Incentives to encourage safer driving behaviour

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Abbreviations and acronyms

ACC	Accident Compensation Corporation
DSDS	dynamic speed display sign
NRSPP	National Road Safety Partnership Program
NZI	New Zealand Insurance
PAYD	pay-as-you-drive
PHYD	pay-how-you-drive
SAM	speed awareness monitor
SCIRT	Stronger Christchurch Infrastructure Rebuild Team
SGI	Saskatchewan Government Insurance
VKT	vehicle kilometres travelled

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Executive summary

An incentive involves a range of actions, systems or approaches (sometimes applied in conjunction) to promote or encourage desired behaviour. In the context of safe driving, this includes anything that increases the perceived benefits of cautious behaviour. Incentives may be extrinsic, whereby there is a financial value attached, or intrinsic, where there is a non-financial value attached, such as positive reputational or recognition-based feedback.

This research focuses on the use of incentives to encourage safer driving behaviour and choices to help inform potential opportunities for the next Road to Zero action plan. To achieve this, a review of international literature and current best practices in other jurisdictions was conducted, followed by interviews with key international and national representatives to supplement publicly available information and explore opportunities for incentives in New Zealand.

The literature review explores the complexity of incentives. There are many factors that can influence effectiveness (eg immediacy, likelihood, behaviour complexity, size and group targeted). Incentives targeting younger drivers and fleet schemes have the greatest evidence for desired behaviour change, while layering or multiple incentives can increase reach and desirability for all groups. There is a risk that some types of incentives may lead to negative impacts on safer driving behaviours, such as time discounts on the graduated driver licensing system process and rewarding existing good driving behaviour as opposed to safer driving behaviour.

New Zealand has some existing incentives with evaluation measures and evidence of desired behaviours (eg Ride Forever programme,[1] EROAD[2]), while in both New Zealand and other jurisdictions incentives have been implemented with no evidence of effectiveness (eg Free Licence and Fair Go Schemes in Australia[3]).

Throughout the literature review and interviews there were consistent opportunities and challenges in successfully implementing incentives for safer driving behaviours, which were aligned with three of the Road to Zero action plan focus areas. Aligned with these focus areas are recommendations for enabling incentives to support the existing penalty system presented below, which are followed by further general recommendations to support successful safer driving interventions.

Incentives aimed at young/novice drivers (Road to Zero: Road user choices)

1. Consider developing a suite of initiatives that incentivise safer driving behaviours in younger drivers, including:
    a. in-vehicle technology for immediate and ongoing feedback that rewards young drivers
    b. parental feedback of safer driver behaviours (safe and unsafe behaviours)
    c. financial incentives (eg insurance or registration discount) earned based on evidence of safer driving indicators (ie safer speeds, no traffic offences, no crashes)
    d. gamification (eg gaining awards and points for driving safely, achieving recognition of safer driving skills or levels, sharing with influential peer groups).
2. Explore opportunities for incentives that increase participation and engagement with existing driver safety education programmes for novice drivers (eg the Drive programme).

[1] An Accident Compensation Corporation (ACC) initiative aimed at improving motorcycle rider safety.

[2] An in-vehicle fleet monitory and feedback system that aims to encourage safer driving behaviour.

[3] Schemes that offer free licences or discounts on licence renewal to drivers who have not committed infringements in a specified timeframe.

   a. Capture and apply lessons from mature, successful incentive-based safety education programmes (eg Ride Forever), including financial discounts earned based on completion of education levels.
3. Partner with insurance companies to introduce incentives related to evidence of safer driving in young and novice drivers, including the use of:
   a. safety-led education and training (ie following the model offered by the Ride Forever programme)
   b. in-vehicle objective evidence of safer driving behaviour (ie using a pay-how-you-drive model).

Workplace-based incentives (Road to Zero: Work-related road safety)

4. Create a public–private governance group with a shared vision of the benefits of work-related driver safety, building on lessons from mature, successful models (eg the National Road Safety Partnership Program (NRSPP) in Australia). This group would enable the benefits of evidence-based workplace incentives, including:
   a. prestigious workplace fleet-recognition awards, which require sharing of evidence and data based on indicators of holistic fleet safety best practice (including attitudes and culture, speeding events, and insurance claim data)
   b. financial (or extrinsic) rewards that focus on small, achievable, frequent rewards.

   This group could also:
   a. encourage trials of fleet and office (ie group-based) and individual driver gamification to reduce speeding events and promote safer journeys (eg safer route selection, or breaking up journeys to limit fatigue)
   b. acknowledge and promote knowledge-sharing of incentive-based case studies and what works and what does not.

Infrastructure-based incentives (Road to Zero: Infrastructure improvements and speed management)

5. Trial incentive-based environmental feedback in the form of dynamic speed messaging signs in specific locations (eg schools and pedestrian crossings) to inform guidance on options that might improve road safety.

General recommendations to consider supporting safer driving incentive success

6. Review central funding around safer driving interventions to enable safer road user behaviours and choices to include funding for evidence-based incentives.
7. Monitor the effectiveness of existing initiatives to inform the incentive space in New Zealand (including the Drive programme).
8. Socialise and use a clear definition of incentives to overcome the limited understanding around how incentives are defined and the wider range of incentive tools available (ie beyond rewards).
9. Develop a process and framework to review the design of any safer driver incentive programme to ensure it follows best practice and is evidence-based, including:
   a. ensuring any incentive is directly linked to safer driver behaviours and not eroded by other competing motivations (eg the use of time discounts to enable earlier access to employment)
   b. use of multiple incentives, including complementary extrinsic and intrinsic incentives.
10. Financial (or extrinsic) rewards should focus on small, achievable, frequent rewards.
11. Consider further investigation into incentives for safe operation at an institutional level.

Abstract

While some individual studies on safer driving incentives and policy interventions are available, a joined-up and complementary review of their impact and implications is surprisingly lacking not only in New Zealand but overseas. This report is an attempt to close the gap. It reviews available international literature on incentives as well as current best practices in different jurisdictions. The evidence gathered for this report is supplemented with insights from interviews conducted with key international and national representatives in this field. In addition to a discussion of principles for successful incentives in the context of safer driving, the findings in this report outline incentive-based approaches and practices ranging from reward schemes to in-vehicle feedback and external feedback signs. The report also identifies challenges such as the lack of proper evaluation of existing interventions, as well as opportunities and avenues for future research. In addition to general recommendations to support safer driving incentive success, we provide specific recommendations for workplace-based incentives, infrastructure-based incentives, and incentives aimed at young/novice drivers. The insights from this report will help to inform and explore potential opportunities for incentives in New Zealand in the context of the next Road to Zero action plan.

1 Introduction

To provide a holistic approach to promote safer driving behaviours, there is an opportunity to understand the effectiveness of incentives. The potential use of incentives draws upon theory from the field of behavioural psychology and the underlying premise that people respond to positive reinforcement. Through advancements in technology and innovation, there is an opportunity to update our knowledge and understanding of how incentives might support road safety outcomes as part of the overall safe system approach.

As part of the safe system approach for the Road to Zero safety strategy in New Zealand (Ministry of Transport, 2019b) there is an opportunity to review the role of incentives as part of the whole safe system approach. This relates particularly to the following driver safety outcomes:

- work-related road safety (focus area 3), where there is an opportunity to incentivise businesses, other organisations, and employees to treat road safety as a critical health and safety issue, including where 'business leadership needs to be accompanied by a regulatory framework that incentivises the right behaviours' (Ministry of Transport, 2019b, p. 48)
- road user choices (focus area 4), where there is an opportunity to incentivise safer choices and safer behaviours on our roads
- infrastructure improvements and speed management (focus area 1), where there is an opportunity to incentivise drivers through environmental feedback.

This research aims to understand the current evidence for the use of incentives to encourage safer driving behaviour and choices and support road safety outcomes. The research comprises a literature review (chapter 2) and interviews with both subject matter representatives and those with practical insights into how incentives could be applied in the New Zealand context (chapter 3).

1.1 Objectives

Objectives of the research are to:

- review international research on the use and effectiveness of incentives to encourage safer driving behaviour and choices
- identify current practices used in other jurisdictions (eg countries, states) regarding the use of incentives to encourage safer driving behaviour and choices and/or barriers to implementation
- explore how these incentives have been used, including their effectiveness and/or barriers to implementation based on in-depth insights from interviews with key international and/or national representatives
- present a set of recommendations about potential opportunities for, and barriers to, applying incentives in New Zealand as part of the overall safe system approach in Road to Zero.

1.2 Incentives defined

The term 'incentive' can be defined as a range of actions, systems and/or approaches (sometimes applied in conjunction) to promote and/or encourage desired behaviour. In the context of safe driving this includes anything that increases the perceived benefits of cautious behaviour (Wilde & Murdoch, 1982). This includes both retention of existing road safety behaviours and encouraging or promoting a change in driving behaviour through increasing desired safety behaviour and/or reducing undesirable behaviour.

For the purposes of this report, 'incentives' is an umbrella term that includes positive stimulus and rewards, which we are defining as follows:

- a **positive stimulus** is something given pre-behaviour to stimulate change to safer behaviour
- a **reward** is something given post-behaviour to encourage the continuation of the behaviour that occurred.

In both cases, an incentive must include some aspect of encouragement for a safe driving behaviour (ie the absence of negative feedback around unsafe driving behaviours is not an incentive). The difference between an incentive and a non-incentive is illustrated using the following examples of external vehicle feedback signage (ie variable message signs).

- **Incentive example:** External vehicle feedback signage that includes some positive feedback on safer driving speeds, such as the use of a positive colour or a smiley face when complying with the speed limit.
- **Non-incentive example:** External speed feedback signage that only provides feedback when a driver is travelling over the speed limit but provides no feedback when they are complying with the speed limit.

1.2.1 Types of incentives

Incentives can be extrinsic or intrinsic in nature (Silverman et al., 2016).

- **Extrinsic incentives** are financial or can easily be assigned a financial value (eg an insurance discount, prizes or other material goods).
- **Intrinsic incentives** are intangible and cannot easily be given a financial value (eg reputational or recognition-based feedback from a parent, peer, colleague or technology).

For the purposes of this research, incentives have been broadly categorised into the following areas:

- Reward schemes
- Vehicle- and technology-based feedback
- Environmental schemes
- Policy
- A combination of the above.

1.3 Out of scope

The geographic and individual access to the incentive is within scope, as this is a barrier to incentives. Beyond this, equity measures and outcomes are out of scope (eg inclusive access to the licensing system).

Existing incentives that may be encouraging less safe behaviour are outside the scope of this research (eg financial benefits for truck drivers driving long distances in a short time). Alternatives to penalties that increase the cost of risky driving behaviour are also outside of scope – these are addressed in the complementary Waka Kotahi NZ Transport Agency research report *Effect on Compliance of Alternatives to Penalties*.

2 Literature review

2.1 Method

A systematic literature review was conducted of national and international literature to identify key authors and/or relevant studies where incentives have been used to encourage safer driving behaviour. This also involved identifying related studies through a snowball method. In doing so, publications by the same author, citing publications or cases identified in a study or the reference list of a study or meta-analysis, were included. The approach was also complemented with literature previously known by the authors.

Appropriate search engines and research databases such as Google Scholar, ProQuest, and Science Direct were used. Keywords included:

- incentive to safe driving
- rewards
- stimulus
- incentive mechanisms
- incentive programme
- incentive on driving behaviour
- safe traffic
- road safety.

The criteria for an identified study to remain in the literature review were that it reported the results of (a) an experiment where the extent of the effectiveness was reported, or (b) a policy intervention with reported outcomes. Evidence published in academic journals from 2010 onward was the primary focus. However, when an earlier key theoretical paper or a seminal study was identified, it was included in the report. As the project developed, we found that the evidence was limited, so we broadened the search criteria to include other sources (eg local government websites), which allowed relevant incentive-based practices and current gaps in research evaluation to be identified.

2.1.1 Literature review structure

The following sections of this report explore the conceptual and empirical evidence for the role of incentives to encourage safer driving behaviour. First, section 2.2 discusses the theoretical underpinning for incentives and the research evidence for their use in this context, including the key population groups that are targeted by incentive-based interventions. Section 2.3 then presents the effectiveness of interventions in both research and practice, and summarises the interventions by the type of incentive approach adopted.

2.2 Behavioural psychology theory

To ensure an effective, sustained behaviour change around safer driver behaviour, it is critical to understand the types of interventions and the rich history of the theory underlying them (eg Hagenzieker et al., 1997; Nelson & Moffit, 1988). This section provides the theory to support the incentive evidence and effectiveness research summarised in section 2.3.

2.2.1 Types of interventions around safer driver behaviour

In a review of different crash prevention strategies, with a focus on the effectiveness of incentives, Wilde and Murdoch (1982) describe four overarching crash prevention strategies to alter behaviour. These are presented in Table 2.1. Strategy 1 (in bold font) is the focus of this research.

Table 2.1 Four broad crash prevention strategies (adapted from Wilde & Murdoch, 1982)

Influence	Crash prevention strategy	Relevant example
Cautious/safe behaviour focus	**1. Increase the perceived benefits of cautious behaviour**	**Incentives or rewards for safer driving behaviour, like incentivising crash-free driving.**
	2. Decrease the expected costs of cautious behaviour	Decrease the cost of safer transport behaviours, like subsidising safer modes of transport like public transport.
Risky/unsafe behaviour focus	3. Increase the expected cost of risky behaviour	Aligns best with more commonly used penalty-based approaches, using fines, penalties, enforcement – for example, increased insurance fee for drivers who crash.
	4. Decrease the expected benefit of risky behaviour	Decrease existing incentives that may be encouraging less safe behaviour – for example, removing financial benefits for truck drivers driving long distances in a short time.

2.2.2 Factors that influence the effectiveness of incentives

There are a number of factors related to the effectiveness of incentives, including the value and type of incentive, the probability of receiving it and the type of behaviour that is rewarded (Elias, 2021; Hagenzieker et al., 1997; Lepper et al., 1973) (see Table 2.2). It is also important to recognise that the interactions between these factors are complex. For example, a higher likelihood of receiving an incentive can be more important than the size of the incentive (Elias, 2021). As Gneezy et al. (2011, p. 204) state:

> *A considerable and growing body of evidence suggests that the effects of incentives depend on how they are designed, the form in which they are given (especially monetary or nonmonetary), how they interact with intrinsic motivations and social motivations, and what happens after they are withdrawn.*

Table 2.2 Summary of factors that can influence the effectiveness of incentives

Factors	Incentive effectiveness
Immediacy	An immediate incentive has greater success than a delayed one (Myerson et al., 2011).
Likelihood	Greater likelihood to receive an incentive increases success (long-term effect; eg Elias, 2021).
Intrinsic incentives	Intrinsic may be better for sustained safer driving. For example, in relation to extrinsic incentives offered, especially monetary, it is argued that these may discourage the intrinsic motivation or self-reflection that is needed to sustain behaviour change (eg Kavanagh et al., 2011).
Behaviour complexity	Incentivising behaviours that require a simple or single point of action (like seatbelt use; Kavanagh et al., 2011) have had more consistent success than behaviours that require ongoing vigilance (like speed), or major changes in travel behaviour (like avoidance of driving in the dark; Greaves et al., 2013).
Size	There are interaction effects with the size of incentives. However, small, highly likely incentives are more effective (Elias, 2021) when compared with larger, less likely incentives).
Homogenous population	Incentives aimed at a similar group, especially school group, work better than incentives aimed at a broader or less targeted community (Hagenzieker et al., 1997).

2.2.2.1 Incentive size

Small-scale incentives amongst similar groups (eg people going to the same school or working at the same company) can work better than large-scale incentives (Elias, 2021; Hagenzieker et al., 1997). A meta-analysis looking at incentives to promote seatbelt use in New Zealand found that programmes focused on children aged 5–11 and their parents were the most successful in both short-term and long-term effects (Hagenzieker et al., 1997). The authors concluded that incentive programmes run in small, homogenous groups provide better results (compared to larger, heterogeneous groups typically found in communities).

Elias (2021) argued that an extrinsic incentive can induce changes in behaviour, but the incentive should not be so large that it would undermine any intrinsic motivation to drive safely. Elias also showed a relationship between incentive likelihood and incentive size, such that small incentives with higher likelihood were better for changing driver behaviour (eg speed, tailgating) than large, uncertain incentives. For more information on trials looking at differing incentive sizes, see section 2.3.1.1.

2.2.2.2 Crowding out of intrinsic incentives

There are some who argue that an extrinsic monetary incentive can ‘crowd out’ or erode an intrinsic motivation (Gneezy et al., 2011; Lepper et al., 1973; Mortimer et al., 2018), reducing the effectiveness of the intrinsic incentive. The underlying reasons for this are as follows.

