indirect (vicarious) experience of punishment, iii) direct experience of punishment avoidance, and iv) indirect (vicarious) experience of punishment avoidance. Direct experience refers to the individual themselves having had the experience (e.g., receiving a speeding fine) where indirect experience relates to knowing of someone who has the experience (e.g., family/friend receiving a speeding fine). Punishment refers to whether an individual is caught and punished (i.e., punishment) or commits a crime, or is not caught and punished (i.e., punishment avoidance). An example of punishment avoidance is where a driver exceeds the posted speed limit and avoids being caught by police or by a speed camera.

Homel's (1988a) extended deterrence-based model proposes that there are four non-legal factors (sometimes referred to as informal sanctions) which may also influence engagement in risky driving behaviours. The four non-legal factors include internal loss (i.e., feelings of shame, guilt or embarrassment), physical loss (i.e., fear of physical injury, for self and others), material loss (i.e., fear of receiving a fine or demerit points) and social sanctions (e.g., social judgement, disapproval from those close to you).

4.1.2. Deterrence and traffic enforcement

The review highlighted the important role of deterrence in traffic enforcement. Overall, the review found some support for the important influence of certainty of apprehension (e.g., Freeman et al., 2020) and certainty of punishment (e.g., Hasan et al., 2023). Additionally, research included in the review which had applied Stafford and Warr's (1993) reconceptualised deterrence theory found that direct experience of punishment avoidance was reported to be a significant predictor of using a

handheld phone while driving (Truelove et al., 2019a), tailgating (Ochenasek et al., 2022), and drug driving (Armstrong et al., 2018). Punishment avoidance (i.e., avoiding detection when performing an illegal behaviour) was also reported in a qualitative study based on focus groups with young drivers as an aspect that encouraged them to continue to engage in illegal driving behaviours (Bates & Anderson, 2019). Collectively, this research highlights the importance of drivers being apprehended and punished when engaging in illegal driving behaviours.

Based on this evidence, we offer several recommendations. First, we offer three of what we term "General Recommendations" which reflect what is required in essence for any jurisdiction looking to adhere with deterrence-based principles. That said, the third of these recommendations relating to policing numbers, we have discussed in relation in the context of Gardaí in Roads Policing. These general recommendations are followed by a series of more behaviour-specific recommendations (of which there are eight "Specific Behaviour Recommendations" relating to speeding, mobile phones and seatbelts, drink and drug driving). Finally, we offer two "Specific Countermeasure Recommendations" pertaining to public education and advertising campaigns.

4.2. General recommendations

First, as mentioned, our three general recommendations are as follows:

General Recommendation 1: Priority should be given to traffic enforcement approaches that increase drivers' perceived risk of apprehension and certainty of punishment, while minimising experiences of punishment avoidance.

General Recommendation 2: Traffic penalties need to be applied swiftly and strictly. The penalty needs to be appropriate and should match the crime.

General Recommendation 3: Establish an ongoing commitment to benchmark the number of Gardaí dedicated to road policing and the extent of technology (e.g., cameras) deployed against countries who are global leaders in best practice road safety. Depending on resources, benchmarking could occur every 1-5 years. Further, publishing the number of tests (e.g., breath tests/checks completed) are also required to gain a greater understanding of offence rates, and the pattern of offence rates over time.

Traffic penalties and sanctions applied to drivers caught offending not only need to be unavoidable, but also sufficiently severe to act as a deterrent. The review found support for ensuring that sanctions are sufficiently severe (e.g., Huang et al., 2023). However, it is also important to note that punishment for the crime needs to be appropriate (i.e., is considered 'just') and commensurate (i.e., match the crime) otherwise the penalties may be perceived as simply too severe and undermine ongoing enforcement efforts. The case studies showed that there are different penalties applied to different behaviours both across jurisdictions and within jurisdictions (e.g., different fines/demerit points for the same behaviour across the different countries in the United Kingdom and different states and territories in Australia). However, it is not possible to determine from the information collected for the case studies whether the differences in penalty severity across countries influenced offence rates. More in-depth analyses would be required to examine the specific extent to which differences in these penalties may impact illegal driving behaviours.

