Guide to Road Safety Part 4

Safe People

Austroads

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Austroads

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Guide to Road Safety Part 4: Safe People

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Abstract

Guide to Road Safety Part 4: Safe People considers the human factors and behavioural considerations that impact safety outcomes on the road network.

This updated edition compiles existing information on Safer People from the previous Austroads *Guide to Road Safety* parts and presents it in a logical restructure.

The Guide presents information on groups of individuals that are at increased risk of injury on the road network. Known categories of road user errors are also presented. Components of the information processing procedure are discussed.

The Guide is intended for road safety practitioners, as well as educators and interested members of public who can benefit from the information presented on road safety demographics, processes, and behaviours. It is designed to cater for a wide audience by providing discussions on topics that may be implemented or incorporated beneficially using a variety of activities.

Keywords

road safety, safe system, safer people

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Austroads

About Austroads

Austroads is the peak organisation of Australasian road transport and traffic agencies.

Austroads' purpose is to support our member organisations to deliver an improved Australasian road transport network. To succeed in this task, we undertake leading-edge road and transport research which underpins our input to policy development and published guidance on the design, construction and management of the road network and its associated infrastructure.

Austroads provides a collective approach that delivers value for money, encourages shared knowledge and drives consistency for road users.

Austroads is governed by a Board consisting of senior executive representatives from each of its eleven member organisations:

- Transport for NSW
- Department of Transport Victoria
- Queensland Department of Transport and Main Roads
- Main Roads Western Australia
- Department for Infrastructure and Transport South Australia
- Department of State Growth Tasmania
- Department of Infrastructure, Planning and Logistics Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- Department of Infrastructure, Transport, Regional Development and Communications
- Australian Local Government Association
- New Zealand Transport Agency.

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Tables

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1. Introduction

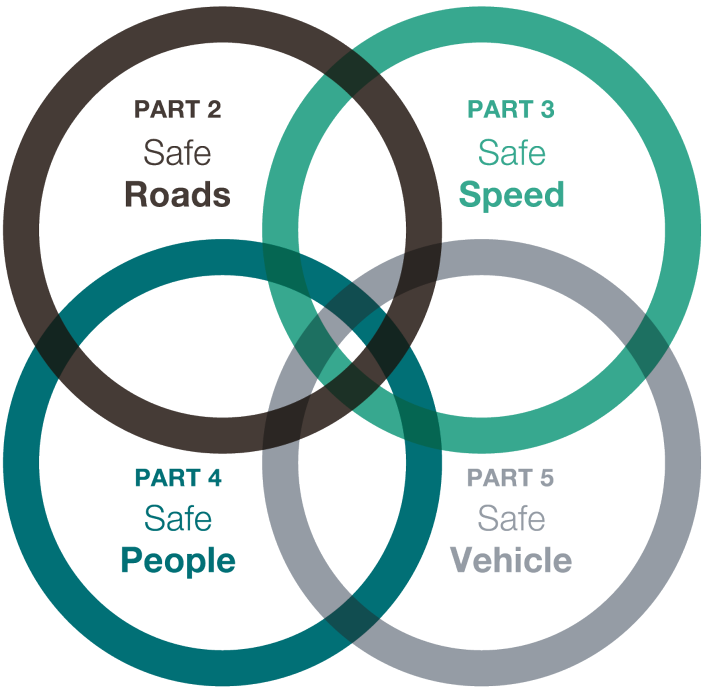
This *Guide to Road Safety* has been structured to reflect the Safe System, which has been adopted by Australia and New Zealand as part of their overall road safety strategy. The Guide consists of the parts as documented in Table 1.1.

Table 1.1: Parts of the Guide to Road Safety

Part	Title	Content
Part 1	Introduction and the Safe System	An overview of the *Guide to Road Safety* and the Safe System philosophy.
Part 2	Safe Roads	Guidance on safe road design.
Part 3	Safe Speed	Guidance on the application of safe speeds.
Part 4	**Safe People**	**Information on safe people and communities.**
Part 5	Safe Vehicles	Information on safe vehicles and vehicle safety features.
Part 6	Managing Road Safety Audits	Guidance on the procurement, management and conduct of road safety audits.
Part 6A	Road Safety Auditing	Guides practitioners through the practical implementation of road safety audits. (Part 6 and 6A will be consolidated)
Part 7	Road Safety Strategy and Management	Guidance on road safety strategies and road safety management.