- A monetary reward is an indication that safe driving is difficult or undesirable and so requires payment to achieve this, much like a child being paid to do chores.
- The intrinsic reputational incentive of safe driving as a signal of someone’s concern for other people on the street or community is undermined because you can no longer distinguish this behaviour from someone who is only financially motivated.

This ‘crowding out’ of intrinsic motivation to be a safe driver can be linked to a dollar value threshold (Mortimer et al., 2018), where staying under that threshold is less likely to erode intrinsic motivation. This supports the idea that smaller extrinsic incentives are likely preferable in a safe driving context.

2.2.2.3 Relative contribution of incentive characteristics

A key challenge with incentive studies is that it is difficult to isolate their contribution to safer driving. Further, due to the complex interactions within different incentives (eg size, type, immediacy) it is difficult to work out the most effective way to deliver an incentive. Hagenzieker et al. (1997) attempted to better understand the contribution of incentives, using a meta-analysis on the effects of campaigns that used incentives to promote seatbelt use. A key component to this study was that it examined the relative contribution of individual and combined components of incentives on the same driver behaviour. It also indicated which aspects of an incentive were important to prioritise across both short-term and longer-term effects.[4]

Hagenzieker et al. (1997) reviewed 34 journal articles and research reports and determined that campaigns[5] to encourage seatbelt use generally led to higher short-term effects (20.6 percentage point increase) rather than longer term (13.7 percentage point increase).[6] Key individual variables adding to incentive success are (see also Table 2.3 for their relative contribution):

[4] It is worth noting that the authors do criticise the robustness of the methodology of the underlying papers, mostly in relation to longer-term effect studies, whereas the short-term effects were believed to be more robust.

[5] ‘Campaigns’ refers to road safety mass media campaigns aimed at changing road user behaviour.

[6] Inclusion criteria for studies were that the incentives were given to individuals, had a material value, were not provided alongside enforcement programmes, and where there was a measure of behaviour (eg questionnaires).

- the immediacy of rewards, which reported larger effect sizes (determined through observed change) than delayed rewards
- the type of population involved whereby small homogenous groups (eg especially school campaigns) produced better results than large heterogenous groups (eg communities)
- delivery based on group (as opposed to individual) behaviour (ie increase in group improvement in seatbelt use rather than individual increase in frequency of use).

The characteristics of incentive schemes that were not significant included:

- duration of the intervention (days)
- number of different kinds of incentive provided
- specific incentive types (eg exchangeable token, chance to win a contest, work-related privilege)
- size of the incentive (dollars) (Hagenzieker et al., 1997).

Table 2.3 Summary of single variables from generalised linear modelling analyses, and their contribution to variance in seatbelt use (by short-term and long-term effects; adapted from Hagenzieker et al., 1997, p. 769)

Incentive variable	Effective type	Proportion of seatbelt use accounted for (R^2; adjusted, weighted)	
		Short-term effect	Long-term effect
Type of population	Small, homogenous (ie school)	0.35[a]	0.12
Immediacy of reward	Immediate	0.13	0.14
Group or individual behaviour	Group behaviour	0.14	-–
Theory referred to	Theory-based	0.01	0.20
Contingency	Non-contingent	0.13	0.12
Incentive type	Promotional item	0.07	0.07
Likelihood	High likelihood	–	0.05

[a] R^2 measures the goodness of fit of a regression model. A higher R^2 number indicates that the variable has a greater contribution to incentive success.

When looking at the effectiveness of combined incentives, the best-fitting models also took into account the context in which the incentive was applied (ie seatbelt law presence OR base usage rate of seatbelts).[7] The relative effect of incentives can be seen where up to 64% of the variation in seatbelt use in short-term incentive studies can be explained (see Table 2.4).[8]

[7] 1 in 5 studies in the meta-analysis had a mandatory safety belt use law.

[8] The long-term effect table was not presented, as this was believed to be based on less robust studies.

Table 2.4 Summary of best-fitting models to show the variables that account for the greatest proportion of variance in short-term seatbelt use effects (adapted from Hagenzieker et al., 1997, p. 771)

Short-term incentive interactions	Proportion of seatbelt use accounted for (R^2; adjusted, weighted)
Mandatory seatbelt law + Type of population	0.42[a]
Mandatory seatbelt law + Type of population + Immediate incentive	0.51
Mandatory seatbelt law + Type of population + Immediate incentive + (Type of population × Immediate incentive)	0.61
Mandatory seatbelt law + Type of population + Immediate incentive + (Type of population × Immediate incentive) + Group behaviour	0.64
OR Usage rate during baseline + Type of population + Immediate incentive + (Type of population × Immediate incentive) + Group behaviour	0.64

[a] R^2 measures the goodness of fit of a regression model. A higher R^2 number indicates that the variable has a greater contribution to incentive success.

2.2.3 Behavioural insights in delivering effective incentives

The body of work related to 'nudge theory' (Thaler & Sunstein, 2009)[9] and behavioural insights has had limited applications in the road safety context. It is often looked at in New Zealand policy to influence administrative processes around positive behaviours, like increasing those who opt in to save for retirement (Ministry of Economic Development, 2006). However, the theory around these design principles could also help existing interventions by improving the delivery mechanism. For example, in the context of in-vehicle technology or environmental feedback, how the message is delivered to the user can benefit from understanding our existing cognitive biases. This report discusses both approaches below.

2.2.3.1 Administrative incentives

In the context of offenders within the existing penalty system, there is some evidence that offenders can have multiple issues with following regulations relating to safe driving (eg unwarranted or unregistered vehicle or paying fines) and equity challenges around the existing penalty system where people who face the most disadvantage in everyday life also incur the most hardship from fines and penalties (Doran & Knight, 2022). Incentives could also be examined in supporting people to drive to the regulations if there were effective administrative incentives. However, in the context of administration of traffic fines, effective incentives are difficult to identify. For example, in relation to the payment of speeding fines, du Plessis et al. (2020) revealed that early payment incentives (while effective) did not differ substantially from the use of late penalty fines.

2.2.3.2 Catalysts to more effective incentive delivery

By understanding known cognitive biases in how people make decisions, behavioural responses to in-vehicle incentive systems and environmental sign feedback could be improved. Some examples of this approach are shown below.

[9] A nudge is defined by Thaler and Sunstein (2009) as 'any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be cheap and easy to avoid. Nudges are not mandates. Putting fruit at eye level [hoping that people then choose fruit over unhealthy alternatives] counts as a nudge. Banning junk food does not.' (p. 6).

Relevant cognitive biases:

- **Loss aversion** is a cognitive bias where people perceive a loss of something they already possess as having greater value than a gain of something new (du Plessis et al., 2020; Sokol-Hessner & Rutledge, 2019). For example, the pain of losing $100 would be resented more than the enjoyment of gaining $100. This means that for delivery of extrinsic interventions, providing a driver a total maximum up front and reducing this amount with each unsafe driving behaviour would likely be more effective than adding an amount for safe behaviour.
- **Gain-based message framing:** When looking to promote behaviour changes via messages alone, gain-based messages are more effective than loss-based messages when the behaviour is focused on preventative action (like slowing driving speed to reduce a risk of a crash) (Chaurand et al., 2015). For example, a safety message could be 'respected speed limit = less crashes' (gain-based message) or 'exceeded speed limit = more crashes' (loss-based message).

2.2.3.3 Underlying motivations

It is important to understand underlying motivations for safer behaviour. For example, in the context of behaviours like speeding, faster speeds can provide an expected benefit of time savings, but the perceived likelihood of a crash may be low.

Aker's Social Learning Theory includes Differential Reinforcement, which captures reinforcement or the provision of a pleasurable experience that can reinforce desirable road user behaviours (Bates et al., 2016). This positive reinforcement can relate to intrinsic motivations (eg recognition) or extrinsic motivations (eg monetary; see also section 1.2).

2.2.4 Incentives earned versus rewards given

> *The benefits resulting from an incentives program are conditional on future safe driving behaviours whereas in a traditional rewards program, they are conditional on previous safe driving practices.* (National Road Safety Partnership Program, 2017, p. 3)

Modest (or inexpensive) incentives that are earned by safe driving behaviour are better than providing modest rewards to those who already have a history of good behaviour (Harano et al., 1974, as cited in Wilde & Murdoch, 1982). This demonstrates how subtle differences in the way incentive schemes are run need to be managed closely against the underlying psychological theory. It also partially explains why there may be mixed or null findings around non-targeted schemes that just focus on good behaviour as opposed to improved behaviour.

The incentives comparison with rewards was clearly demonstrated in trials run in California that examined a licence extension incentive and a 'good driver' reward programme. In the incentive programme, a sample of drivers who had been in a collision or traffic violation in the last year were sent a letter informing them they would receive a free 1-year extension to their licence if they had a clean driving record (violation and crash free) over the next year (a similar comparison group did not receive a letter; Harano et al., 1974, as cited in Wilde & Murdoch, 1982). The contacted incentivised drivers had a 22% decrease in crashes in the following year (relative to the comparison group).

Within the 'good driver' rewards trial, the sample was composed of drivers who already had a clean driving record (ie no offences) and had received either a congratulatory letter or a letter and a 'good driver' key chain (as a constant reminder), with a similar comparison group who were not contacted (Harano et al., 1974, as cited in Wilde & Murdoch, 1982). This reward-based approach had an actual increase in crashes of about 10% (versus the comparison group).

Arguably, this could be because this group had not earned it (ie they did not require a change in behaviour). Alternatively, the congratulatory approach of explicitly confirming someone was a 'good driver' could have promoted driver overconfidence and resulted in less cautious behaviours, or a perception that the rules (like speed limits) were more relevant to bad drivers.

2.2.5 Incentives and age

2.2.5.1 Younger drivers

There is evidence that:

- younger age groups (up to 25 years old) are more affected by incentives (Hagenzieker et al., 1997; Harano & Hubert, 1974)
- young drivers are influenced by the external environment (Shope, 2006), including parental feedback (Farmer et al., 2010)
- younger males are particularly higher risk takers – for example, younger males have been found to exhibit risk-taking behaviours like speeding, including due external influences like peer pressure, inappropriate parental modelling, and a greater tendency for thrill-seeking (see Cestac et al., 2011; Simons-Morton et al., 2012; Taubman-Ben-Ari, 2014).

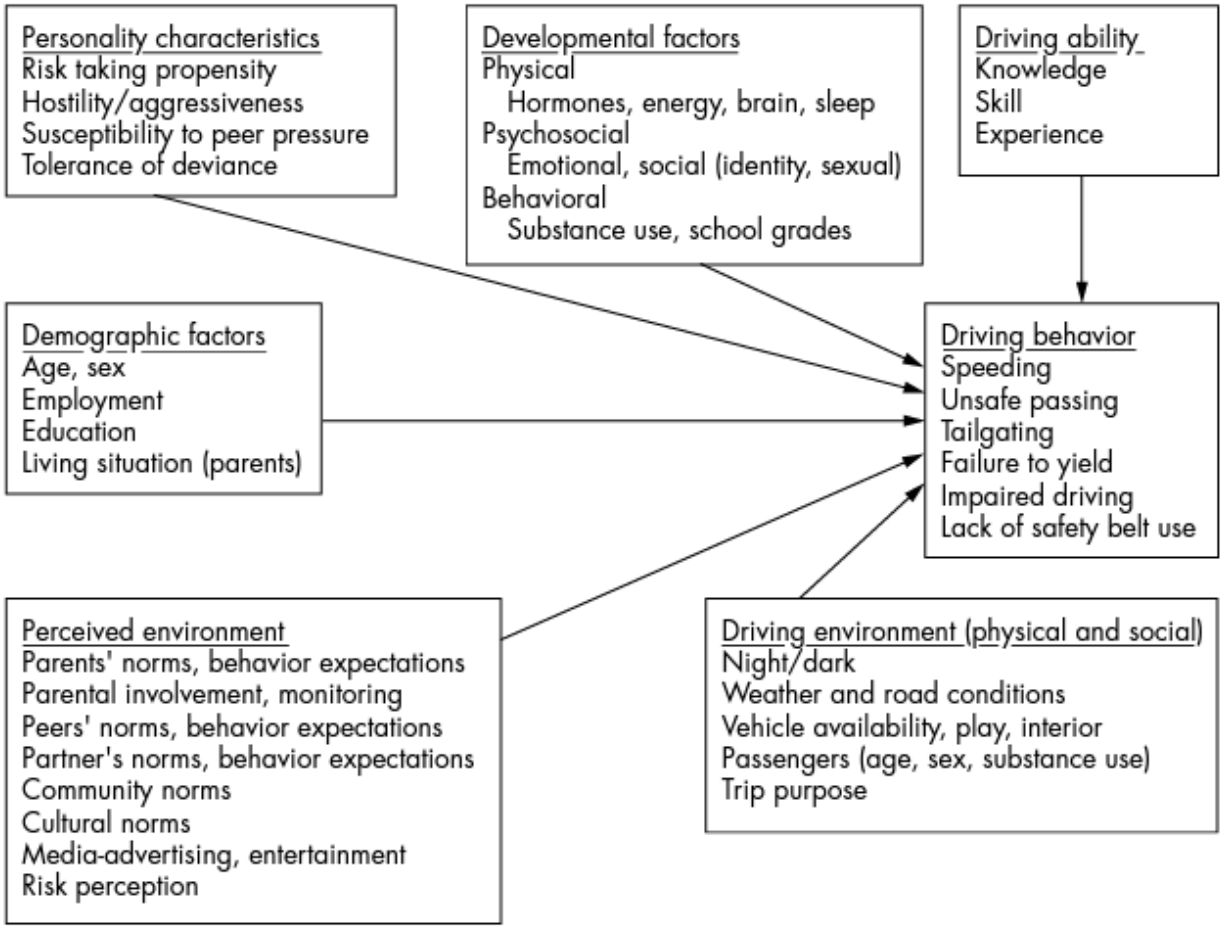
There is also evidence that younger drivers are over-represented in crashes (Te Manatū Waka Ministry of Transport, 2020), which indicates opportunity for incentives to support existing interventions.

In a review of factors known to influence young drivers' behaviour (Shope, 2006), six categories of influence were identified, which are summarised in Figure 2.1. Areas where incentives have the greatest opportunity to influence include:

- **Perceived environment –** intrinsic incentives like approval and recognition from external sources, including peer norms and expectations, and parental influences and monitoring
- **Driving ability –** incentivising safer behaviours on the learning journey
- **Driving environment –** incentivising exposure to safer environmental conditions.

For details on how incentives have been applied with younger drivers, see also section 2.3.2.1.

Figure 2.1 Influences on youthful driving behaviour (reprinted from Shope, 2006, p. 11)



There is some evidence that the younger age group finding for incentives and influence in general translates to younger drivers. In a driver licence extension incentive programme run in California (Harano et al., 1974, as cited in Wilde & Murdoch, 1982; see section 2.2.4), there was evidence that the incentive programme was more effective with younger age groups (up to 25 years of age).

2.3 Incentive evidence and effectiveness

This section provides an overview of the evidence of the effectiveness of incentives for safer driving behaviour. This is presented according to the broad categories noted in the method section:

- Reward schemes
- Vehicle- and technology-based feedback
- Environmental schemes
- Policy.

New Zealand examples are summarised separately in section 2.3.5.

2.3.1 Reward schemes

Reward schemes are extrinsic incentives that are financial, or can easily be assigned a financial value, provided for exhibiting safer driving behaviours. Reward-based approaches have been shown to have

undesirable outcomes, as discussed in section 2.2.4. However, **when applied appropriately** there is some evidence that rewards can be effective in encouraging safer and more desirable driving behaviours. As some commentators have pointed out (see Hagenzieker, 1999), key factors to consider for an effective incentive intervention are the value and type of incentive, the probability of receiving it and the type of behaviour that is recompensed, as discussed in the following sub-sections.

2.3.1.1 Size of the reward

In looking at the financial value of rewards there is some indication that low-value but more obtainable rewards are more effective than those that are large but rarely obtained (Elias, 2021; Hagenzieker et al., 1997). However, the size of the financial incentive can influence the reach or intake into the incentive scheme. Greaves and Fifer (2011) pointed out that small rewards still face the issue of not generating enough driver interest and participation in a scheme, with up to 2 in 5 drivers not engaging with this sort of initiative.