The number of Gardaí in Roads Policing has been declining in Ireland since 2009. As of April 2025, there were 618 Gardaí involved in the roads policing unit[51]. To improve road policing, An Garda Síochána instructed all uniformed Gardaí to perform 30 minutes of road safety policing per shift in 2024. To assist with understanding enforcement activities, it is important that there is an ongoing commitment to benchmark the number of Gardaí dedicated to road policing and the extent of technology (e.g., cameras) deployed against countries who are leaders in global-based practices in road safety. Publishing the number of tests (e.g., breath tests/checks completed) are also important to gain a greater understanding of offence rates, and the pattern of offence rates over time. This benchmarking is particularly important to remain up to date with any advancements in technologies that may assist with the enforcement of particular behaviours and thus complement and enhance efforts of the Gardaí.

4.3. Specific behaviour recommendations

4.3.1. Speeding behaviour

Specific Behaviour Recommendation 1: To use a combination of covert (i.e., hidden) and overt (i.e., visible) automated and manual operated speed cameras for optimal speed enforcement. Random deployment of speed enforcement activities should also be considered to increase the unpredictability of the operations.

In Ireland, overt cameras are used to enforce speed limits. However, evidence identified in the review supports that a combination of both covert and overt automated and manual operated speed cameras are required for optimal speed enforcement (e.g., Bates et al., 2012). Covert cameras serve the purpose of detecting those offenders who have developed strategies to evade detection by overt cameras, thereby addressing the problem of punishment avoidance. Further, automated cameras have more localised and site-specific effects, while manual operated speed cameras may have more network-wide impacts (Bates et al, 2012). In other words, both automated cameras and roadside/non-automated enforcement by members of An Garda Síochána are recommended to enforce speed limits and improve road safety. The review also highlighted the benefits of average speed cameras. Specifically, average speed cameras have been shown to reduce vehicle speeds as well as fatal and serious injury crashes (Soole et al., 2013). Further, evidence has also reported that more widespread implementations of average speed cameras would produce more network-wide effects (i.e., broader reductions in vehicle speeds and crash rates; Soole et al., 2014). Random deployment of speed enforcement activities is also recommended to increase the efficacy of operations.

Specific Behaviour Recommendation 2: Consideration should be given to implementing a graduated approach to speeding fines and penalty points, whereby penalties increase based on how much a driver was exceeding the posted speed limit. Immediate licence suspension should also be considered for high-range speeding offences.

In Ireland, a driver who exceeds the posted speed limit is fined €160 if the fine is paid within 28 days of the offence and €240 if the fine is paid after 28 days of the offence. If a driver is summoned to court because of nonpayment, then a third payment option allows the driver to pay the fine up to seven days before the court date. In this situation, the fine for speeding doubles. Driving disqualification only applies if a driver accumulates 12 penalty points within a 3-year period (or accumulates 7 penalty points for learner and novice drivers within two years of holding a full licence).

[51] https://www.irishtimes.com/crime-law/2025/06/04/garda-road-policing-numbers-drop-safety/

In all other countries outlined in the case studies, the fine for speeding behaviour depends on what speed the driver was exceeding the speed limit by, with higher speeds resulting in higher fines. This graduated fine structure is designed to reflect the fact that the frequency and severity of crashes increase as vehicle speeds increase. In Norway, Sweden, and Australia, a driver licence can be immediately suspended for high-range speeding offences. For example, in Queensland, Australia, if a driver is caught exceeding the posted speed limit by 40km or more, their licence will be immediately suspended for six months. Having a set punishment for different speed limits ensures that punishment matches the crime (i.e., severity and 'justness' of the fine). Further, and to ensure the certainty of traffic penalties, consideration needs to be given to immediate mandatory licence loss for high-range offenders and increased penalties for repeat offences (Sakashita et al., 2021; Watson et al., 2013). This change may also assist with reducing the number of speeding detected offences back to pre-COVID levels. In a similar vein, consideration could also be given to requiring repeat speeding offenders to have intelligent speed assistance (ISA) fitted to their vehicles upon relicensing (Watson et al, 2015).

4.3.2. Mobile phone and seatbelts

Specific Behaviour Recommendation 3: The methods used to detect handheld mobile phone use and seatbelt non-compliance in Ireland should be based on learnings from other jurisdictions, including the optimal mix of overt/covert and fixed/mobile operations.