The four pillars of the Safe System are reflected in this Guide through the aforementioned structure and also through the contents of the Guide. It is noted that each pillar does not stand on its own but, rather, interlink with other pillars to form the Safe System (Figure 1.1). As such, readers of this Guide are encouraged to refer to multiple pillars when reading this Guide, even though this AGRS Part focusses on Safe People (Figure 1.2).

Figure 1.1: AGRS Part 2 to Part 5 interlink with each other

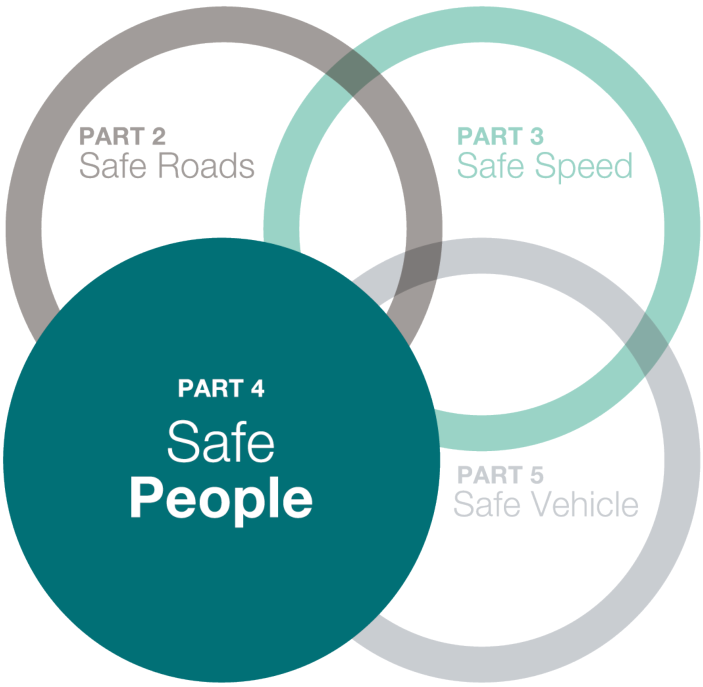


1.1 Purpose of the Guide

The *Guide to Road Safety*, in association with other key Austroads publications, provides road safety practitioners with knowledge and techniques that enable the application of Safe System principles.

Part 4 considers the human factors and behavioural considerations that impact safety outcomes on the road network. Section 2 presents information on groups of individuals that are at increased risk of injury on the road network. Section 3 examines components of the information processing sequence that may impact road user behaviour. Section 4 summarises types of road user errors that increase the risk of crashing and the risk of injury in the event of a crash. Section 5 presents information on unlicensed drivers, and notes other factors that may lead to insufficiently educated road users. Section 6 will be further developed in the future to provide information about the types of facility misuse and their impacts on crash risk. Section 7 presents information about the impact of alcohol and illicit drugs on crash risk. Section 8 discusses the use of restraints in vehicles. Section 9 considers the issue of distraction. Section 10 lists the skills required to drive a vehicle. Section 11 considers the issue of fatigue. Section 12 reviews the human factors that may impact post-crash emergency response.

Figure 1.2: AGRS Part 4: Safe People



2. High Risk Road User Demographics

The risk levels of road users vary between individuals. Risk profiles across populations demonstrate that different road user groups are also subject to different levels of risk. These may occur for a large variety of reasons such as the difference in fragility between a healthy adult and an elderly road user, or the difference in experience between a resident and an international visitor.

The road user groups noted in the subsections below have been identified through statistical analysis to be involved in crashes at a disproportionately high rate. It does not specifically note the most vulnerable users on the road network (pedestrians, cyclists, and motorcyclists), although there is significant overlap. Vulnerable road user groups are those that are disproportionately prone to high-severity crashes given that a crash occurs, whereas high-risk road user groups may result from disproportionate representation in crash likelihood and/or severity.