In Israel, research evidence suggested the positive impact of small rewards. A recent study of 92 bus drivers (Elias, 2021) used the fitted electronic driver assistance system to construct a safe driving index and safe driving score, which were reported via text message to the drivers at the end of each day. Indicators of less safe driving included exceeding the speed limit, tailgating alerts, pedestrian and vehicle collision warning and lane changes without speeding. A greater presence of these indicators resulted in a higher safe driving score. The message included the score, amount of financial reward and cumulative reward. Drivers were divided into two groups: one was offered the opportunity for a large reward determined by the best driving score for the day among the group (US$140 for the period of the study), and the other was offered small rewards where the top 50% of drivers were given up to US$7 each. The study period included collecting a baseline of behaviour (13 days), two experimental conditions (30 days each) and a post-experimental period (13 days) during which the drivers were not aware that data was being used for the study but were aware of the electronic driver assistance system in the vehicle. Results showed that for both groups the safe driving score decreased over time, indicating improvements, and that this continued in the post-study period. There were some indications that the smaller but more likely rewards were more effective, consistent with previous research in other areas (Erev, 2007, as cited in Elias, 2021).

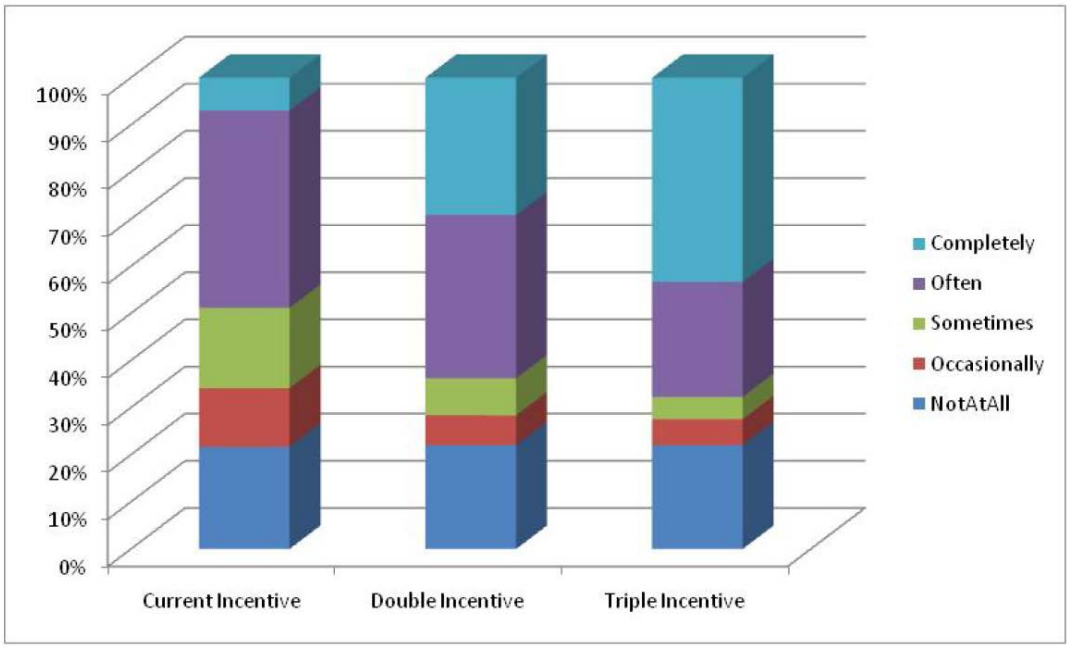
An Australian simulator-based study obtained similar results among 78 novice drivers aged between 18 and 24 (Mortimer et al., 2018). The study compared the effect of financial incentives versus no financial incentives, high-value versus low-value financial incentives, and penalties versus rewards. Risky driving behaviour was primarily determined by total seconds exceeding the speed limit, with secondary measures of braking and swerving. Reductions in speeding were seen for all penalty and reward conditions, with penalties having a greater impact than rewards of the same value, although these were not significant.

The study concluded that low-value financial incentives have an impact in reducing risky driving behaviour such as speeding and swerving and that increasing the value of the incentive may not be as effective as initially thought (Mortimer et al., 2018).

Another approach with financial rewards in isolation was trialled in Australia (see Greaves & Fifer, 2011) where rewards were offered to motorists for decreasing their vehicle kilometres travelled (VKT), night-time driving and speeding over a 5-week period, compared to their previous 5 weeks of driving. The value of the reward was dependent on their initial driving, and they were given a budget (maximum) which then reduced based on a rate table of charging rates for day/night driving and speeding. On completion of the trial, participants received a financial payment for any money they had left in their budget. At the end of the study, 61% made money, with payouts ranging from AU$2 to AU$619. The authors concluded that while most participants made money and were incentivised by this pay-how-you-drive (PHYD) solution, a substantial proportion (39%) did not, suggesting that they were unwilling or unable to change for the monetary incentives on offer. When looking at speeding in particular, exit interviews identified a ‘hard core’ group of

participants (20%) who would not be incentivised to reduce speeding at all, while others would completely or often be reducing speeding to earn financial rewards if the value was increased. However, as shown in Figure 2.2, this indicates diminishing returns with increased financial reward (Greaves & Fifer, 2011).

Figure 2.2 Exit interview responses to the question 'During the charging phase did you reduce speeding to earn financial rewards and to what extent would you reduce speeding if the reward was increased?' (reprinted from Greaves & Fifer, 2011, p. 12)



2.3.1.2 Driving bonus

In Sweden, a different type of extrinsic incentive was tested, namely driving bonus. Researchers used a monthly bonus system as a financial incentive to test reduction in speeding. The experiment lasted two months and targeted older drivers (*n* = 114). The bonus credit was reduced according to the participants speeding behaviour – a device was installed in their vehicles and acoustic feedback informed them about the speed limit and if they were driving above the speed limit. At the end of the month, each participant received the cash value of the remaining amount. The findings showed that, compared to the control group, participants who received the monetary bonus committed fewer speeding violations overall and that the number of serious speeding violations was substantially reduced (Hultkrantz & Lindberg, 2003).

2.3.1.3 Insurance premium rewards

Insurance premium rewards is another type of extrinsic incentive with multiple examples in the literature. A Dutch study investigated its impact among young drivers (Bolderdijk et al., 2011). Through a randomised controlled field trial, the authors assessed the effect of a pay-as-you-drive (PAYD) vehicle insurance policy on driving behaviour. The study offered a discount of up to €50 to participants if they kept the speed limit, avoided driving during weekends and night-time hours, and reduced their mileage. The study only found a modest but significant 6% reduction in speeding. While the study suggested that financial incentives could play a positive role for safer driving, the generous value of the incentive was not feasible for the insurance industry (Bolderdijk & Steg, 2011).

Another study in Quebec, Canada, evaluated the impact of insurance premiums based on demerit points (Dionne et al., 2011). The incentive was established in 1992 by the Société de l'assurance automobile du

Québec, a public insurance company that is responsible for licensing drivers and vehicles and providing public auto insurance in the province. After examining the company's panel data from 1983 to 1996, the study found a 15% decrease in the frequency of traffic violations after the incentive's inception. While the result was encouraging, the fact that the public insurance company was also in charge of the point-record licence system could have explained, in part, this reduction (Dionne et al., 2011).

In relation to private incentive schemes, motor vehicle insurance incentive schemes appear to be shifting to usage-based insurance and away from a lump sum based on characteristics of the driver, such as age or gender (Tselentis et al., 2017). The approach is broadly grouped into two categories:

- **Pay-as-you-drive (PAYD)** – based on a driver's travel behaviour and exposure, especially the distance travelled, or risk of road condition
- **Pay-how-you-drive (PHYD)** – based on a driver's actual driver behaviour, such as speeding or harsh braking (insurance companies using the PHYD model state they provide safe drivers with discounts up to 45%).

In relation to insurance-based driving data that might influence safer driver behaviour and actual risk, there are a number of contributing factors, some of which have been reviewed by Handel et al. (2014). See Table 2.5 below.

Table 2.5 Key insurance telematic data, by rated driver ability to influence the metric and overall risk profile (adapted from Handel et al., 2014, p. 62)

Incentive type	Metric	Description	Driver influence	Overall risk profile
Pay-how-you-drive (PHYD)	Speeding (relative)	Amount of speeding relative to a location specific speed limit	High	High
	Speeding (absolute)	Amount of absolute speeding (ie fixed limit like 100 km/h)	High	Medium
	Braking	Number of harsh braking events and their harshness	Medium	High
	Acceleration	Number of rapid acceleration events and their harshness	High	Medium
	Cornering	Number of events when turning at too high speed and their harshness	High	Medium
	Eco-ness	Instantaneous or trip-based energy consumption or carbon footprint	High	Low
	Swerving	Number of abrupt steering manoeuvres and their harshness	Medium	Low
Pay-as-you-drive (PAYD)	Elapsed distance	Distance of the trip (km)	Low	High
	Time of day	Actual time when making the trip	Low	High
	Location	Geographical location of the trip	Low	Medium
	Elapsed time	Time duration of trip	Low	Low

Arguably one of the more promising PHYD approaches would then focus on metrics like speeding (relative), as the driver has a high ability to control this metric and subsequent safety outcomes (compared with sudden braking or swerving that can be influenced greatly by other road users), and speeding has a strong link to a driver's actual risk profile (see Table 2.5). This look at speeding (relative) has been supported by trial

findings. For example, in a vehicle insurance incentive scheme run in Borlange, Sweden, 114 private cars were instrumented with intelligent speed adaptation equipment to test a ‘pay-as-you-speed’ approach (Hultkrantz & Lindberg, 2011). Participants were randomly assigned to treatment groups, and a non-random comparison group was also formed (from those who did not engage in the incentive experiment but did have monitoring equipment). The treatment groups examined a high versus low incentive (monetary), with a zero, low and high penalty level (for speeding/min over speed limit, with higher penalties for higher speeds). All treatment groups received monthly reports on their performance. Compared to non-participants, overall treatment groups reduced their total driving time speeding by 10 percentage points by the end of the third month of the trial (from about 15% down to 5%). For those receiving a penalty or reduction in their bonus based on speeding violations, severe speeding (speeding 10% over the speed limit) reduced initially and over time, as opposed to the zero-penalty group (ie who just received a bonus), who had an initial drop in speed severity in month 1, but this effect did not last over the second month.

The authors concluded that a penalty charge was required on a bonus to have a lasting effect on severe speeding behaviour (Hultkrantz & Lindberg, 2011). There was no significant difference between the socio-economic variables based on the size of the initial monetary incentive or in the size of the penalty (ie the low and high penalty levels tested). The authors further surmised that the presence of the incentive and its loss based on speed violation behaviour were enough to reduce speeding. Overall, the penalty treatment groups had a relative 49% reduction in severe speeding (64% reduction in severe speeding for the penalty groups, compared with 15% for the zero-penalty group).

Recent studies have demonstrated that low-value incentives can be effective when combined with feedback, but attempts to amplify the effects of these low-value incentives have proven disappointing (Dijksterhuis et al., 2015). Specifically, Dijksterhuis et al. combined low-value PAYD incentives (capped at €3 per simulator run) and in-car feedback (providing a running total of rewards and penalties during simulator runs) with the aim of increasing the immediacy of financial consequences arising from participants’ driving behaviour.

While the combination of feedback and low-value PAYD incentives produced significant improvements in driving behaviour when compared to untreated controls, varying the immediacy of feedback made little difference (€0.01/minute difference in payoffs between immediate and delayed feedback groups after feedback, equating to a €0.26 difference in payoffs for an average simulator run). The authors concluded that efforts to improve the effectiveness of PAYD incentives could yet prove fruitful but that these efforts should now turn to factors other than the immediacy of feedback (eg certainty of feedback) (Dijksterhuis et al., 2015).

2.3.1.4 Fleet-level rewards

In a combined-reward approach, Bie et al. (2010) investigated the implementation of incentives and an insurance premium programme. The programme was operated by a logistics company that rewarded drivers for taking the safest routes. Meanwhile, an insurance company ran a variable insurance premium. For the logistics company, the expectation was that the incentives would allow it to pay lower insurance premiums for its vehicles while the insurance company projected to pay less for potential crash claims. The safety performance of the drivers was measured considering the safety performance of the company’s drivers (measured by safest route for the trip as determined by the Dutch Institute for Road Safety Research, including road categories along the route, distance, travel time, number of left turns and number of intersections). This was combined with a driver reward for individual fleet drivers for following the safest route rather than their normal route. A desktop route choice exercise was conducted with 45 drivers across 20 routes in the Netherlands, USA and Europe. On average there was an 8 percentage point increase in safe route selection when provided with financial incentives (from 50% to 58% selecting the safest route), indicating that monetary incentives can be an effective way to encourage drivers to follow the safest route.

2.3.1.5 Willingness to change and rewards

Elvik (2014) identified and reviewed seven trials designed to reward safe and environmentally sustainable driving. Overall, the most successful incentive schemes had stronger safety effects (60–80% reduction in speeding) compared with environmental driving effects (0–10% reduction in distance travelled). Elvik (2014) also critiqued incentive trials, with the major limitation being that there was a self-selection bias, indicating that the effects found in the trials showed the effects within a group of motivated drivers (ie those less likely to alter their behaviour who may have higher risk driving behaviour may not engage in these types of scheme as readily). This implies that incentive-based approaches do work for those drivers willing to change but should be complemented with other approaches in a holistic way for other driver types.

2.3.2 Vehicle- and technology-based feedback

Another approach used as an incentive to encourage safer driving (and fuel efficiency) is vehicle-based feedback, which is typically given in the vehicle while driving, although it can also include post-driving feedback (eg through a website or app). This approach relies on in-vehicle monitoring (black box) technology that encompasses a range of dedicated information tools providing the driver and/or other parties with feedback about driving behaviour, conditions and environment (Birrell et al., 2014). While it can be a stand-alone tool, black boxes can also be integrated with other technologies such as apps on mobile devices, emailing and text messaging. In-vehicle technology provides a real-time digital footprint of a driving event (Birrell et al., 2014).

In the early days of digital technologies, the negative implications of technology-based interventions (particularly cell phones) for safe driving were the subject of policy concerns and research interest (Mccartt et al., 2006). As technological tools have become more prevalent, sophisticated and interactive, research has focused on the opportunities that these tools can offer to prevent and/or deal with driving risks and associated incidents. For example, Creaser et al. (2015) investigated how effective apps are at blocking the use of cell phones while driving.

The focus of studies on vehicle and technology-based feedback is varied. Studies have looked at the impact of vehicle-based feedback on young or new drivers (Farah et al., 2013; Musicant & Lampel, 2010). Others have studied drivers' attitudes towards in-vehicle technologies, in particular among older drivers (Eby et al., 2018; Svancara et al., 2020). Design aspects and usability have also been explored (see Stevens & Burnett, 2018).

2.3.2.1 Younger drivers

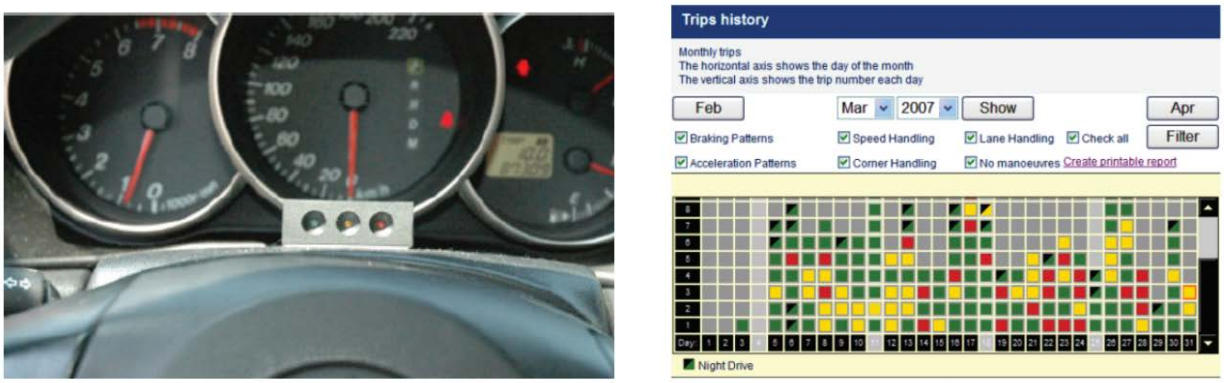
Research on the applicability of vehicle-based feedback has centred on its impact on young and/or new drivers' behaviours. In the UK, for instance, Musicant and Lampel (2010) conducted a before-and-after experiment with a group of 32 young drivers. The study, which was conducted for 12 months, evaluated the usefulness of feedback from an in-vehicle tool to moderate risky behaviour of the research participants. The first stage of the experiment consisted of the installation of the tool in participants' cars, but no feedback was provided. This stage represented participants' normal driving behaviour. In the second stage, driving participants received real-time feedback about the occurrence of risky driving (eg extreme braking, accelerating, sharp turning, and sudden lane changing). The feedback given was also automatically updated in web-based and email reports. The study found that due to the intervention, the overall frequency of risky driving among the participants was reduced by more than 50% when feedback was provided.