For all countries outlined in the case studies, it is illegal for a driver to use a handheld mobile phone while driving (hands-free phone use is allowed) and for a driver and passengers to not wear a seatbelt. However, detecting use of a handheld device and seatbelt non-compliance is difficult for police to manually monitor and enforce. Using smart cameras which capture seat belt non-compliance and handheld mobile phone use across Ireland will increase the number of detected offences. As highlighted in the Australian case study, since the introduction of mobile phone and seatbelt detection cameras in some Australian States and Territories, the number of detected seat belt offences has increased from 5,531 in 2021 to 58,073 in 2023, and the number of detected mobile phone offences has increased from 138,987 in 2020 to 311,563 in 2023. Like speed cameras, smart cameras which can detect handheld mobile phone use will further assist the Gardaí in detecting and enforcing road rules.

It is important to note that given that this camera technology is new and emerging, there is a need for ongoing research to determine the most effective ways to deploy these cameras in terms of their intensity and modes of operation. In Australia, the location of mobile phone and seatbelt detection cameras are not made public (i.e., covert operation). There are two types of mobile phone and seatbelt cameras, including i) fixed cameras and ii) portable cameras. Similar to speed cameras, having a mixture of covert and overt operations (i.e., cameras which are easily visible to drivers) may also increase compliance with these road rules. However, and as noted above, ongoing research is needed to determine the most effective ways to deploy these cameras in Ireland.

4.3.3. Drink driving

Specific Behaviour Recommendation 4: Consideration needs to be given to expanding the powers of the Gardaí so that they can stop and breath test and/or drug test a driver at any time, irrespective of the circumstances. This would replicate the powers that police have in jurisdictions such as Australia, which serve to reinforce to drivers that they can be breath/drug tested 'anywhere and at anytime'.

Most of the literature presented in the review published in the 1980s and 1990s focused on drink driving and the impact of RBT on this behaviour. As highlighted in the review, RBTs have been a

very successful police enforcement strategy at reducing drink driving. Earlier evidence suggested that, "*The aim of RBT is to create a sense of unease about drinking and driving amongst potential offenders through highly visible police enforcement which gives the impression of being unpredictable, unavoidable, and ubiquitous*" (Homel, 1993, p. 28S). Other research reported in the review argued for a mixture of covert and overt stationary RBTs. Specifically, overt stationary RBTs act as a general deterrent, whereas covert mobile operations which can occur outside of peak periods, may be more effective at detecting drink driving offenders (i.e., a specific deterrent effect; Bates et al. 2012). In Ireland, mandatory alcohol testing (MAT) has been implemented since July 2006, and the Gardaí can breathalyse a driver if they believe that the driver is intoxicated, has been involved in a crash, or committed a road offence. In other countries, such as Australia, police have the power to stop a driver and undertake a breath test and/or drug test at any time, irrespective of the circumstances.

Specific Behaviour Recommendation 5: The number of alcohol breathalyser tests return to, at a minimum, pre-COVID levels.

The case studies highlighted that across all countries there was a decline in breathalyser tests in 2019/20 due to COVID-19 and police resources being allocated elsewhere (e.g., border controls). In terms of deterrence, a decline in the number of breath tests will reduce indirect and direct punishment and increase punishment avoidance. It is also important to note that the effects of enforcement are dynamic; that is, the deterrent effects of enforcement will diminish if insufficient resources are devoted to RBTs.

Since COVID-19, the number of breath tests conducted in Ireland, England, Wales, Northern Ireland[52] and Australia have remained below pre-COVID testing levels. In Norway, the number of breathalyser tests conducted in 2023 (515,303) was slightly lower than the number of breathalyser tests conducted in 2018 (528,532). Similarly, the number of breathalyser tests conducted in Sweden in 2023 (1,263,057) was slightly lower than the number of breathalyser tests conducted in 2019 (1,312,152). Historically, in the Australian context it was recommended that police conduct one breath test per licensed driver each year (Travelsafe, 1996). Based on the statistics outlined in the case studies, it is recommended that the number of breathalyser tests return, at a minimum to pre-COVID levels.

Specific Behaviour Recommendation 6: Consideration should be given to lowering the BAC limit for learner and novice drivers from 0.02 to 0.00.

The case studies highlighted that BAC levels of novice drivers in Ireland, the United Kingdom, Norway, and Sweden was 0.02. In Australia, learner and provisional (novice drivers) are subject to zero BAC. This change was introduced in different States and Territories at different times. For example, a zero BAC limit for novice drivers was introduced in New South Wales in 2004; however, in Queenland, the zero BAC limit for novice drivers was not introduced until 2010. Prior to the zero BAC limit, the BAC limit for learner and provisional drivers was 0.02. The move from 0.02 to a zero BAC limit was about sending a clear message to young novice drivers that they could not drink alcohol at all before driving.