A number of issues discussed below are specific to regional and remote areas. Where relevant, this has been specifically mentioned.

2.1. Youth

Youth are over-represented in road crashes in Australia. During 1996, young people (aged 17-25 years) were involved in 41% of fatal crashes and 37% of hospitalisation crashes in Australia. In 1997 youth were involved in a total of 8513 fatal and hospitalisation crashes (Austroads 2000).

Males comprised 77% of all youth fatalities. The average proportion of male youths (of all youth) hospitalised annually was 65% between 1993-1997. This proportion is less than the male proportion of youth fatalities. The number of youths who are hospitalised is greatest for youths aged 18-21 years.

Improvements in driver education, training and licensing have been identified as countermeasure to youth involvement in crashes. Although these countermeasures target a broader group of road users, they are used disproportionately by youth (Austroads 2000).

2.2. Older Road Users

Australia and New Zealand are experiencing aging populations. By 2031, the proportion of people aged 65 and older is expected to represent nearly 20% of the total population, compared to 14% in 2012 (Austroads 2016b). Along with an older population is an increase in the number and participation of older road users on our road network. A recent report by (Austroads 2016b) looked into the question of whether the increasing numbers of older road users pose an increased safety risk to either themselves or others and what can be done to reduce the safety risk to this demographic (Austroads 2018).

As older road users become more dependent on their vehicles as a primary mode of travel and to make more frequent and longer trips, there will be an increase in exposure to older drivers. A review of literature found that older drivers have a higher rate of crashes per distance driven, however this may be the effect of low mileage bias, cohort effects and physical fragility. Impairments to their health and cognitive and functional abilities may also increase the crash risk of older drivers. A review of crash data from Australia and New Zealand showed that road users aged 60 and above represented a growing part of the road trauma problem, when compared to those under the age of 60. The proportion of injured road users aged 60 to 74 increased from 7.6% in 2003 to 10.4% in 2012, with the proportion for those aged 75 and over increasing from 3% to 4%. Despite this, in the same time frame every age group has seen and decline in the rate of crashes per head of population and the increasing proportion of injured older road users is likely a function of a greater crash rate reduction for the group of road users aged below 60, rather than increasing numbers of injured older road users (Austroads 2018).

Austroads (2016b) suggested that the increased crash risk among older drivers could result in increased crash numbers as the population of older drivers increases. The increased fragility of older drivers compared to younger age groups also means that they are more likely to be seriously or fatally injured in the advent of a crash, meaning there is a risk that serious and fatal injury numbers may increase with an increase in the number of older drivers. Despite these issues, there is growing recognition that the mobility associated with driving is important for the health and wellbeing of an older population. As such, it was suggested that it is important for older people to continue to drive for as long as it remains reasonable for them to do so (Austroads 2018).

However, as it becomes unreasonable for older people to drive, they may choose to use alternative modes of travel, including those classified as vulnerable road user modes. Vulnerable road users are already at a higher risk of serious injury and fatality in the advent of a crash. Combining this with an increase in the fragility of older people, it means that older road users may be at in increased risk when selecting these alternative modes of travel. Austroads (2016b) found that between 2003 and 2012 in Australia and New Zealand, there was a greater proportional involvement of road users aged 75 and over being involved in crashes as pedestrians than for other age groups. However, they were also less likely to be involved as bicyclists or motorcyclists. An analysis of the in-depth crash investigation program run by the Centre for Automotive Safety Research (CASR) also showed that older pedestrians chiefly contributed to their involvement in crashes with vehicles through no or insufficient observation of traffic before crossing the road. This is in contrast to younger pedestrians, where erratic behaviours due to intoxication, cognitive impairment or a child running onto the road were key factor (Austroads 2018).