In-vehicle feedback for younger drivers is often combined with parental involvement, and the relative contribution of the two types of feedback is not specified. For example, Carney et al. (2010) conducted a pre-test/post-test quasi experiment with 18 drivers to compare the rate of coachable error events per 1,000 miles (identified using a combination of accelerometers and dash-cams fitted to the vehicle) when immediate visual feedback was provided to drivers and weekly event reports were given to parents and drivers. Results

showed that the combination of immediate and weekly feedback led to a reduction in number of coachable events by 61% (from 21 to 8 per 1,000 miles), with the greatest reduction seen in improper turns or curves and for drivers identified at the first baseline as ‘high-event’ drivers (Carney et al., 2010).

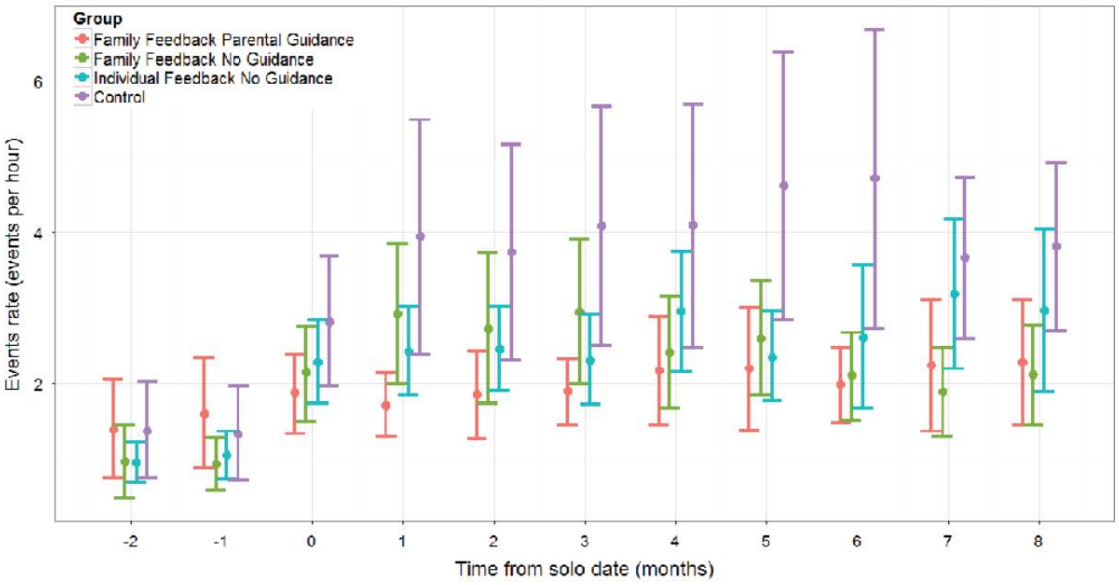
Two studies were identified where the additional contribution of parental feedback was assessed (Farah et al., 2013; Farmer et al., 2010). In Israel, an experiment with 217 male participants aged between 17 and 22 looked at the provision of vehicle-based feedback and the role of parental monitoring on the safety performance (excessive manoeuvres determined by g-force intensity) of the young drivers. Participants were randomly allocated into four groups. A group of them and their families received feedback on their own driving and on that of other family members. A second group received, in addition to the vehicle-based feedback, guidance from their parents, who were trained on ways to enhance their involvement and monitoring strategy (see Figure 2.3). A third group of participants along with their families only received individual feedback on their own driving behaviour. Finally, the control group did not receive any feedback at all (Farah et al., 2013). The results showed that the control group recorded the highest event rates (braking, accelerating, turn handling, lane handling, and speeding) while other groups’ rates were significantly lower (see Figure 2.4). There was no significant difference between the three feedback groups. However, findings were more noticeable in the first three months of solo driving between the control group and the group of participants whose parents received guidance on parental involvement and monitoring, where event numbers were highest (Farah et al., 2013).

Figure 2.3 (a) In-vehicle feedback and (b) web-based feedback provided (reprinted from Farah et al., 2013, p. 28)



(a) (b)

Figure 2.4 Average event rate per group per month (reprinted from Farah et al., 2013, p. 31)



Another study with 84 teenage drivers (aged 16–17) from the Washington, DC, area (Farmer et al., 2010) also found that while vehicle-based feedback could help to monitor young people's risky driving, another key factor was parental involvement. Feedback was provided for sudden braking/acceleration, seatbelt non-use and speeding. For instance, the study found that participants' use of seatbelts improved after their parents were notified of the situation (non-use rates decreased by 59%) and improved even more when vehicle-based feedback was provided (non-use decreased by 91%). Further, participants initially consistently reduced their speeding when they received feedback, when they believed their speeding behaviour would not be reported to parents if adjusted, and when parents were notified of such behaviour. However, over time, speeding instances for all three of the feedback groups increased to approaching that of the control group (Farmer et al., 2010).

A further study combined vehicle and parental feedback with gamification (Simons-Morton et al., 2013). A randomised controlled trial on 90 teens assessed immediate in-vehicle feedback (in the form of lights) versus immediate feedback plus family access to event videos, and rankings of teens relative to other teenage drivers. Participants' vehicles were fitted with accelerometer activated data recorders with an indicator light for the driver. In a two-week baseline period, there was no significant difference in events between the two groups. However, over the course of the 15-week study period, the combined feedback group were involved in significantly fewer events and showed a decline in event numbers over time, while the in-vehicle feedback group did not.

Research has also looked at driver feedback through smartphone applications and its link with speeding time. In a naturalistic experiment with 13 motorcyclists, Kontaxi et al. (2021) found that the provision of rider feedback and riding during afternoon peak hours were statistically significant and correlated with decreased percentages of speeding time.

2.3.2.2 Barriers to use of in-vehicle feedback

Qualitative inquiry also provides some relevant insights about people's perceptions of the impact and acceptance of vehicle-based feedback. In Israel, Gesser-Edelsburg and Guttman's (2013) study found that young drivers perceived vehicle-based feedback as an invasion of their privacy and a restriction to their independence. While participants acknowledged that feedback is based in 'objective' information, they also perceived it as an extension of parental supervision, which, according to the researchers, could create

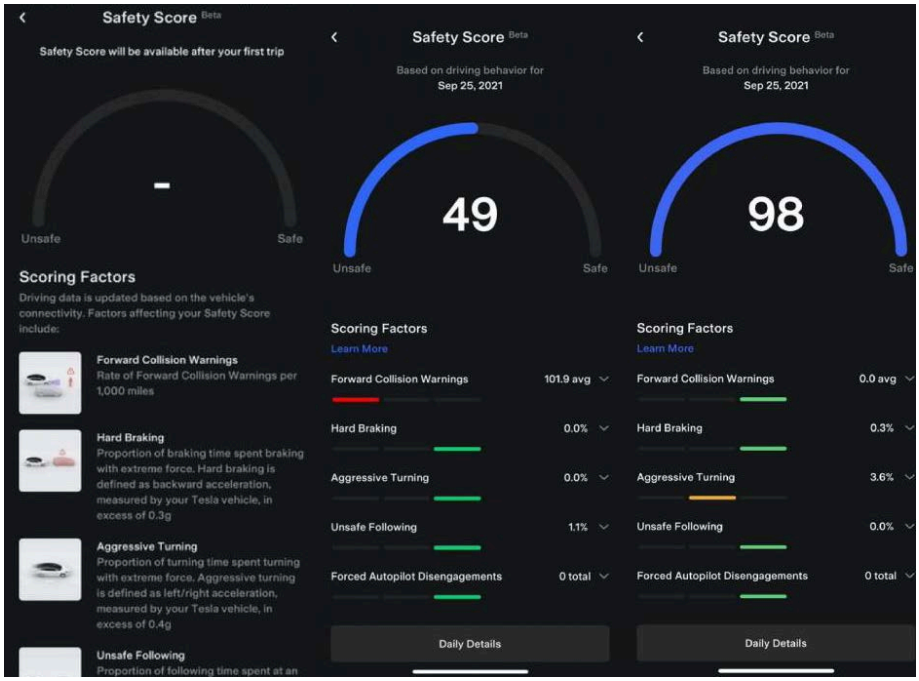
tensions in the parent–young driver relationship. Another Israel-based study found that most parents felt morally obligated to use vehicle-based feedback to monitor their child's driving. Half of participating parents indicated their willingness to use it, adding that it would enhance communication with their child regarding their driving behaviour. However, those who did not support its use thought vehicle-based feedback would damage their relationship with their child (Guttman & Lotan, 2011).

2.3.2.3 Gamification

Recently, the field of transport science has shown increasing interest in gamification[10] as an area of research and practice. Gamification relies on a range of techniques such as quests, role-playing, and the use of points, badges and instant feedback, among others. Seminal work on gamification has looked at its positive influence in encouraging active modes of transportation, namely walking, instead of car use (Harris & Crone, 2021). In terms of encouraging eco-driving, which requires many of the same driving behaviours as safe driving behaviours albeit with potentially different motivations (Frith & Cenek, 2012), research has suggested that gamification could be more effective than providing only feedback, and that the addition of a financial reward did not further improve eco-driving (Günther et al., 2020).

However, despite the apparent promise of gamification, there remains a paucity of evidence on its role in enhancing safer driving behaviours in isolation. A number of apps (eg TrueMotion Family, RoadReady, Life360, DriveSmart) have been developed to encourage safer and eco-driving; however, how effective these tools are is still unknown (Köse, 2021). This has also been evident in the automotive industry. For example, in late 2021, the electric car manufacturer Tesla introduced Safety Score, a beta system that assesses drivers' behaviour (Tesla, 2021). Safety Score evaluated five safety factors (see Figure 2.5) and awarded safety points for those drivers who performed well on the safety factors. However, no evidence of evaluation was identified.

Figure 2.5 Tesla Safety Score beta app (Technopixel, 2021)



[10] Gamification is defined as 'a process of enhancing services with (motivational) affordances in order to invoke gameful experiences and further behavioural outcomes' (Hamari et al., 2014, p. 3026).

Limited evidence has been found of the role of gamification in the context of safer driving. In an experiment conducted in Australia with 32 male participants aged 18–25, Steinberger and his team conducted an intervention using a driving simulator to investigate driver boredom and found that the intervention reduced unsafe coping mechanisms (eg speeding) while promoting anticipatory driving (Steinberger et al., 2017). The gamified intervention found that the percentage of speeding for the intervention group was significantly lower (28%) compared to the control group (34%). Furthermore, the mean for speed reduction (km/h) while approaching speed signs was −3.37 for the intervention group. The difference with the control group was statistically significant (−2.15). However, a less successful intervention of gamification in relation to driving skills has also been reported in Australia. The study looked at 25 novice young learners' use of a gamified logbook smartphone app intended to encourage them to undertake a wider range of driving practice (Fitz-Walter et al., 2017). The intervention was found to be perceived as more enjoyable and motivating than the non-gamified version of the app; however, statistically significant changes in behaviour were not found (ie those with the gamified version did not show a greater time spent practising).

2.3.2.4 Fleet implementation

The online edition of *The Handbook of Road Safety Measures* (Phillips & Nævestad, 2016) included a summary of work-related road safety management. It indicated that in the few controlled studies available to review, one study found that company drivers who participated in an incentive programme in the form of a driving bonus had a decrease in accident risk compared to a control group, but this was not as great as those who participated in training or group discussions (Gregersen et al., 1996), while a second study demonstrated that in-vehicle feedback resulted in a 20% decrease in accident risk compared with those drivers who did not receive in-vehicle feedback (Wouters & Bos, 2000).

Newnam et al. (2014) suggested that in a workplace environment, one approach could be to integrate the feedback into already existing practices within the workplace. For example, leaders and work-group supervisors could be pivotal to improving safety for driving-related behaviour in the workplace by providing feedback to individuals

As with individual application of gamification, there is a lack of empirical research on the effectiveness of fleet implementation. Some providers of fleet gamification solutions indicate measured outcomes. For example, Intellishift reports a 71% reduction in rear-end collisions, a 63% reduction in unsafe following conditions, and a 60% reduction in speeding (Intellishift, n.d.). Zendrive similarly states that fleets who gamify coaching achieve a 21% reduction in speed, a 59% reduction in distracted driving, and a 49% reduction in collision risk (Zendrive, n.d.). In addition, case studies presented by EROAD in New Zealand provide some additional company-reported data showing positive impacts on safety indicators, including speeding and collisions (as detailed in section 2.3.5).

Meanwhile, Myers et al. (2012) showed the effectiveness of combining technology with work practice reviews. In this study a US-based ambulance fleet had driver monitoring equipment installed that was able to detect pre-determined excessive g-force events. These events were then reviewed and combined as part of a feedback and coaching programme for drivers. The results showed a significant decrease in excessive events over the course of the study (Myers et al., 2012).

2.3.3 Environmental feedback (external to vehicle)

Environmental feedback is information provided to the driver from outside the vehicle. This is typically conveyed in the form of road-side signage. There is some evidence that dynamic speed display signs (DSDSs) combined with positive reinforcement (eg smiley face, a thank you message or the use of green numbering) is effective in encouraging safer driver behaviour. However, a drawback of these types of signs is that they have been shown to only reduce speed in the proximity of the sign and can be subject to habituation (Ando et al., 2017; Phillips & Nævestad, 2016).

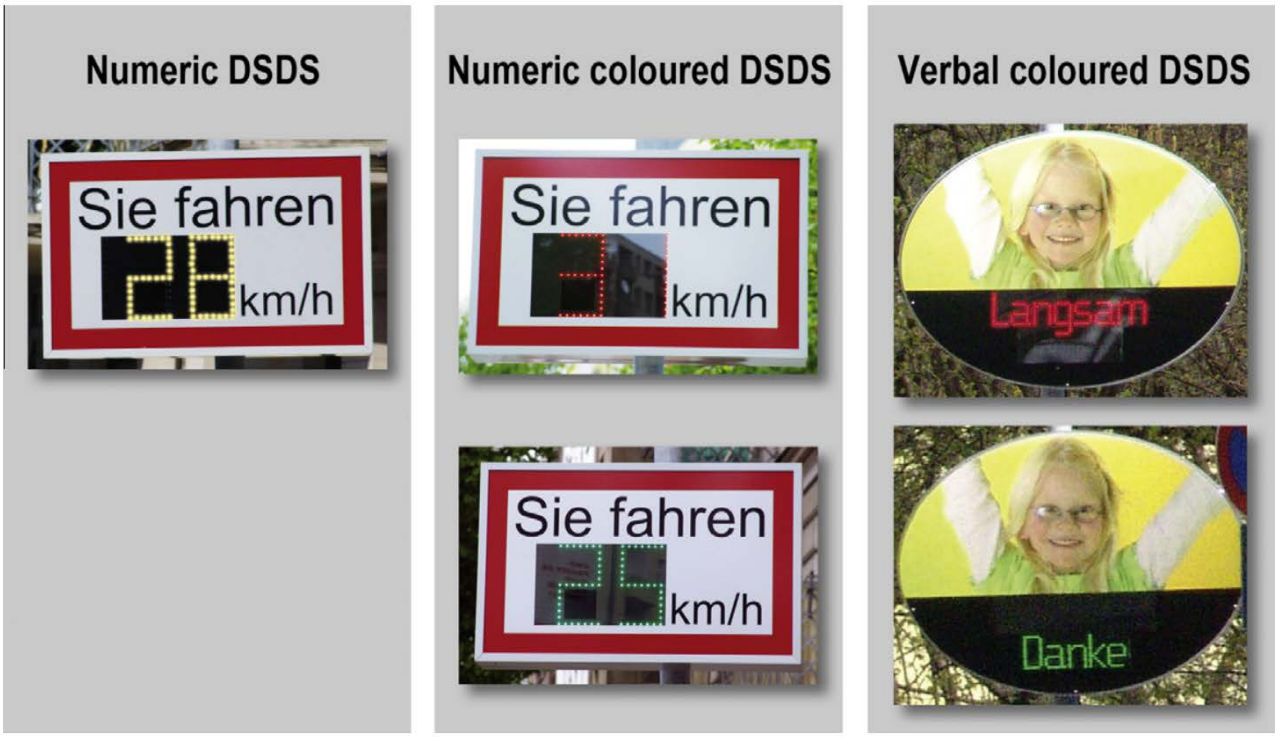
For the purposes of this review, only those studies where DSDSs were combined with positive reinforcement or another intervention are included. The overall effect of DSDSs alone is documented in a recent meta-analysis published by the US National Highway Traffic Safety Administration, where it was determined that reductions of 4 mph (6.4 km/h) were estimated for passenger vehicles because of DSDS installation, with an overall reduction of 2–4 mph (3.2–6.4 km/h) for all vehicles (Fisher et al., 2021).