Specific Behaviour Recommendation 7: Ireland should consider introducing a requirement for repeat and/or high range (i.e., a BAC of 0.15 or over) drink drivers to have an alcohol ignition interlock fitted to their vehicle as a condition of relicensing. Ideally, the interlocks

[52] Data on number of breath tests were only recorded for Scotland since 2022.

should be part of a broader rehabilitation program and remain fitted until drivers demonstrate sustained compliance with the device.

The literature review provided support for vehicle sanctions (e.g., alcohol ignition interlocks) in preventing drink driving behaviour (e.g., Watson, 1998). Specifically, Watson (1998) states that alcohol ignition interlocks fitted to the vehicle of a repeat offender may be effective in reducing drink driving behaviours. Watson et al. (2013) further highlighted that alcohol ignition interlocks should be considered as part of a broader rehabilitation strategy, as the approach on its own may not produce long-term behavioural change. Three countries outlined in the case studies had an alcohol ignition interlock program: Australia (all drivers), Sweden (all drivers), Norway (some categories of professional drivers). In Ireland, alcohol ignition interlocks are being considered as part of a broader programme (i.e., supported by a drink drive rehabilitation course) as part of the Ireland's Government Road Safety Strategy.

4.3.4. Drug driving

Specific Behaviour Recommendation 8: Consideration should be given to implementing a more random approach to roadside drug testing.

Five studies were identified in the literature review that focused on drug driving. The findings provided some support for deterrence theory. For example, Hasan et al. (2023) found that stronger perceptions of punishment certainty were associated with lower intentions to report drug driving. Further, Armstrong et al. (2018) reported that stronger perceptions of punishment avoidance and vicarious punishment avoidance were associated with stronger intentions to drug drive in the future. The case studies show that Ireland, the United Kingdom, Australia, and Sweden all have a zero-tolerance approach to drug driving. In Norway, legislative limits are applied for driving under the influence of drugs (e.g., for the drug amphetamine, the impairment limit is comparable to 0.02 BAC). Drug swipes were reported to be used by police to detect drug driving offences across all jurisdictions. Unlike drink driving, in some countries there appears to be a more targeted approach to drug testing (i.e., drug swipes are used by police if they think that a driver has taken an illicit substance as opposed to random testing). The reason for the more targeted approach may be due to the added costs associated with drug swipes. In Ireland, the Gardaí can conduct preliminary drug tests at the roadside or in Garda stations. Since 31st May 2024, the Gardaí must test a driver for drugs at the roadside if they have been involved in a serious collision.

4.4. Specific countermeasure recommendations

Specific Countermeasure Recommendation 1: Public education campaigns should continue to be used to support enforcement activities in Ireland as well as in efforts to change road user behaviour. The development of these campaigns needs to be theoretically underpinned.

Overall, the findings from the literature review were mixed regarding the role of public education campaigns relative to the implementation of enforcement. For instance, while Tay (2005a,b) reported that anti-drink driving campaigns had significant independent effects in reducing crashes, Tay (2005b) found that there were no independent effects of anti-speeding campaigns in reducing crashes; instead, anti-speeding campaigns and police enforcement activities reinforced each other. In his seminal meta-analysis, Elliott (1993), concluded that combining public education campaigns and enforcement was most influential. Despite the reported differences regarding the role and interplay of campaigns and enforcement, evidence supports the use of public education campaigns as one countermeasure to help reduce risky driving behaviours. However, it is worthwhile noting that

most studies included in the review acknowledged that it is very difficult to measure the independent effects of public education campaigns given that campaigns are continually operating concurrently with other initiatives.

The review provided some support for targeting non-legal sanctions to prevent engagement in illegal driving behaviours. Examples of non-legal sanctions included, internal loss (i.e., feelings of shame, guilt or embarrassment), material loss (i.e., fear of receiving a fine or demerit points), and social sanctions (e.g., social judgement, disapproval from those close to you). Public education campaigns could be designed to incorporate these factors (e.g., disapproval from those important to you if you engage in speeding behaviour; Lewis et al., 2010). Other studies which have examined psychosocial predictors of intentions to engage in handheld phone use while driving have also recommended that road safety messages could target social factors, including social disapproval of important others to engage safer driving behaviours (e.g., Gauld et al., 2014, 2023).

Specific Countermeasure Recommendation 2: Public education campaigns are required to signpost any changes to road rules and penalties.