2.3. Motorcyclists

Over the previous ten years, motorcycle riding has grown in popularity which has subsequently resulted in significantly increased exposure for this road user group. Despite the growth of motorcycle ownership and riding during the past decade, there has been improvement in national trends in motorcyclist fatality rates per registered vehicle and per kilometre travelled. However, the number of deaths of motorcycle riders in Australia is similar to that of 10 years ago (BITRE 2017). There appears to have been a shift in the proportion of fatal crashes involving motorcyclists from urban areas to regional and remote areas. For instance, 59% of crashes involving a motorcyclist fatality occurred in regional and remote Australia during the four-year period 2012-2015, which is an increase from 53% for the period 2008-2011 (BITRE 2017). National data from Australia indicated that, while motorcyclist deaths decreased in major cities, they increased in regional and remote areas in 2016 compared to the baseline period, 2008-2010 (Table 2.3: Austroads 2019b). The largest increase in motorcyclist deaths was observed in remote Australia where there was a 49.3% increase in 2016 compared to the baseline period, 2008-2010.

The typical motorcycle fatality or hospitalisation in regional and remote areas is a male motorcyclist who is riding recreationally during daylight hours on the weekend and is involved in a single-vehicle crash (Australasian College of Road Safety 2012; BITRE 2017; Johnston, Brooks & Savage 2008; Motorcycle Safety Review Group 2015; Parliament of Victoria 2012).

2.4. Rural Residents

Contrary to commonly held beliefs among residents in regional and remote areas, it is local residents who are involved in the majority of crashes in regional and remote areas. Sticher and Sheehan (2006) conducted a focus group study to look at risk factors for regional and remote crashes and compared the opinions of their participants with 290 control drivers and the findings from a study of 143 patients hospitalised following a road crash in Far North Queensland. They found that, contrary to the opinions of the focus group members, most crashes involved local residents as opposed to visitors from within Queensland or Australia. In fact, 60% of crashes involved drivers also from Far North Queensland, 19% from Cairns, 9% from other areas of Queensland and 6% from other states (place of residence was missing in 6% of cases). In addition, a recent media campaign ‘Saving Lives on Country Roads’ by Transport for NSW states that more than 70% of fatal crashes on country roads involve country residents (New South Wales Centre for Road Safety 2018).

2.5. International Drivers

One of the most comprehensive review of crashes involving international drivers remains that of Watson et al. (2004), which showed that the proportion of international driver crashes occurring in regional and remote areas was higher than in the metropolitan area. This is supported by the finding of a more recent study conducted by RACV (Catchpole et al 2014). Overall, international visitors represented a small proportion (0.7%) of fatal and serious injuries in Australia, apart from the Northern Territory where they represented over 13% of fatalities and 8% of serious injuries. Factors that may increase the risk of crashing for those unfamiliar with Australian regional and remote roads include travelling long distances and fatigue; sub-optimal road conditions, particularly with regard to unsealed roads; the need for a four wheel drive vehicle with which they may also be unfamiliar; and left-hand side driving and disorientation (Dempsey 2016). There are also anecdotal reports of road safety issues concerning interactions between international and interstate drivers towing caravans, and heavy vehicle drivers. Drivers towing caravans may not be accustomed to overtaking large road trains (double, triple, and quads) or understand the time and distance required for such a manoeuvre.

2.6. Aboriginal People

Aboriginal people are a special consideration especially in relation to regional and remote road safety and, while they face the same issues as all other regional and remote residents, there are a number of issues of particular concern for this population (Thomson, Krom & Ride 2009).

Henley and Harrison's (2013) analyses of road injury rates in Australia by remoteness and indigenous status indicate that both fatal and serious injury rates increase with remoteness for both Aboriginal and non-Aboriginal populations (see Table 2.1). The rate of fatal land transport injuries is significantly higher in the outer regional, remote and very remote Aboriginal population than in the non-Aboriginal population. However, rates of serious land transport injury are significantly lower in the Aboriginal population in regional and very remote areas. A similar lower (but non-significant) rate of serious land transport injury exists among the Aboriginal population in remote areas. The latter findings may due to the lower rates of non-traffic land transport injuries in the regional and remote Aboriginal population compared to the non-Aboriginal population (Henley & Harrison 2013). Further research is required to disentangle this relationship.