When looking at the effect of positive environmental feedback, an extensive rollout of speed awareness monitors (SAMs) by Brisbane City Council was carried out and evaluated (see Figure 2.6). The council reported an average speed reduction of about 8.7 km/h by those initially alerted of exceeding the speed limit, and in a review, 63% of people agreed SAMs had a positive impact on speed awareness and more impact on motorist behaviour change than other speed signs (Brisbane City Council, 2019). Details of this review are limited.

Figure 2.6 Slow for SAM signs in Brisbane, Australia, include special updates for different holidays during the year (Fitz-Walter, n.d.)

We found two further studies where the different types of positive incentives through DSDSs were evaluated. Firstly, Gehlert et al. (2012) compared numeric DSDSs with numeric coloured DSDSs and verbal coloured DSDSs (see Figure 2.7) in a high-density residential area in Berlin with a speed limit of 30 km/h. All DSDSs resulted in a reduction in speed, with 85th percentile speed decreasing between 1 and 3 km/h. The verbal coloured DSDSs, which do not indicate actual speed, reduced speed by the greatest amount, followed by the numeric coloured DSDSs and then the numeric DSDSs. The verbal coloured DSDSs were effective over a long period, with no habituation associated with it. This research indicated that verbal messages with an instruction associated (eg ‘slow down’ or ‘thank you’) were more effective than speed notification with no action associated (Gehlert et al., 2012).

Figure 2.7 Three types of DSDSs. The verbal coloured DSDS states 'slow down' or 'thank you' (reprinted from Gehlert et al., 2012, p. 669).



A second study comparing the effect of messaging in a simulator study with two 70 km/h to 50 km/h transition zones and three condition messages – (a) laughing or sad smiley, (b) 'thank you' or 'you are speeding', and (c) 'speed control' (which was displayed regardless of the vehicle speed) (see Figure 2.8) – and a control condition with no messages.

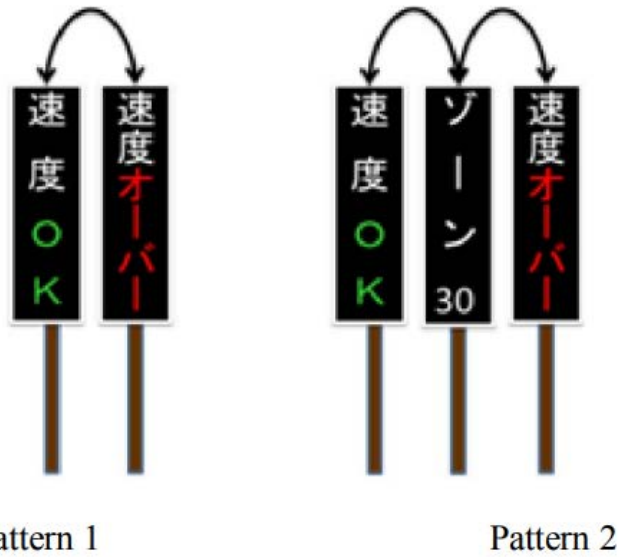
Driving performance measures (mean speed and acceleration/deceleration) were analysed for 66 participants. A significant speed reduction effect (1.2–3.2 km/h) was found for all three digital messages compared to the control condition from 50 m before the display to 100 m after the display with the speed control condition c having a greater reduction than the other two conditions. Conditions b and c had lasting effects 175 m following the display, with condition c being the most effective. This indicated that in this study the risk of receiving a fine was more effective than social approval/disapproval messages (Arien et al., 2013).

Figure 2.8 DSDS messages (a) laughing or sad smiley, b) 'thank you' or 'you are speeding', and c) 'speed control' (reprinted from Arien et al., 2013, p. 5)

The long-term effects were further evaluated in Japan, where a series of studies were conducted to identify the most appropriate DSDS for city-wide implementation in Kariya City. Ando et al. (2017; see Figure 2.9) determined that the Pattern 2 sign (showing 'speed is ok', 'speed is 30' [the speed limit] and 'speed is over') was more effective in reducing speeds than Pattern 1, which omitted the 'speed is 30' message. This was

rolled out across Kariya City and evaluated immediately following implementation and again 10 months later. Speed reduction effects were identified immediately, with an average 85th percentile speed reduction effect of 8.34–10.45% (morning and afternoon), and after 10 months, with an average 85th percentile speed reduction of 5.5–5.78% (Ando et al., 2017).

Figure 2.9 Evaluated DSDSs (reprinted from Ando et al., 2017, p. 523)



DSDSs designed to be effective in a point location have been shown to have only positive effects. Malin and Luoma (2020) evaluated the effects of DSDSs at pedestrian crossing signs installed at 4 experimental and 2 control conditions in southern Finland. Speed was presented and alternated with a green smiley face if the speed limit was not exceeded, a red sad face if the speed limit was exceeded by up to 10 km/h, and only an explanation mark (no speed) if the speed limit was exceeded by more than 10 km/h. Vehicle speed was recorded before installation (one week prior), throughout the period of being in place (1, 3 and 5 months) and one week after removal. While the speed signs were in place, the mean speed of all vehicles reduced by 0.5–2.9 km/h, with the speed displays having less of an effect at quiet sites where drivers were selecting their speed rather than being in flowing traffic. The speed reductions were stable over the time of the installation, indicating that DSDSs could have a long-term effect on driving. When the signs were removed, speeds remained lower than before installation; however, the authors acknowledged that long-term effects were not evaluated (Malin & Luoma, 2020).

Less successful applications of environmental intrinsic incentives have also been reported. A study in the Netherlands investigated the effectiveness of children's book illustration 'Dick Bruna signs' intended for traffic calming (see Figure 2.10). These signs were intended to evoke feelings of caution and care in drivers that would result in lower speeds. Vlakveld et al. (2022) applied a desktop presentation of signs, including the Dick Bruna signs, where participants were asked to report the speed they expected themselves and others to drive. When the Dick Bruna signs were presented, drivers reported lower speeds than when a neutral sign or no sign was visible, while there was no difference between the neutral sign and no sign conditions. The authors recognised that this desktop study did not imply that the Dick Bruna signs will reduce speed on urban roads in real traffic but were indicative enough to consider carrying out a field test in which the speeds of nearly 500,000 vehicles were assessed in conditions before the introduction of the Dick Bruna sign and up to 7 weeks after implementation, at which time the signs were removed. These signs were not placed near official speed limit signs or in areas where there were other cues on the road (eg a school zone). The study found a small reduction in vehicle speed when the Dick Bruna signs were in place. This was only significant

in the first week of implementation (85th percentile speed reduced by 1 km/h); however, there was a continued (but insignificant) speed reduction in subsequent weeks compared to comparison sites. Vlakveld et al. (2022) concluded that this type of nudge incentive should be used in conjunction with other traffic calming measures.

Figure 2.10 Dick Bruna signs intended to draw attention to special traffic situations in a positive way (reprinted from Leer in het Verkeer, 2022)

As with other types of incentives, there is stronger evidence for a combined approach in environmental feedback. In a study looking at DSDSs with and without enforcement-vehicle visibility, Karimpour et al. (2021) evaluated three conditions – DSDSs alone; DSDSs with enforcement-vehicle visibility; and enforcement-vehicle visibility alone – across nine sites in Arizona, USA. This study measured baseline speed (pre-intervention), intervention site speed and downstream speed between 0.22 and 0.33 miles following the intervention. Karimpour et al. (2021) found that while all interventions were effective in reducing speed at the intervention site, only the condition of a DSDS combined with enforcement-vehicle visibility was effective at the downstream location.

The mixed findings of environmental feedback studies indicate the complexity of applying this type of feedback. When relying on intrinsic incentives, the context must be considered. The limited research on positive environmental feedback suggests that this is more successful in areas that evoke an emotive response (eg schools, high-density residential) than in areas where the perceived risk of harm to others is lower (eg higher speed-limit transitions, areas with no other speed cues).

A limitation of all the studies where environmental incentives were applied was the use of vehicle speed as a safer driving indicator – except for Arien et al. (2013), who also reported on acceleration and deceleration as relevant to transitional speed-limit zones. We could not identify any further studies that discussed other indicators of safer driving (eg driver gaze behaviour, sharp turning and sudden lane changing).

2.3.4 Policy interventions

Policy interventions applied to incentives for safe driving are varied in terms of the intervention and its reach. This is a summary of some jurisdictions that have implemented a variety of initiatives. To date, these have not been evaluated with quantifiable metrics.

2.3.4.1 Licensing

In Australia there are several incentive-based initiatives set up to encourage safe driving. At the state level, different state governments have established reward schemes that mainly target young drivers. For instance, since 2006 Western Australia has run a safe driver reward that recompenses provisional drivers with free licence renewal for the first year after their provisional period once they have shown no traffic offences were committed while on a provisional licence. Similarly, the Free Licence Scheme in Victoria is aimed at young and novice drivers. The scheme rewards a free three-year driver licence to drivers under 25 years old who have a probationary licence and have maintained a good driving record (ie free from any driving offences). A good driving record implies that the driver has not committed any offence, including drink/drug driving, speeding, demerit point offences, and unlicensed/disqualified driving. The Tasmanian Government runs a similar scheme, but it does not apply an age limit. Meanwhile, New South Wales' Fair Go for Safe Drivers scheme provides an automatic 50% discount on licence renewal to those who hold a full New South Wales driver, rider or heavy vehicle licence for at least 5 years. To be eligible, drivers must not have committed any infringement such as driving and parking offences attracting demerit points, a conviction for a major offence (eg drink driving), and/or unlicensed driving offences. At the time of writing, no impact assessment of the effectiveness of these schemes was publicly available.

2.3.4.2 Driver education

For a long time, different jurisdictions have implemented driver education programmes, in some cases based on incentives, as a way to enhance not only driving skills but also safe driving, particularly among young drivers (Venkatraman et al., 2021). For instance, some states in the USA encourage participation in driving education by allowing young drivers to obtain unrestricted licences at an earlier age if they complete the programme, or by offering other types of incentives such as reducing the required number of supervised driving hours, waiving portions of licensing tests, or reducing the minimum permit age (Venkatraman et al., 2021). However, early research evidence suggests that, in general, driving education programmes do not have an impact on the reduction of crash rates among young drivers (Roberts & Kwan, 2001; Vernick et al., 1999). Similarly, a 2019 evaluation of the Graduated Driver Licensing System commissioned by Te Manatū Waka Ministry of Transport in New Zealand did not find statistically significant differences in crash rates between drivers who completed advanced driver training and those who did not complete such a programme (Schiff, 2019). Moreover, evidence shows that driver education programmes that rely on incentives may not have the desired impact on safe driving. For instance, an international literature review found that young drivers who received a time discount for attending driving education reported higher crash rates compared to those who did not (Mayhew, 2007). Evidence from New Zealand regarding the impact of time discount as an incentive showed a similar pattern. For example, using matched driver licensing and crash data from 1999 to 2006, Lewis-Evans (2010) found a nearly three times higher incidence of crash involvement in young drivers who gained a full licence after completing a time discount associated programme compared to those who did not attend such incentive-based training and spent more time on their restricted licence. Meanwhile, Begg and Brookland's (2015) study on a New Zealand-based defensive driving course compared those attendees who received a time discount and those who did not. The findings showed that young drivers who got a time discount were more likely to receive a traffic offence notice in their first years on a full licence than those who did not have a time discount. In this respect, speeding was the most common infringement (46%) among those who received a time discount compared to the group without it (30%). While some challenge the adequacy of the incentive-based driver education programme (Begg & Brookland, 2015), others find an

opportunity to redefine and improve driver education as an approach (Mayhew, 2007). Meanwhile, a research evaluation commissioned by Te Manatū Waka Ministry of Transport (Schiff, 2019) found that crash rates for fully licensed drivers who received time discounts after attending a driving course were similar to the crash rates for those drivers without advanced driving certificates. The evaluation also found that crash rates were significantly lower among those who took the driving course without the time discount incentive compared with those who did not undertake the driving course (Schiff, 2019).

In the policy and education spaces, long-term programmes often involve intrinsic or extrinsic incentives, but isolating the benefit of these is difficult. What is important to acknowledge is identifying the underlying mechanisms that may be making these effective. For example, in the USA, the Kansas Department of Transport has been running multiple initiatives around seatbelt use, including one to sponsor a ‘bucks for buckles’ campaign (since 2005). Kansas has observed increased seatbelt usage from 77% in 2009 to 85% in 2020 (Kansas Department of Transportation, n.d.). The campaign gained media attention (see Figure 2.11) and provided an opportunity to enable a wide-reaching incentive, combined with other activities (including long-term education).

Figure 2.11 Images from the TV broadcast related to the Kansas ‘bucks for buckles’ campaign (reprinted from WIBW, 2021, 00:06)

2.3.4.3 Incentives to support the penalty system

In the United Arab Emirates, the police conducted an experiment in 2012 to reward responsible drivers. Known as the Traffic White Points, the scheme is still running and targets registered drivers in the city of Dubai. Eligible drivers must not have incurred any driving offence or have received any fine in the last 12 months. Responsible drivers can win a maximum of 24 white points during a year, while those who have committed an offence will lose two points for any infringement. Rewards include retail vouchers, mobile phones, airline tickets and cash (Shaaban, 2017).

In Europe, some countries have tried innovative incentive-based approaches, but the attempts have only reached the trial stage. In 2010, Sweden’s National Society for Road Safety implemented a speed camera lottery. Informed by fun theory, the experiment sought to encourage speed reduction on a specific street in Stockholm where the average speed of traffic before the experiment was 32 km/h. During the experiment, speed of traffic experienced a 22% reduction, an average of 25 km/h. The lottery’s financial incentive was funded by Volkswagen; however, the concept was based on a proposal where incentives came from fines paid by speeding drivers. The initiative was tried in other Swedish cities and ended a year later (Haggarty, 2010). In the Netherlands, the city of Helmond piloted a ‘speed-meter money box’ on a road facing an issue with speeding drivers. Based on information collected through speed sensors, the system rewarded drivers who did not exceed the 30 km/h limit with money to support a community project. Drivers who observed the

speed limit added €0.10 to the monetary figure displayed, to a maximum of half a euro per vehicle each day (Hunt, 2018). The system was used for two years.

2.3.4.4 Workplace incentives

The National Road Safety Partnership Program (NRSPP) in Australia summarised the power of incentives in improving fleet safety, including guidance and capture of lessons from multiple case studies (NRSPP, 2017). These often included incentives along with disincentives, including a range of key benefits (see Figure 2.12 and Figure 2.13).

Figure 2.12 Examples of workplace incentive benefits (reprinted from NRSPP, 2017, p. 3)

Benefits of Incentives

The NRSPP and Accident Compensation Corporation (ACC)'s guide to applying road safety within a workplace outlines the following benefits of increased workplace road safety:

- Reduction in the number of actual and potential road traffic crashes and injuries
- Reduced sickness and injury absence
- Retained corporate knowledge, less reliance on the use of temporary staff
- Reduced risk of being sued for negligence
- Reduced repair bills
- Reduction in volume and value of insurance claims and costs
- Improved social responsibility credentials and corporate image
- Increased customer confidence
- Tendering advantages, and
- Increased staff morale.

For example, at the local government level, the Blacktown City Council in New South Wales established a reward and recognition scheme as part of its approach to workplace road safety compliance (NRSPP, 2017). In this respect, employees who took initiative towards safe driving (eg undertaking a pre-start check) were recognised by their supervisor with a certificate of acknowledgement. Employees were also rewarded with movie tickets, dinner vouchers and theme park vouchers among other one-time goals (NRSPP, 2017). These incentives were combined with a disincentive, where drivers who had regular or high-cost crashes could not drive until they were cleared under the direct guidance of a driver educator. Average crash costs subsequently decreased from AU$5,000 to less than AU$3,000.

Metropolitan Express Transport Services were able to achieve a reduction in insurance claims of 44%, an average cost of claim (indicating severity of crash) of 12%, with improvements seen over a 6-year period (NRSPP, 2017). The programme used a combination of:

- **tangible incentive** – drivers who are safer 'A level' drivers are considered for promotion
- **monetary incentive** – a 5% increase in remuneration with progression in the programme
- **disincentive** – demotion to a lower category if the driver fails to adhere to safe driving policies.