It was highlighted in several studies included in the literature review that road users need to be aware that a behaviour is illegal and have knowledge about the penalties for deterrence to have an effect. While most drivers are aware of the basic road rules (e.g., exceeding the posted speed limit or using a handheld mobile phone while driving are illegal behaviours), some drivers may not be aware of restrictions which apply to specific groups of drivers (e.g., novice drivers) or the specific penalties associated with engaging in illegal driving behaviour. Public education thus has a role to play in this regard insofar as ensuring road users are aware of the latest penalties for particular illegal behaviours.

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Appendix

Table A1. Brief overview of deterrence papers

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
Armstrong et al. 2018	Australia	To examine the impact of Roadside Drug Testing (RDT) which was recently introduced in the Australian Capital Territory (ACT) in terms of driver awareness and deterrent effect.	Phone interview N = 801, drivers 17 – 88 years old	Classical deterrence theory Reconceptualised deterrence theory	Age was significantly related to past behaviour (driving within 24h of drug-taking) and future behaviour. Awareness of RDT was significantly correlated with future drug-driving likelihood Certainty, severity, and swiftness were not significantly correlated with future drug-driving likelihood and were not significant predictors in the logistic regression model. Punishment avoidance was significantly correlated with future drug-driving likelihood and was a significant predictor in the logistic regression model. Indirect experience of punishment was significantly correlated with future drug-driving likelihood but was not a significant predictor in the logistic regression model. Indirect experience of punishment avoidance was significantly correlated with future drug-driving likelihood and was a significant predictor in the logistic regression model.
Bates et al. (2020)	Australia	To explore perceptions of Classic deterrence theory concepts in young drivers in two states, in metropolitan and regional areas.	Focus groups, N = 31, Queensland and Victoria, young drivers (17-25 years), metropolitan and regional locations	Classic deterrence theory	Geographical location affects certainty of apprehension – higher in metropolitan than regional areas. Use of traffic cameras increases apprehension certainty. Authors suggest that certainty, swiftness and severity of apprehension and punishment should be increased, particularly in regional areas.
Bates & Anderson (2019)	Australia	To explore young drivers experience of punishment avoidance	Focus groups N=31, Queensland and Victoria, young drivers (17-25 years).	Reconceptualised deterrence theory – punishment avoidance	Avoid punishment in following ways: Active punishment avoidance – e.g., taking off P-plates to avoid graduated driver licence restrictions. Direct and vicarious punishment avoidance of police enforcement – e.g., deceive police officer to avoid punishment, talked way out of fine. Parental punishment avoidance – e.g., parents taking penalties (e.g., demerit points) for their child.

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
Bates et al. (2017)	Australia	Using a reconceptualised deterrence theory the study examined young drivers' perceptions of road rule enforcement particularly related to graduated driver licence (GDL)	Survey N= 236 17 – 24 years old	Reconceptualised deterrence theory	DV: self-reported non-compliance Licence type and personal enforcement significant predictors of non-compliance in hierarchical regression. DV: self-reported transient rule violations Licence type, personal enforcement, and parental enforcement significant predictors of transient rule violations in hierarchical regression. DV: Self-reported fixed rule violations Gender (males) and personal enforcement significant predictors of fixed rule violations in hierarchical regression.
Freeman et al. (2015)	Australia	Systematic review to identify theoretical advancements within deterrence theory that has informed evidence-based road safety practice.		PRISMA review of deterrence-based road safety research (1960-2015)	The deterrent impact of most approaches are not clear. Criminal theorists have continued to expand deterrence knowledge, but this had not been transferred to road safety. The most important questions revolve around which enforcement techniques have the most deterrent effects and how can the deterrent effect of these techniques be maximised.
Freeman & Rakotonirainy, (2017)	Australia	To explore pedestrians' perceptions of legal and non-legal sanctions at level-crossings and identify factors that would maximise perceptual deterrence and reduce violations.	Survey N = 636 Age range 10-82 years (Mage = 34.94). 56.6% males.	Classical deterrence theory Non-legal sanctions (social loss, internal loss, physical loss).	DV – Self-reported crossing rule violation. Certainty, severity, swiftness, and social loss were not significant predictors in logistic regression model. Intention to violate rule in future, internal loss, and physical loss were significant predictors in logistic regression model. Perceptions of countermeasures to prevent intentional rule braking in next 6 months – police presence, rail transit officer presence rated higher likely factors to deter sample.
Freeman et al. (2020)	Australia	To examine the effect of legal sanctions on drink-driving offences and how alcohol consumption	Survey N = 773 Queensland drivers	Classical deterrence theory Non-legal sanctions (social loss, internal loss, physical loss).	3 binary logistic regression models DV: future intentions to drink drive