Figure 2.13 Examples of intrinsic (recognition), extrinsic (tangible and monetary) and disincentive types used in workplace incentive programmes and evaluation metrics (reprinted from NRSPP, 2017, p. 5)

Recognition	Tangible Rewards	Monetary Benefits	Disincentives	Measurable Results
Certificates of acknowledgement Engagement between drivers and managers Hearing drivers concerns through near-miss reporting follow-ups Talking to drivers in the yard can highlight key issues Engaging drivers in risk management decisions by obtaining their feedback	Drivers who excel are considered for higher positions or promoted to the managerial team. Rewards increase overtime, e.g. from movie tickets to dinner vouchers, etc. Some voucher schemes have proven ineffective	5% remuneration when employee reaches next level Bonuses paid to top performing group of drivers, not individuals Incentivise senior management to reduce workplace injuries and improve safety	A standardised demerit point system Using a risk matrix to determine if drivers are reckless Demotion if drivers fail to meet safe driving requirements In-ability to drive for work until deemed a safe driver after an at-fault incident. Drivers can comply with safety requirements or they are not the right fir for the organisation	Insurance premium costs per vehicle significantly reduced Claims frequency dropped Reductions in average cost of insurance claims Increased productivity Reduced maintenance costs Reduction in lost-time injuries Reduction in the number of driving exceptions

2.3.4.5 Incentives as a component of designated-driver programmes

Incentives have also been used as a component of some designated-driver programmes. In Australia, for instance, the Queensland Government developed Skipper, a designated-driver programme that was trialled in Mackay in 2007. Through the programme, people who agreed to stay sober and drive their friends home received free soft drinks (Watson & Watson, 2014). The goal of the programme was to reduce the incidence of alcohol-related crashes by rewarding designated drivers. It targeted drinkers in hotels, clubs and other licensed premises and was tested in 41 venues. The programme was also heavily advertised in media outlets. An evaluation of the Skipper programme (Watson & Watson, 2014) found both an increased awareness of the programme – even 16 months after its inception – and a higher use of designated drivers in its first 3 months. However, evidence for changes in alcohol-related crashes remained inconclusive (Watson & Watson, 2014). The findings were based on survey data collected 3 weeks before the trial and 4 months and 16 months after the commencement of the programme. Using designated drivers seems to be an accepted approach to safe driving among the public. A representative American study conducted by the Traffic Injury Research Foundation (Vanlaar et al., 2017) found that 7 in 10 participants had served as designated drivers and that more than half (64%) indicated nearly always using a designated driver. However, 19% said they have never used one. Finally, a 2005 literature review did not find conclusive evidence of the effectiveness of incentives such as free soft drinks, non-alcoholic drinks, food, or free admission in relation to designated-driver programmes (Ditter et al., 2005). An explanation for this may be that this type of programme is usually informally determined and imprecisely defined (Venkatraman et al., 2021).

2.3.4.6 Insurance

In other jurisdictions such as the Canadian province of Saskatchewan, a Safe Driver Recognition Program awards drivers who have safe driving records with discounts on their insurance premiums.[11] Run through the

[11] Note: New Zealand does not have compulsory insurance, therefore uptake of this type of scheme is likely to differ.

Saskatchewan Government Insurance (SGI), the programme also includes financial penalties for those drivers who lose points from its Safety Rating Scale (SGI, 2022). In the USA, the Kansas City Area Transportation Authority has operated similar programmes (the Annual Safe Driver Award and the Distinguished Driver Award) since the 1990s. Drivers who have not been charged with a driving offence for the calendar year receive an incentive cash payment or paid days off (Deacher, n.d.). At the time of writing this report, there was no independent assessment of the effectiveness of this approach publicly available.

2.3.5 New Zealand examples

The following are New Zealand examples of incentive-based programmes across all four themes. Where relevant, interview comments from chapter 3 are included to support the literature.

2.3.5.1 Ride Forever

The Ride Forever programme of motorcycle training is an Accident Compensation Commission (ACC) initiative aimed at improving rider safety (ACC, 2022a). This is a well-established, incentivised education programme that includes a combination of extrinsic and intrinsic incentives.

In relation to effectiveness, a sample of 3,000 riders who had undergone at least one Ride Forever course was compared with a demographically matched comparison sample of the same size who had not undergone Ride Forever training. The Ride Forever and ACC websites claim that those who had undergone the course were 27% less likely to have a crash (and had an associated 45% lower injury claim cost) (ACC, 2022b). There also appears to be a marked reduction in injury rates of trained riders (relative to a non-trained comparison group) since the course moved from a pilot trial to a nationally rolled-out programme in 2017.

Another aspect in relation to effectiveness is high participation (about 7,000 riders per year), which is based on a range of initiatives including brand campaigns and participation at ‘shiny side up’ motorcycle events. In addition, there was a steady increase in recommending the course to others, with a net promoter score of 85% (ACC, 2022a).

In addition to the reports on this programme, an interview was conducted to inform a deeper understanding of the nuance of the layered incentive design applying both extrinsic and intrinsic incentives (see also chapter 3).

Extrinsic incentives include:

- $200 cash back on motorcycle registration for riders who complete the Gold Ride Forever course (and hold a Full Class 6 Motorcycle Licence for at least 2 years)
- links to benefits (eg reductions on excesses to any claims) from five insurance companies
- reductions in warrant of fitness costs ($5 off at Vehicle Testing New Zealand).

Deeper insights about extrinsic incentives (from an interviewee) include the following.

- During motorcycle registration consultation, riders were particularly motivated by extrinsic incentives relating directly to registration. A key part of this was about fairness. They felt the higher cost that related to higher crash risk was unfair if they were safe riders.
- To partner with insurance companies, providing a point of difference was a key incentive, as was showing the numbers in the education programme growing, and that they would be insuring safer riders. As noted by the interviewee:

  > *What insurance companies are looking to do is incentivise people with reasons why they would join them … they wanted to be different from everyone else.*

> *…if you've got a 27% less likely chance of making a claim … for them it's a win, and it's a win for them to try and bring more riders in, but also brand recognition and brand loyalty then comes into play.*

The interviewee described the following intrinsic incentives.

- The course is tiered, so riders are incentivised to move from Bronze to Silver to Gold badges. This is underpinned by the individual motivation to be the best rider they can be.
- Peer recognition and acknowledgement is also a key component of this, with a constant visible reminder of the different levels of rider skill by receiving Bronze, Silver and Gold pins that riders can wear upon completion.
- Increased rider socialisation and belonging is another incentive of the rider pins.

> *…what's really interesting is when you go out as a rider … I go to a café … and there's a bunch of riders come through the door … they'll all look at each other and be chatting. The pin is what they're really interested in. It starts a conversation … So you're a gold rider. Well, I've only done my silver.*

2.3.5.2 EROAD

EROAD is an in-vehicle fleet monitoring and feedback system that aims to act as a driver aid to encourage safer driving behaviour. Drivers are provided with instant feedback on their driving performance so they can adjust their driving immediately, and fleet managers are provided with dashboard reporting at individual and fleet level. Implementation varies across organisations, which may choose to offer incentives such as leader boards offering recognition and intrinsic reward or financial incentives. A number of case studies are published on the EROAD website, with safer driving outcomes and implementation details (EROAD, n.d.) (see Table 2.6). Overall, this indicates about a 94% reduction in speeding events.

Table 2.6 Case studies with safer driving outcomes through the use of EROAD (adapted from EROAD, n.d.)

Organisation	Reported incentive	Outcome measure	Outcome
McConnell Dowell	Weekly reporting, competition environment	Speeding events	Decreased from 25,000/month to 1,200/month (95.2% improvement)
		Crash and injury	~20% reduction in crash/incident events
Cardinal	Gamification tool	Harsh braking, accelerating, speeding events	A change in leaderboard position from the bottom 50% to top 9% of all EROAD users
Recreational Services	• Leader board • Weekly team reviews • Direct positive feedback messages	Driver behaviour (not specified)	• Top 6% of all EROAD users • 94% improvement in driver behaviour
Downer	In-vehicle feedback	Speeding events	93.8% reduction in speeding events per VKT

In a workplace context, New Zealand Insurance (NZI) has implemented a Safe Driving Rewards Programme that uses EROAD to monitor driver behaviours. Workplace fleets with driving performance results in the top 25% of all EROAD clients could qualify to have the excess waived the following month if a crash occurs (NZI, n.d.). No published evaluation of this programme was identified.

2.3.5.3 DriveGo

DriveGo is an app released in July 2019. Sitting within the overall Drive (n.d.) licensing programme, the DriveGo app is an initiative from Waka Kotahi, ACC and the Ministry of Education. The purpose of the app is to help new drivers learn essential safe driving skills and be ready for the restricted licence test. To do so, the tool applies some gamification principles that informed not only its aesthetic but also its overall design principles such as the achievement badges. In addition, the app allows the user to track their driving with GPS. During the interviews to complement the literature review, one participant (whose name was coded as P9) referred to the DriveGo app currently supporting the licensing journey of new drivers:

> *There is a website which is to support young drivers working towards getting their learner licence. Once they get their learner licence, they can use the app to support them to practise their driving skills and work towards getting their restricted licence. So, they log into the app. And it has like modules that they complete [unintelligible], it gives them an idea of the skills that they should be learning, and then they can tick them off within the app once they've done them. And it is GPS enabled, so they can track their drives and things like that.*

P9 summed up the gamified features of the app:

> *The game in the app looks like a road and they [users] move through different sections and so they try to advance their progress. Then they get feedback and rewards like trophies when they have passed and participated in more and more modules.*

2.3.5.4 Temporary traffic management

Low-cost incentives in the form of chocolate fish have been used to encourage driver patience and safe driving habits by the Stronger Christchurch Infrastructure Rebuild Team (SCIRT), who handed out chocolate fish wrapped in an information flyer about a construction project to stationary drivers at intersections to help them understand the delay and thank them for their patience and tolerance. This received excellent feedback and was used at many locations with people affected by traffic delays as a way of recognising and rewarding good driver behaviour (SCIRT Learning Legacy, 2021); however, no formal evaluation of driver behaviour was conducted.

2.3.6 Summary and insights from incentive evidence and effectiveness

The interventions where there were reported quantitative findings are summarised in Table 2.7. Some of the high-level insights relating to incentives are outlined briefly below.

2.3.6.1 Positive incentive insights

There are many positive insights around opportunities to apply incentives in a New Zealand context. For example:

- Younger drivers have been shown to be an excellent target group for incentives based on behavioural psychology, and they have also been a target group for many successful safer driver trials. This includes incentivising safer behaviours through in-vehicle feedback and monetary rewards, which found additional benefit from combining this with parental feedback (additional intrinsic layering).
- Fleet scheme feedback: Acknowledgement and reputational feedback (intrinsic), tangible incentives (extrinsic), and penalties (disincentives) working together appear to be commonly used and show success in mature fleet incentive schemes.
- Layering or multiple incentives can:
  - enable increased reach by capturing a wider set of people who have different motivations
  - make it easier or more desirable to engage in safer behaviour (gamification and nudge techniques)

  - improve effectiveness through the combination of extrinsic and intrinsic incentives working together.
- Insurance-based incentives alongside technology (via in-vehicle systems and mobile phones) have been run successfully across multiple studies and countries. This approach can overcome challenges around participation (ie capture a wider audience), promote a direct link between the incentive and evidence of safer driving, and provide an ongoing mechanism for an incentive (ie avoiding any issues around incentive withdrawal).

2.3.6.2 Negative incentive insights (elements to avoid)

The literature identified two areas around road safety incentives to avoid because they could lead to negative impacts on safer driving behaviours:

1. Time discounts on the licence process
2. Rewarding existing good driver behaviour (as opposed to earning an incentive based on safer behaviour).

Table 2.7 Summary of incentive-based interventions by incentive type (red text indicates negative impacts)

Incentive type	Example	Source	Jurisdiction	Outcome measure	Effectiveness
Environmental feedback	Driving speed and symbols (smiley face, sad face, explanation mark)	ACC (2022b) Malin & Luoma (2020)	Finland	Speed, corresponding to pedestrian fatality risk	• 0.5–2.9 km/h mean speed reduction. • 4–22% reduction in pedestrian fatality risk.
	SAMs (speed awareness monitors)	Brisbane City Council (2019)	Australia (Brisbane)	Speed reduction	• 8.7 km/h speed reduction by those exceeding the speed limit.
	Numeric DSDSs, numeric coloured DSDSs, and verbal coloured DSDSs (no speed)	Gehlert et al. (2012)	Germany (Berlin)	Speed reduction	• 1–3 km/h reduction in 85th percentile speed. • Longer lasting effects with verbal coloured DSDSs than numeric DSDSs and numeric coloured DSDSs.
	Smiley/sad face; thank you/you are speeding; speed control signs	Arien et al. (2013)	Belgium	Speed reduction; acceleration/deceleration	• 1.2–3.2 km/h speed reduction for all signs. • Speed control signs were effective over a longer post-sign period.
	Two DSDS options: Pattern 1: 'Speed OK' (green) or 'Speed is over' (red) Pattern 2: 'Speed OK' (green), 'Speed is 30' (the speed limit), or 'Speed is over' (red)	Ando et al. (2017)	Japan	Speed reduction	• 85th percentile speed reduction effect of 8–10%, reducing to 5–6% after 10 months of implementation. • Pattern 2 was more effective than Pattern 1.
	Dick Bruna children's book illustration signs	Vlakveld et al. (2022)	Netherlands	Speed reduction	• 85th percentile speed reduction of 1 km/h for the first week of implementation.
Vehicle- and technology-based feedback	Real-time feedback of risky driving for younger drivers through in-vehicle feedback tool	Musicant & Lampel (2010)	UK	Risky driving (extreme braking, accelerating, sharp turning, sudden lane changing)	• 50% reduction (compared with no feedback).
	Immediate in-vehicle and weekly feedback	Carney et al. (2010)	USA (Minnesota)	Number of coachable events per 1,000 miles	• Combination of immediate and weekly feedback led to a 61% reduction (from 21 to 8 per 1,000 miles).

Incentive type	Example	Source	Jurisdiction	Outcome measure	Effectiveness
	Combined approach: In-vehicle feedback plus authority figure feedback (eg parents)	Farah et al. (2013)	Israel	Event rates (braking, accelerating, lane handling, speeding, turn handling)	• Reduction in 1.7 mean events per hour between control and combined feedback groups. All feedback groups significantly improved over control.
	Combined approach: In-vehicle feedback and parent notification	Farmer et al. (2010)	USA (Washington, DC)	Risky driving (braking, seatbelt non-use, speeding)	• Seatbelt non-use improved when parents notified (decreased by 59%). • Further improved with in-vehicle feedback (decreased by 91%).
	Fleet solutions	Zendrive (n.d.)	USA	Speeding, other risky driving	• 21% reduction in speed. • 9% reduction in distracted driving. • 49% reduction in collision risk.
	Fleet solutions	Intellishift (n.d.)	USA	Speeding, other risky driving	• 71% reduction in rear end collisions. • 63% reduction in unsafe following conditions. • 60% reduction in speeding.
	Fleet: EROAD workplace fleet monitoring	EROAD (n.d.)	New Zealand	Speeding events, crash, and injury	• 94% reduction in speeding events (in-vehicle, not tickets). • 20% reduction in crash/incidents reported (anecdotal).
	Gamification – experiment using a moving-base driving simulator with a mobile app with gamified features to encourage drivers to stay within the speed limit.	Steinberger et al. (2017)	Australia	Driver boredom/hazard reactions; road lane position; driving speed	• Reduction in overall driving speed and speeding (3.37 km/h). • Improvement in anticipatory driving. • Slower hazard reactions. The percentage of speeding for the intervention group was significantly lower (28%) compared to the control group (34%).
	Fleet-level vehicle data recorders with in-vehicle feedback on driving behaviour; 840 vehicles, 270 equipped with recorder	Wouters & Bos (2000)	Netherlands	Accidents	• 20% average estimated accident reduction.

Incentive type	Example	Source	Jurisdiction	Outcome measure	Effectiveness
Reward scheme	Insurance premiums for younger drivers (€50 discount)	Bolderdijk et al. (2011)	Netherlands	Speeding	• 6% decrease in speeding.
	Large, less easily obtained vs smaller, more easily obtained reward, communicated with bus drivers via daily text message	Elias (2021)	Israel	Safer driving index	• Significant improvement in safer driving behaviours from baseline for both large/less obtainable and small/more obtainable rewards. • Higher correlation between driving behaviour and rewards with small/more obtainable rewards.
	Pay-how-you-drive (PHYD)	Greaves & Fifer (2011)	Australia	Decreasing VKT, night-time driving, speeding	• 61% of participants made money through improvements in driving (from individual baseline).
	Pay-as-you-speed trial (using intelligent speed adaptation technology and loss aversion)	Hultkrantz & Lindberg (2011)	Sweden	• Proportion of time speeding (total %) • Relative time reduction for 'severe' speeding (more than 10% over speed limit)	• 10% reduction in time spent over speed limit. • 49% relative reduction in 'severe' speeding duration.
	Insurance premiums based on demerit points	Dionne et al. (2011)	Canada (Quebec)	Demerit points	• 15% decrease in frequency of traffic violations following inception of incentive.
	Fleet-level rewards: insurance premium reduction and individual driver rewards	Bie et al. (2010)	Netherlands	Safe route selection	• 8 percentage point increase (from 50% of drivers to 58% of drivers).
	'Good Driver' key chain (constant reminder) or letter based on no reported traffic violations for the previous year (negative impact)	Wilde & Murdoch (1982)	USA (California)	Car crashes	• 10% increase in crashes (relative to comparison group).
Policy	Ride Forever motorcycle training with incentives (registration cashback, insurance reductions)	ACC (2022a)	New Zealand	Motorcycle crashes	• 27% less likely to crash (compared with comparison group).
	Time discount-based education programme (negative impact)	Lewis-Evans (2010)	New Zealand	Car crashes	• Nearly three times higher crash rate among young drivers who gained a full licence after completing a time discount

Incentive type	Example	Source	Jurisdiction	Outcome measure	Effectiveness
					associated programme compared to those who did not attend such training.
	Skipper – designated-driver programme	Watson & Watson (2014)	Australia (Queensland)	Car crashes	• Increased awareness of the programme, higher use of designated drivers in its first three months but evidence for changes in alcohol-related crashes remained inconclusive.
	Speed camera lottery	Haggarty (2010)	Sweden (Stockholm)	Speeding	• During the experiment, speed traffic experienced a 22% reduction, an average of 25 km/h hour.
	Bucks for buckles	WIBW (2021)	USA (Kansas)	Seatbelt use	• From 77% in 2009 to 85% in 2020.

3 Interviews

Semi-structured interviews were run with representatives from international academic institutes, practitioners with experience in incentives, and New Zealand representatives in this field. The purpose of these interviews was to complement the insights gathered in the literature review and to inform opportunities for the application of incentives to support safer driving in New Zealand. This report recognises that the views of the interviewees do not necessarily align to the published literature. The discussion section considers any contradictory views that were expressed.

A total of 12 potential interviewees were identified, contacted by email and asked to participate in the study. Ten responded positively to our request, of which seven were New Zealand-based government agency representatives/practitioners and three were international representatives (including two academics). The interviews, which lasted between 30 and 60 minutes, were recorded with the consent of the participants.

Our interview technique included semi-structured questions that allowed participants to freely express and further develop their views regarding incentives to safe driving. In doing so, they also had a chance to raise emerging topics. Semi-structured interviews are a valuable and well-established technique in research and evaluation (Adams, 2015). While some questions or a list of topics need to be prepared beforehand, this data collection technique also needs some level of improvisation (Myers & Newman, 2007). Semi-structured interviews are flexible in the sense that 'the interviewee has a great deal of leeway in how to reply' (Bryman, 2008, p. 438). Further, unscripted questions could be asked by the researchers depending on what emerged from the interviewees' previous answers (Patton, 2014).

To safeguard participants' confidentiality, this report replaces all names with codes. Table 3.1 provides a broad description of those who contributed to the project.

Interviewees were asked questions around three key themes:

1. How would you describe incentives in relation to safer driving interventions?
2. What underlying elements do you see as contributing to the success of incentives?
3. What do you see as the main opportunity for incentives for safer driving in New Zealand?

Interviewees were also asked if there was one intervention they were particularly familiar with. The literature review section (chapter 2) captured more in-depth lessons from these interventions and quotes from interviews with case study participants to supplement the published literature (as opposed to here).

Table 3.1 Participant code and knowledge contribution

Participant code	Background
P1	New Zealand practitioner
P2	New Zealand policy
P3	New Zealand policy
P4	UK academic
P5	Australian academic
P6	Australian practitioner
P7	New Zealand policy
P8	New Zealand policy
P9	New Zealand practitioner
P10	New Zealand practitioner

An inductive approach was used for data analysis (Patton, 2014). Adopting an inductive approach meant that patterns, categories and themes were built from the bottom up by organising the data into increasingly abstract units of information (Bryman, 2008). In other words, the themes developed and presented in this section of the report are based on what the data revealed. Interview transcripts were read and analysed several times to identify themes and to refine interpretations. Analysis of the semi-structured interview data started in parallel with data collection.

3.1 How would you describe incentives in relation to safer driving interventions?

Across interviewees there was no consistently agreed definition of incentives. When discussed, there was a tendency to explain incentives in terms of practical examples as a safety point rather than a definition. Some interviewees broadly categorised incentives as government- and industry-led incentives. P4, an overseas academic, noted that incentives for safe driving can involve a range of services, initiatives and practices such as in-vehicle based feedback, apps, advanced driving courses and smiley face speed signs, among others.

Most of the New Zealand-based interviewees related incentives with financial or material rewards, particularly insurance premiums. P7 described incentives as follows:

> *I know some insurance companies have like a telemetric type of app that you can download onto your phone, and it measures your braking and your speed and you might get things like a discount on your premiums, or you might get fuel discounts, that sort of thing. So that's what comes to mind when I think of incentives for the safe driving.* (P7)

Another participant shared a similar description of what an incentive is:

> *One of the insurance companies had an app that you could download that was … tracking how you were driving. And then if you, as you were driving more safely, I guess then your insurance premiums would come down … it's also a form of incentive. That's not a government incentive, but it is a sort of a private sector incentive.* (P8)

However, one participant recognised that financial rewards come at a risk and may detract from intrinsic motivations:

> *Of course, the issue with extrinsic rewards, financial rewards and things like that is people become focused on that as opposed to the behaviour itself.* (P5)

It was clearly recognised that in the workplace environment, incentives were wider than purely financial, and intrinsic incentives around reputation were likely to be more successful.

> *That's an incentive. How I look to the businesses around me is very important, how I look to my customers is very important, how I look to my clients is very important. Then this is what drives safety outcomes.* (P2)

Participants also referenced incentives in the wider context of the penalties programme.

> *How incentives sit within disincentives is important.* (P2)

An interesting observation was provided by P10 about how complex defining incentives can be when differing desired outcomes may underpin them.

> *If you think about incentive, that is a massively broad term, isn't it? Is incentive to avoid non-compliance with the law? Is an incentive to get from A to B safely without harm to yourself and others? Is that the sort of incentive?* (P10)

3.2 What underlying elements do you see as contributing to the success of incentives?

When asked about underlying elements that contribute to the success of incentives, two themes emerged:

1. Multiple incentives working together (layering incentives)
2. Incentives targeted to an individual user's motivations.

When discussing barriers to effectiveness, participants highlighted challenges in implementation of incentive schemes and a lack of evaluation.

3.2.1 Multiple incentives working together

P2 was a strong advocate for layering incentives (ie multiple incentives working compatibly) and the benefits of this approach.

> *The more you layer incentives, you get the message to the people being targeted. This is really important because it's not just one incentive. It's really hard to manage and it's really hard to monitor and it's really hard to evaluate. But it actually is where you get the gold.* (P2)

This interviewee was also an advocate of partnering to achieve a layered incentive approach. They provided an example of layering incentives raised around partnering with parallel safety programmes. In the area of quad bike safety and wearing helmets in the context of farming and agriculture, family reputation (ie being a role model to the family, especially in order to keep their children safe) was identified as a meaningful incentive for safer behaviour. Education in schools around the benefit of helmet use when riding bicycles is an example of leveraging off other safety programmes, including where parents who ride quad bikes would also be motivated to wear helmets to role model good behaviour and reinforce the educational safety programme targeting their children.

P2 also recognised that this partnering approach to make layering incentives more achievable is an opportunity that often is overlooked.

> *You've got to make it really 'tasty'. But to do that, if you're only doing it as one organisation … you increase your cost line so high that you can't do the incentive scheme … If you collaborate with other actors who provide disincentives and incentives for the receiving people, then you layer the incentives in, and this is what people don't do.* (P2)

Other participants concurred that incentives have more potential when complementing each other. An example of multiple incentives working together was provided by P4, who indicated that a driving course will be more effective if the driver also receives in-vehicle based feedback. This interviewee argued that those who attend a driving course tend to forget what was instructed after some time. However, providing the driver with immediate feedback will help them to maintain the good driving behaviour.

> *A training programme is great for a month, two months afterwards, and it tails off over six months, but giving in-vehicle feedback is a way to maintain that high standard, the good behaviours.* (P4)

Similarly, P10 added that multiple incentives may be needed to target different audiences, and context is important.

> *If we think about individuals, they are motivated in different ways by different triggers, by different things that matter to different levels. I don't think it's just a case of coming up with one incentive. I think there needs to be multiple incentives that target different audiences, who will have different senses of social responsibility, who will have different ways in which they assess risk, who will have different ways of assessing the consequence of outcomes. And that may be*

> *demographically driven, or it may be based on personality type or based on social context.* (P10)

3.2.2 Targeted to underlying motivations

Underlying motivations, including competition (through gamification) and a desire to be a safer driver, were presented as leading to successful implementation of incentives. Participants recognised that reach and uptake of an incentive is a key success indicator.

> *An incentive is only as good as how many people use it.* (P2)

Monetary incentives are more effective when they are anchored to something someone cares about. For example, in the Ride Forever programme, where motorcyclists pride themselves on being good riders and where they also know the registration cost is higher for motorcyclists because they have a greater likelihood of crashing, riders feel this extra cost is unfair, as it blanketly affects all of them, even if they are safer riders. Consequently, linking the incentive back to the registration cost, with an earned rebate based on safer rider training, is a key part of what makes this a motivating and effective incentive.

> *During levy consultation, we asked the riding community a question. Do they think motorcyclists should be compensated for looking after their own safety … 96% responded positively. Yes, absolutely.* (P1)

During the interviews, gamification was discussed as an approach to engage people in safe driving and keep them engaged.

> *Gamification is essentially video games, and games are really good at engaging, or some of them that are really well designed. Video games are good at motivating people in terms of intrinsic motivation … Gamification looks at different elements of what makes a video game engaging and tries to apply that to non-game contexts. Essentially it has its roots in motivational psychology, behavioural economics and user experience design.* (P5)

> *The gamification was identified to make it more engaging and keep people using it for longer, and it was also changed to give them more rewards earlier on, which I think was sort of a best practice thing with apps.* (P8)

The importance of gamification in providing immediate feedback to the driver was discussed.

> *And it could also potentially be more effective because you're closing the feedback loop, you're giving people feedback and helping them to change their behaviour in the moment, which I think is one of the biggest benefits of gamification and mobile technology combining with the safer driving space.* (P5)

In addition to its potential to engage people, gamification, according to P5, is worth considering as it can be a more affordable approach to implement:

> *There is a huge opportunity there. You don't have to do things like providing financial rewards because if you're doing digital rewards or digital feedback or some kind of immediate feedback, then it's cheaper.* (P5)

P5 emphasised the importance of motivation for driving safety in gamification.

> *…so if you can get people more intrinsically valuing safer driving as being something that is important to them rather than I want to safely drive because I want to get this reward … you know, internalise it, have it as part of their values, their beliefs that I want to be a safer driver versus I want to be a safer driver because I get these rewards.* (P5)

However, there was also an emphasis on the importance of good design in gamification, which is essential for success.

> *Just like video games, there's good video games, there's bad video games, and so you know, designing an effective gamification experience is very important.* (P5)

3.2.3 Challenges around implementation

During the interviews some participants commented on the challenges for the implementation of incentives aimed at good driving. In this sense, when thinking about a central-government initiative, there are different challenges for an incentive's implementation, according to P7, who is based in New Zealand. These include allocating adequate funding and/or linking the potential incentive with the Ministry of Transport's current work programme so legal and policy resources can be adequately directed.

However, a major challenge is how to involve some hard-to-reach population groups.

> *So, it's designing something and how you get the public to buy it. There would need to be quite a communications package wrapped around it so people actually understand what it would mean for them.* (P7)

Meanwhile, having the willingness to explore the opportunities of different incentives' mechanisms was an aspect mentioned by P5, an Australian. For this interviewee, while financial or material rewards have a place in the incentive space, providing drivers with real-time feedback can also be an effective way to encourage drivers to adjust their driving behaviour as soon as they are notified. In this sense, technology offers a range of options that, in P5's view, need to be further explored.

Another interviewee from Australia, P6, commented that while some incentive-based initiatives can be compelling, they also can pose complex legal challenges. P6 referred to the case of lotteries as a way to encourage driving safely. P6 said that the implementation of a lottery system rewarding good drivers – for instance, with an electronic device or a holiday ticket – was considered at some point. However, determining who enters the lottery and who does not is 'legally quite complicated'.

Meanwhile, P8 commented that New Zealand has a large portion of repeat offenders. For this group of drivers, P8 said:

> *It's more widely accepted that they will end up in court and they'll just be paying off the fine sort of $5 a week. For them financial penalties are not going to really change their behaviour.* (P8)

P8 pointed out that it can be hard to design an incentive-based intervention when this sort of behaviour seems to be ingrained.

> *The New Zealand public see road safety as 'I'm a good driver. I'm the best driver. It's other people making mistakes. I don't make mistakes' until they make a mistake and then you know they're in a crash. It is that mindset that you need to change.* (P8)

Interviewee P2 raised another challenge (also linked to evaluation): proving the value of incentives. The way to prove the investment is to look at each intervention in isolation, but when an incentive by itself is then less effective it can fail to gain the traction required to continue.

> *…then they don't do it. They do a siloed look into each intervention. Then it only has a limited effect because you're not using the system and the catalyst of incentives to really drive their behaviour.* (P2)

Looking at the Australian experience, participant P6 commented that incentives need to be implemented in a more strategic way:

> *We need to decide what's the sort of* [inaudible] *reduction incentives could give us and then start building that into our approach. I think we are still* [inaudible] *a scattergun approach to strategies. We don't have a joined plan at this stage. We're doing lots of actions, but I don't think we've got a strong sense of what needs to be done and when.* (P6)

3.2.4 Challenges with evaluation

A common theme highlighted by the participants was that research and practices regarding incentives lack proper evaluation. P4 commented that while varied types of incentives have been implemented in diverse jurisdictions, there is still a lack of research-based evidence of these interventions' effectiveness. As P4 put it, research and practice have been 'mainly stick rather than carrot'. This participant added that assessing the effectiveness of an incentive-based intervention is currently a challenging task because most of these interventions are applied in isolation without comparison between measures and/or are implemented only for a short term. P4 said that it is even more critical to know what happens once the intervention has stopped, and added that evaluation based on applied behavioural analysis design is scarce in the space of incentives.

Another interviewee, P5, concurred and said that when research evaluation is conducted, this is short term. When looking at the case of gamified interventions, P5 commented that one of the gaps is that evaluation is currently unable to measure any resulting behaviour change because of the short timeframes set.

When reflecting on the New Zealand experience, P7 believed that apart from reliable measures for success there is a need for independent evaluation of incentive-based initiatives. This interviewee highlighted some evaluations conducted in terms of time-discount incentives in recent years.

Another challenge for an incentive-based initiative is the need to consider, and address, any potential contextual issues. P6 mentioned, for instance, New Zealand's driving course system, which in P6's view faces some equity challenges because those who can afford to pay for the course end up getting their licence earlier than those who cannot. For them this means that, as course fees are high, those who pay are afforded other opportunities through social mobility that a full licence provides.

In addition, while driving courses can contribute to safe driving, P6 thinks that a system based on a time discount incentive will not provide the desired outcomes.

> *Any type of course that gives you your licence earlier doesn't actually motivate safe driving. It motivates people who want to get their licence earlier than they should before they're fully developed or they're fully experienced. And so, I believe in the research, I believe the research shows that leads to negative outcomes, which is the person as they [are] getting their licence earlier than they normally would.* (P6)

3.3 What do you see as the main opportunity for incentives for safer driving in New Zealand?

In this section we describe key findings regarding interviewees' personal views of the opportunities and promise of some types of incentives to encourage and support safer driving behaviours in New Zealand.

3.3.1 Driver licensing journey

Some interviewees commented on the licensing journey of novice drivers and provided some ideas for how to better support them.

Reflecting on an international experience, interviewee P4 mentioned the case of advanced driver courses. Their view was that these courses are targeting the wrong audience by focusing on those who are already safer, experienced drivers and are therefore not incentivising a driver behaviour change to safer driving.

> *Those who will do an advanced driving course, they are probably those who are good drivers anyway. They just want to kind of get a little bit better ... or learn how to save a bit of fuel or to reduce the insurance premiums … or sometimes like to be able to drive faster but safer.* (P4)

Other interviewees concurred that licensing incentives play a positive role in safe driving but highlighted that they should target young novice drivers. However, these interviewees also pointed out that the focus should be on safer driving outcomes as opposed to a shorter licence journey.