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
		affected the decision to drink-drive.			Risky drinking, certainty and physical loss significant predictors of future intentions to drink drive. DV: Drive when know above the limit Gender, risky drinking, swiftness, severity, and physical loss significant predictors of driving when know above the limit. DV: Drive when think above limit Age, gender, risky drinking, and physical loss significant predictors of driving when think above limit.
Freeman et al. (2021a)	Australia	To determine which factors (of self-reported perception of classical and reconceptualised deterrence and alcohol consumption) had the greatest effect on promoting drink-driving.	Survey N = 718 Queensland drivers	Classical deterrence theory Reconceptualised deterrence theory	2 binary logistic regression models DV: Self-reported possible drink driving events Risky alcohol use, direct and indirect punishment significant predictors of self-reported possible drink driving events DV: Self-reported acknowledgment of drink driving events Age, risky alcohol use, severity, direct and indirect punishment, and direct punishment avoidance significant predictors of self-reported acknowledgment of drink driving events
Freeman et al. (2021b)	Australia	To examine the amount of exposure needed by RBT operations to influence deterrence-based perceptions and subsequent drink-driving violations.	Survey N = 961 n=741 completed questionnaire in the community; n=243 completed questionnaire after being breath tested Licenced drivers in Queensland	Classic deterrence theory – focus on certainty of apprehension only.	2 logistic regression models DV: Drink driver (Yes/No) Age, gender (male), risky drinking (yes), and drink driver apprehension (yes) significant predictors. DV: Future intentions to drink drive (Yes/No) Gender (male) and drink driver (yes) significant predictors.

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
					Apprehension certainty – not significant in either model.
Hasan et al. (2023)	Australia	To investigate the relative influence of legal and non-legal sanctions on drug-driving and how it may be similar or different from drink-driving.	Survey N = 1,394 licenced drivers from Queensland, New South Wales and Victoria	Classical deterrence theory Reconceptualised deterrence theory Akers' social learning theory	3 logistic regression models DV: Self-reported drug driving Age, drug dependence, self-reported drink driving, direct experience of detection avoidance, attitudes to drug driving, and anticipated instrumental awards significant predictors. DV: Self-reported drink driving Age, gender, licence type, alcohol dependence, self-reported drug driving, perceived certainty of punishment, direct experience of detection avoidance, and attitudes to drink driving all significant predictors. DV: Self-reported combined drug and drink driving Drug dependence, direct experience of detection avoidance for drug (and drink) driving, attitudes to drug driving, behavioural dimension of differential association for drink driving, anticipated non-social punishment for drink driving all significant predictors.
Huang et al. (2023)	Australia	To examine the association of habit, the perceived legitimacy of deterrence and enforcement on 3 levels of speeding (low – less than 10km/hr; mid – 10-20km/hr; high 20+ km.hr above speed limit).	Survey N = 870 Median age 37 years.	Classical deterrence theory Reconceptualised deterrence theory Perceived legitimacy	3 hierarchical multiple regression models DV: low-range speeding Habitual speeding, severity of punishment, direct punishment, and direct punishment avoidance were significant predictors. DV: mid-range speeding Gender, driving hours, habitual speeding, severity of punishment, direct punishment, and direct punishment avoidance were significant predictors.

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
					DV: high range speeding Gender, habitual speeding, perceived legitimacy, severity of punishment, direct punishment, and direct punishment avoidance were significant predictors. In all models, certainty of apprehension, indirect punishment, and indirect punishment avoidance were not significant predictors of speeding behaviour.
Kaviani et al. (2020)	Australia	To examine the effects of formal and informal deterrence-based methods on phone use while driving	Survey N = 2774 drivers in Victoria, self-reported phone use while driving	Classic deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	Law abiders significantly higher mean scores for worrying about getting caught by police (personal apprehension certainty) than law breakers. Law abiders significantly higher mean scores for social loss (i.e., concerns about what friends, parents, peers would think of them using phone while driving), physical loss (i.e., might hurt others or get hurt when using phone while driving), and internal loss (i.e., would feel guilty even if not caught by police) compared to law breakers. Binary logistic regression DV: illegal phone use while driving Age, social loss, physical loss, and internal loss significant predictors; certainty, severity, and swiftness not significant.
Kaviani et al. (2022)	Australia	To explore the efficacy of risk information related to phone use while driving and non-legal sanctions	Survey N = 1027 Young drivers from Victoria who used phones when driving	Non-legal sanctions (social loss, physical loss, internal loss)	Age – significant differences in age-related perception of internal loss, and one social loss item (i.e., loss respect by important others if use phone while driving); younger drivers less guilt than older drivers; young drivers more concerned what others thought than older drivers. Gender – Significant differences between males and females regarding perception of internal loss, social loss, and physical loss; females higher mean scores for all non-legal sanctions. Perceptions towards messages:

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
					Greatest impact on increasing physical loss (hurt self): "*A 2 s glance at your phone while driving at 50km/h effectively means driving bling for 27m"* Most effective in deterring phone use: "*Contributes to 16% of Victorian road deaths and serious injuries annually"* Strongest increase in perceptions of social loss/physical loss: "*Increases risk if a crash comparable to those associated with driving under influence of alcohol or cannabis"*
Love et al. (2024)	Australia	A systematic review and meta-analysis on the factors that are associated with drink-driving intentions (DDI)	19 articles were identified for the systematic review and 12 for the meta-analysis	Classical deterrence theory Reconceptualised deterrence theory Theory of Planned Behaviour	Theory of Planned behaviour explained DDI. Deterrence theory was more ambiguously related to DDI. Punishment avoidance experience was relevant to DDI but not direct punishment.
Meirambayeva et al. (2014)	Canada	To evaluate the deterrent impact of street racing and extreme speeding legislation in Ontario, Canada.	Data related to 24,401 driver licence suspensions and extreme speeding convictions between Sept 2007 and Dec 2011 were examined	Classic deterrence theory	DV - Street racing and extreme speeding legislation Certainty, severity and swiftness of punishment deters risky behaviours. Punishment of vehicle impoundment and licence suspension is regarded to be more severe than speeding tickets alone and are severe enough to deter from risky behaviours.
Mills et al. (2022)	Australia	An exploration of two types of exposure to roadside drug testing (RDT) and the relationship with certainty of apprehension and future drug-driving intention.	Survey N = 803 Queensland drivers, mean age 27.12 years. All reported using cannabis and/or MDMA and/or amphetamines at least once in past 12 months	Classical deterrence theory – focus on certainty of apprehension	RBT: never tested (60%); never seen (17%) RDT: never tested (46%); never seen (46%) Binary logistic regression model DV: likely future intentions to offend Age, marijuana use and certainty of apprehension significant predictors.
Nguyen-Phuoc et al. (2014)	Vietnam	To explore the interaction between psychosocial factors and legal intervention on two groups of motorcycle riders (delivery riders and private	Survey N = 423 delivery riders, N = 411 private riders	Classical deterrence theory Theory of Planned Behaviour	PLS-SEM models DV: intentions to engage in risky riding behaviours Food delivery riders: Swiftness of sanctions significant predictor of intentions (certainty and severity not significant)

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
		riders) regarding risky behaviours.			Private riders: Severity of sanctions significant predictor of intentions (certainty and swiftness not significant)
Ochenasek et al. (2022)	Australia	To examine the impact of legal and non-legal sanctions on following a vehicle too closely (tailgating)	Survey N = 887 Queensland drivers. 17-84 years; Mean age 49 years.	Classical deterrence theory (certainty of apprehension, severity of punishment) Reconceptualised deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	Hierarchical multiple linear regression DV - Following too closely Age, direct punishment avoidance, indirect punishment, severity of punishment, physical loss, and social loss were all significant predictors.
Ogden et al. (2022)	Australia	To examine the influence of legal and non-legal deterrents on young drivers' smart phone use.	Survey N = 524 Australian drivers, 17 – 25 years old	Classical deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	2 hierarchical regression models DV: initiating using while driving License type, internal loss, and physical loss significant predictors. DV: responding using smartphone while driving License type, residence, internal loss (anticipated action), and physical loss significant predictors. The three classical deterrence variables were not significant in either model.
Szogi et al (2017)	Australia	To find which deterrent factors based on classical and reconceptualised deterrent theory influenced the intention to drink drive.	Survey N = 1257 Australian drivers, 16 – 85 years old	Classical deterrence theory Reconceptualised deterrence theory	Logistic regression model DV - Self-reported drink-driving behaviour Age, gender, average hours driving per week, certainty (personal), severity, direct punishment avoidance, indirect punishment significant predictors of drink driving.
Truelove et al. (2023a)	Australia	To understand the differences between drink and drug-driving in terms of legal and non-legal deterrence and influence on future intentions to drink and drug drive.	Survey N = 564, 18 – 69 years old	Classical deterrence theory Reconceptualised deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	2 hierarchical regression models DV: future intentions to drive under the influence of alcohol Punishment avoidance only significant predictor DV: future intentions to drive under the influence of drugs