There was a belief that incentives around licensing should support a new driver through 'the whole licensing journey' (as opposed to incentivising a component of it like entry into the Learners phase). This would mean entry incentives and retention incentives. Another aspect was that the incentives should focus on safe driving outcomes and building a:

> *…safer driving community because they're actually getting safe driving process in play from start to finish.* (P1)

The example given was improving incentives around existing safety-led driver programmes (such as Drive).

> *…you send them through something that we already know works, which is the Drive programme. So you can see that has safety benefits mapped all the way through it … where they get the right information, the right knowledge.* (P1)

3.3.2 Supporting safe speeds

P3 provided insights into the approach to tackling unsafe speeds in Road to Zero, and the potential for incentives to be applied to certain aspects of those initiatives, including:

1. the use of technology-based incentives (in-vehicle and environmental) to support compliance with posted speed limits
2. potential application of nudging to the process of paying, or being reminded to pay, an infringement and in doing so making it easier to comply
3. the use of incentive-based penalties to support the current penalties regime, such as the good behaviour bond as used in New South Wales, Australia.

> *We talk about being firm and fair. We need to improve our deterrence and enforcement, but we are a responsive regulator … Responsive to the reasons for people's behaviour.* (P3)

3.3.3 Collective impact approach (workplaces)

P2 highlighted the benefits of a collective impact approach, with the public and private sectors working together. A collective impact approach can bring together businesses, researchers and government in an industry-led collaborative network, where individual agencies may have differing objectives, but they have an agreed shared vision. P2 referred to work at Stanford University on the need for collective impact (Kania & Kramer, 2011):

> *Large-scale social change requires broad cross-sector coordination, yet the social sector remains focused on the isolated intervention of individual organisations.* (P2)

This also covers the five elements of collective success (Kania & Kramer, 2011):

1. a common agenda or vision
2. shared measurement systems
3. continuous communication
4. mutually reinforcing activities (each participant undertaking activities it is good at in a way that supports and is coordinated with others)

5. a backbone support organisation (ie a separate organisation to cover the time commitment and skillset required).

P2 also referred to the NRSPP in Australia as an example of this working effectively in work-related road safety (see section 2.3.4.4), where the vision of the programme was:

> *All businesses and organisations striving to eliminate serious injury and death from work-related vehicle crashes.* (NRSPP, 2022)

This provided a platform where organisational safety culture improvements were recognised (reputational benefit) and rewarded.

4 Discussion

4.1 Opportunities for incentivising safer driving for New Zealand

Overall, New Zealand lacks research-based evidence of incentive approaches to safer driving. Like most of the world, New Zealand seems to have implemented incentive-based practices to encourage safer driving with isolated or limited evaluation. Two areas of focus for incentives appear to be:

1. education space for higher risk road users (eg Ride Forever, Drive)
2. incentives that support in-vehicle fleet monitoring for workplaces (eg EROAD).

Following the international trend, the insurance industry in New Zealand seems to be applying sustainable policies to incentivise their customers, so this is another area of opportunity to explore further.

Based on the literature review and in-depth interviews, several areas were consistently identified as opportunities and challenges for safer driver behaviour incentives in New Zealand. The consistent opportunities showed three potential areas for the use of incentives:

1. Encourage safer speed choices for everyone.
2. Encourage safer driver behaviour targeted at young and novice drivers.
3. Encourage safer work-related driver culture and behaviours.

If we consider our drivers across younger, middle and older age groups (see Figure 4.1), we find that the majority of the theoretical evidence (Shope, 2006; Simons-Morton et al., 2012) and many of the trials of incentives are focused on the younger age group (eg Farah et al., 2013; Farmer et al., 2010; Musicant & Lampel, 2010). Within the middle age group, breaking this out into sub-groups, the work-based initiatives had the largest reach and the next best supporting evidence (Bie et al., 2010; NRSPP, 2017).

Figure 4.1 Example target groups, with work-related drivers and young drivers providing the best evidence of incentive effectiveness

4.1.1 Young and novice drivers

Studies of young drivers' psychology show they are more susceptible to external influences, including peer and parental pressure (Shope, 2006; Simons-Morton et al., 2012) – this makes them very open to intrinsic incentives. Further, there is evidence that they are encouraged towards safer driver behaviour by in-vehicle feedback and monetary reward, as well as the additional benefit of parental monitoring and feedback (Farmer et al., 2010). Utilising extrinsic (monetary) rewards with intrinsic layering also seems to work

successfully in other interventions, including education interventions. However, the incentives already embedded in the existing younger driver education programmes in New Zealand (eg Drive) remain unevaluated.

If the Drive programme (or other equivalent programmes) did demonstrate safer driver behaviour, this would be a practical place to build on, enabling incentives for young and novice drivers (following the successful elements and principles around incentive design captured in this report). More specifically, the programme could consider capturing lessons from Ride Forever, an evaluated New Zealand-based education programme that has demonstrated safer road user behaviours and utilises layered incentives (ACC, 2022a; see section 2.3.5.1 for details).

4.1.2 Workplaces

> *All businesses and organisations striving to eliminate serious injury and death from work-related vehicle crashes.* – vision of the NRSPP (2022)

There is a major opportunity with work-related incentives to take a collective impact approach, with public and private cross-sector collaboration, and following the principles of collective success (Kania & Kramer, 2011). The NRSPP in Australia is a model example of this working effectively in work-related road safety, including one of the best workplace incentive case study resources (NRSPP, 2017). The NRSPP shows reliable tools that combine in-vehicle technology with extrinsic and intrinsic incentives (combined with penalties) in the workplace to achieve safer driving programmes that have longevity (see sections 2.3.4.4 and 3.3.3).

The Road to Zero action plan already acknowledges the benefit of providing incentives for workplaces to install in-vehicle systems, focused on the outcome of sharing of regulatory data (Ministry of Transport, 2019a). The NRSPP approach builds on this intent, with the opportunity to extend this into a wider range of workplaces and supporting the regulatory tools with a broader range of incentive-based ones.

4.1.3 Target groups with less evidence

Target groups identified where there may be opportunities to look at incentives further, but where there was limited evidence, were:

- **designated drivers –** incentives to acknowledge and encourage sober driver activities or programmes (eg Skipper; Watson & Watson, 2014; see section 2.3.4.5)
- **reoffenders –** incentives to support existing reoffender programmes (eg the One for the Road Driver Intervention Programme), which was suggested by one interviewee (see section 3.3.2); incentives here could consider the reoffender but also consider the friends and whānau supporting the reoffender
- **older drivers –** where incentives could help self-regulate driving, support drivers to continue driving safely, and support existing older driver programmes (eg the Senior Driver Coaching Session; New Zealand Automobile Association, n.d.).

Korner-Bitensky et al. (2009) also identified an opportunity to improve safer driver behaviour in relation to older driver safety programmes; in particular, those that have combined either (a) educational and on-road components, or (b) educational components and physical training targeted to flexibility, coordination and speed of movement.

> *It is time for a strategic public and private sector collaboration that supports older driver safety programs. The implicated stakeholders, including the general public, older citizens, the health care system, legislators, and insurance companies amongst others, working together, can build a comprehensive plan that has both behavioral and monetary incentives encouraging*

participation in programs aimed at keeping older drivers safe. (Korner-Bitensky et al., 2009, p. 110)

4.2 Challenges around incentives

When justifying the value of incentives, a consistent challenge was the difficulty with evaluation. When isolated interventions were evaluated, it was difficult to show their value, as they were typically less effective, whereas within the more mature incentive programmes that did show success, these typically used layered incentives or multiple incentives working together to drive safer behaviours. But within this grouping or system of incentives it was then difficult to identify the isolated benefit of each incentive. Arguably, taking a longer-term additive evaluation approach, where one incentive is added and evaluated before another is added, is one way to mitigate this challenge.

Another challenge was the lack of a consistent understanding of incentives. Interviewees talked about different things when discussing incentives based on their own experiences. This means it will be challenging to implement incentives; for example, in a policy environment. In this sense, the limited understanding of how incentives are defined and the wider range of incentive tools available (eg beyond rewards) can lead to a narrow focus.

4.3 Principle-based approach to successful incentives

Overall, the design of incentive programmes appears to benefit from careful layering of multiple incentives that complement each other. A lot of the effective incentives in the literature can be attributed to key underlying principles and ensuring the incentive considers the underlying motivations of the target audience. The factors in Table 4.1 should be considered when reviewing the implementation of any incentive scheme.

Table 4.1 Factors that can influence incentive effectiveness

Factors	Incentive effectiveness
Immediacy	An immediate incentive has greater success than a delayed one (Myerson et al., 2011).
Likelihood	Greater likelihood to receive an incentive increases success (long-term effect) (Elias, 2021).
Intrinsic incentives	Intrinsic incentives may be better for sustained safer driving. For example, in relation to extrinsic incentives offered, especially monetary, it is argued that these may discourage the intrinsic motivation or self-reflection that is needed to sustain behaviour change (Kavanagh et al., 2011).
Behaviour complexity	Incentivising behaviours that require a simple or single point of action – for instance, seatbelt use (Kavanagh et al., 2011) – have had more consistent success than behaviours that require ongoing vigilance such as speed, or major changes in travel behaviour; for example, avoidance of driving in the dark (Greaves et al., 2013).
Size	There are interaction effects with the size of incentives. For example, small, highly likely incentives are more effective when compared with larger, less likely incentives (Elias, 2021).
Homogenous population	Aiming incentives at a similar group, especially a school group, works better than aiming them at a broader or less targeted community.

4.4 Key findings from the different incentive types

A brief summary of findings from the four types of incentive investigated is outlined below (see also section 2.3.6).

4.4.1 Reward schemes

Small or low-value rewards that are more obtainable were aligned with safer driving, as opposed to large but rarely obtained financial rewards (Elias, 2021). However, the size of the reward may have an impact on initial entry into the incentive scheme (Greaves & Fifer, 2011).

Studies used different measures, but the most common were:

- VKT reduction
- night-time driving
- speeding tailgating
- braking and swerving.

Of these measures, speed (especially relative speed) appeared to have the best evidence around incentive effectiveness, with the driver having a strong ability to control speed (sensitivity to incentive-based feedback) and had a strong association with driver safety (Handel et al., 2014).

Most studies on financial rewards were experimental, with limitations for longer-term implementation. However, the exception was insurance-based rewards; in particular, PHYD, which was an effective incentive to reduce speeding.

4.4.2 Vehicle- and technology-based feedback

Immediate in-vehicle feedback is effective, and certain target groups (especially younger drivers and workers) have been shown to gain complementary benefit from authority-figure feedback – whether this is a parent or manager (Musicant & Lampel, 2010). There is limited evidence on gamification for safer driving behaviours at an individual level, possibly due to the emerging nature of this area of research. However, gamification at a fleet level can be effective when managed by organisations (based on EROAD's case studies).

While many published studies required installing a dedicated technology solution in a vehicle, with the move towards connected vehicles where a wealth of data is collected from the driver, future vehicle monitoring technology is likely to be in-built removing the need for a separation installation, as is the case with the Tesla safe driver feedback (see 2.3.2.3) providing additional opportunities for monitoring of in-vehicle feedback.

4.4.3 Environmental feedback on speed

Overall, there was evidence that imagery and positive/negative text were more effective in lowering speed than displaying current vehicle speed (ie the positive intrinsic incentives are better than the 'slow down' messages). To apply these robustly in a New Zealand context these would have to be officially trialled and evaluated to justify their use and ensure there are no unintended consequences (NZ Transport Agency, 2011). In relation to any guidance for their use by transport authorities, they were found to be most effective for point locations (not over distance) where there were other visible cues that supported slower speed (eg school zone, residential, crossings).

4.4.4 Policy

Different policy-based approaches have been implemented – for example, financial discount for licensing, time discount, lottery, designated driver and workplace recognition. Largely, these initiatives focus on younger drivers; however, independent evaluation of these policy initiatives is scarce. If New Zealand is going to enable more incentives, the incentives will need independent evaluation, including a better understanding and evaluation of existing incentive-based programmes.

4.5 Limitations

Despite the extensive reporting of incentive initiatives, including policy interventions across different jurisdictions, there is a lack of their reported evaluation. Key reasons for this are:

- incentives are often embedded as a small component of a larger programme, including long-term education campaigns
- where incentives are examined in isolation, they are often only run over short-term trials that are not funded beyond trial phase (even when successful).

There are also elements that can influence the quality of the evaluations that were available, which include the following.

- **Independence of evaluation:** Often the source is the company or agency running the trial (as opposed to an independent third party).
- **Participant selection bias:** Due to the voluntary nature of some incentive programmes, drivers who currently drive in a safe manner and those who do not mind altering their behaviour may be more likely to opt in. People who display the most unsafe behaviour may be less likely to participate in an incentive approach because their behaviour is motivated through other means (eg as thrill-seeking or timesaving). This means that their behaviour is least likely to be changed through the suggested rewards-based systems.
- **Safety metrics used by vehicle and technology-based feedback:** The use of vehicle telematic data needs to be used with caution, unless there is evidence that it relates back to crash risk. For example, defining accurate thresholds at which excessive braking or swerving links to crash risk (Khorram et al., 2020).

This report attempts to mitigate some of these limitations by focusing on recommendations where the literature was consistent, and interviewees provided feedback.

4.6 Recommendations for the applicability of incentives to the New Zealand road safety context

Below are recommendations for Waka Kotahi's consideration for enabling incentives to support the existing penalty system. These align with three of the Road to Zero focus areas, followed by general recommendations to support successful safer driving interventions.

Incentives aimed at young/novice drivers (Road to Zero: Enabling safer driver behaviours and choices)

1. Consider developing a suite of initiatives that incentivise safer driving behaviours in younger drivers, including:
    a. in-vehicle technology for immediate and ongoing feedback that rewards young drivers
    b. parental feedback of safer driver behaviours (safe and unsafe behaviours)
    c. financial incentives (eg insurance or registration discount) earned based on evidence of safer driving indicators (ie safer speeds, no traffic offences, no crashes)
    d. gamification (eg gaining awards and points for driving safely, achieving recognition of safer driving skills or levels, sharing with influential peer groups).
2. Explore opportunities for incentives that increase participation and engagement with existing driver safety education programmes for novice drivers (eg the Drive programme).

   a. Capture and apply lessons from mature, successful incentive-based safety education programmes (eg Ride Forever), including financial discounts earned based on completion of education levels.
3. Partner with insurance companies to introduce incentives related to evidence of safer driving in young and novice drivers, including the use of:
   a. safety-led education and training (ie following the model offered by the Ride Forever programme)
   b. in-vehicle objective evidence of safer driving behaviour (ie using a pay-how-you-drive model).

Workplace-based incentives (Road to Zero: Work-related road safety)

4. Create a public–private governance group with a shared vision of the benefits of work-related driver safety, building on lessons from mature, successful models (eg the National Road Safety Partnership Program (NRSPP) in Australia). This group would enable the benefits of evidence-based workplace incentives, including:
   a. prestigious workplace fleet-recognition awards, which require sharing of evidence and data based on indicators of holistic fleet safety best practice (including attitudes and culture, speeding events, and insurance claim data)
   b. financial (or extrinsic) rewards that focus on small, achievable, frequent rewards.

   This group could also:
   a. encourage trials of fleet and office (ie group-based) and individual driver gamification to reduce speeding events and promote safer journeys (eg safer route selection, or breaking up journeys to limit fatigue)
   b. acknowledge and promote knowledge-sharing of incentive-based case studies and what works and what does not.

Infrastructure-based incentives (Road to Zero: Infrastructure improvements and speed management)

5. Trial incentive-based environmental feedback in the form of dynamic speed messaging signs in specific locations (eg schools and pedestrian crossings) to inform guidance on options that might improve road safety.

General recommendations to consider supporting safer driving incentive success

6. Review central funding around safer driving interventions to enable safer road user behaviours and choices to include funding for evidence-based incentives.
7. Monitor the effectiveness of existing initiatives to inform the incentive space in New Zealand (including the Drive programme).
8. Socialise and use a clear definition of incentives to overcome the limited understanding around how incentives are defined and the wider range of incentive tools available (ie beyond rewards).
9. Develop a process and framework to review the design of any safer driver incentive programme to ensure it follows best practice and is evidence-based, including:
   a. ensuring any incentive is directly linked to safer driver behaviours and not eroded by other competing motivations (eg the use of time discounts to enable earlier access to employment)
   b. use of multiple incentives, including complementary extrinsic and intrinsic incentives.
10. Financial (or extrinsic) rewards should focus on small, achievable, frequent rewards.
11. Consider further investigation into incentives for safe operation at an institutional level.

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