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
					Punishment avoidance only significant predictor
Truelove et al. (2023b)	Australia	To examine the external and internal influences on using a handheld phone while driving.	Survey N = 866, Mean age 37.51 years	Classical deterrence theory Reconceptualised deterrence theory Self-determination Self-determination theory	DV: Phone use while driving Direct punishment avoidance and the self-determination theory constructs of perceived pressure, effort and importance, and relatedness significant predictors.
Truelove et al. (2021)	Australia	To examine the legal and non-legal factors that impact on young drivers and speeding.	Survey, Time 1 and Time 2 (3months later). N = 200, 17-25 years, mean age was 20.44 years	Classical deterrence theory Reconceptualised deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	Structural equation model DV – Exceeding speed limit by more than 10km/hr Direct effects Perceived severity of punishment – significant negative effect Direct punishment – significant positive effect Indirect effects Indirect effect of material loss on speeding via perceived severity of punishment Direct punishment avoidance significantly predicted engagement in speeding via perceptions that it is safe to engage. All other direct and indirect effects were not significant.
Truelove et al. (2020)	Australia	To examine the perceptual stability of deterrence variables over time. Behaviours: exceeding speed limit by more than 10km/hr; reading a message on phone while driving; using Snapchat while driving	Survey, Time 1 and Time 2 (3months later). N = 200, mean age was 20.38 years	Classical deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	6 Hierarchical regression models (i.e., one for each behaviour for experiential effects and deterrent effects) DV: exceeding speed limit by more than 10km/hr Deterrent effect model: Gender only significant predictor Experiential effect model: Material loss only significant predictor DV: reading a message while driving Deterrent effect model: Severity of punishment, material, and physical loss significant predictors Experiential effect model: Severity of punishment and material loss significant predictors DV: Snapchat Deterrent effect model: Physical loss only significant predictor Experiential effect model: Material and physical loss significant predictors Fluctuations were found in all deterrence variables over 3 month period.

Article	Country	Main aim/objective	Sample	Theory(ies)	Key findings
Truelove et al. (2019a)	Australia	To use qualitative and quantitative methods to study young drivers in Queensland and phone use while driving (specifically Snapchat)	Focus groups N = 60, Survey N = 503, 17-25 years old	Classical deterrence theory Reconceptualised deterrence theory Non-legal deterrent (safety)	Qualitive study: Snapchat while driving most common social media application used by participants. Hierarchical regression model DV: Snapchat while driving Age, direct punishment, direct punishment avoidance, indirect punishment, indirect punishment avoidance, safety all significant predictors.
Truelove et al. (2019b)	Australia	To identify and explore major mechanisms that influence young drivers ' compliance with Queensland Graduated Driver Licence (GDL) restrictions.	Focus groups N = 60. Age 17-25 years.	Classical deterrence theory	Participants had low perceptions of enforcement as the GDL violations are difficult to detect. Participants displayed low levels of knowledge of the GDL restrictions and the associated sanctions. Phone restrictions were most often violated, and the zero-alcohol restriction most often complied by participants.
Truelove et al. (2017)	Australia	To examine speeding in terms of perceptions of legal and non-legal sanctions	Survey N =- 1253 Queensland drivers	Classical deterrence theory Non-legal sanctions (social loss, physical loss, internal loss)	Hierarchical regression model DV: Speeding over 10km/hr Age, gender, and average hours of driving per week significant in Step 1; personal certainty of apprehension and personal severity significant in Step 2; material loss and physical loss significant in Step 3.
Watling et al. (2014)	Australia	To examine how awareness of drug-testing methods impact on the effectiveness of drug-driving deterrence and the intention to drug-drive in future	Survey N = 161 drivers who self-reported drug-driving in the past 6 months	Classical deterrence theory	Logistic regression DV: Intentions to drug drive in the next 6 months Overall drug use was the only significant predictor; certainty, severity, and swiftness were not significant predictors,