Differing patterns in road use by Aboriginal people are partially a result of low socioeconomic status, which impacts upon the ability to gain a driving licence, to drive legally and safely, and to access and maintain safe vehicles. Aboriginal people often travel large distances to attend cultural events with family members (Helps & Moller 2007; Watson et al. 1997). Travel commitments, combined with the regional and remote residence of a large proportion of Aboriginal people, result in travelling greater distances on roads with higher speed limits that are not as well maintained, and in cars that may be overcrowded, lacking modern safety features as well as being poorly maintained (Thomson, Krom & Ride 2009).

A recent report by Austroads on Aboriginal driver licensing programs highlighted the high level of transport disadvantage in Indigenous people occurring as a result of socio-economic, geographic and historical factors (Austroads 2019a). Transport disadvantage perpetuates disadvantage by resulting in reduced access to education, training, employment and services. Barriers to obtaining a driving licence are also documented in this report.

Table 2.1: Age-standardised fatal and serious land transport injury rates by remoteness area of usual residence and Indigenous status, 2005-06 to 2009-10

ASGC remoteness area of usual residence	Age-standardised rate[a] (95% CI)					
	Indigenous Australians			Other Australians		
	Males	Females	Persons	Males	Females	Persons
Fatal Injury						
Major cities	13 (10-17)	7 (5-10)	10 (8-12)	9 (9-10)	3 (3-3)	6 (6-6)
Inner regional	21 (16-28)	11 (8-16)	16 (13-20)	20 (19-21)	7 (7-8)	14 (13-14)
Outer regional	33 (27-41)	12 (9-17)	22 (19-26)	24 (23-25)	8 (7-9)	16 (15-17)
Remote	63 (51-79)	37 (28-50)	50 (42-60)	32 (28-37)	11 (8-14)	22 (20-25)
Very remote	67 (56-79)	31 (24-40)	48 (42-56)	33 (27-41)	14 (9-20)	25 (20-30)
Overall[b]	**27 (23-31)**	**13 (10-15)**	**20 (18-22)**	**11 (10-11)**	**4 (3-4)**	**7 (7-7)**
Serious Injury						
Major cities	289 (270-308)	146 (133-160)	216 (205-228)	266 (265-268)	124 (123-126)	196 (195-197)
Inner regional	395 (368-421)	180 (161-199)	288 (272-305)	450 (445-454)	192 (189-195)	322 (320-325)
Outer regional	452 (424-480)	192 (175-210)	320 (304-336)	536 (529-543)	220 (215-224)	383 (379-387)
Remote	613 (562-664)	300 (268-333)	453 (424-483)	697 (677-717)	270 (256-283)	496 (483-508)
Very remote	586 (548-623)	283 (258-308)	432 (409-454)	857 (816-897)	436 (404-468)	667 (641-694)
Overall[b]	**425 (412-438)**	**200 (191-208)**	**311 (303-318)**	**331 (329-332)**	**148 (147-149)**	**240 (239-241)**

a) *Per 100 000 population per year, adjusted by direct standardisation to the Australian population in June 2001*
b) *All remoteness areas are combined. Age standardised; not standardised for remoteness*

Note: The geographic scope of this table is the Northern Territory and all Australian states except Tasmania

Source: Henley and Harrison (2013)

2.7. Heavy Vehicle Drivers

While heavy vehicles may be prevalent in regional and remote areas, they tend to be under-represented in crashes when considering vehicle kilometres travelled (VKT) in comparison to heavy vehicle crashes in urban areas. Table 2.2 shows that the fatal crash rate per 100 million VKT is slightly lower outside of greater capital cities for heavy rigid truck crashes and much lower for articulated truck crashes whereas the passenger car fatal crash rate is higher (BITRE 2016).

Table 2.2: Fatal crashes, VKT and rates of fatal crashes per 100 million VKT, 2014

Vehicle	Greater Capital City			Rest of State		
	10^8 VKT	Fatal crashes	Rate per 10^8 VKT	10^8 VKT	Fatal crashes	Rate per 10^8 VKT
Heavy rigid truck-involved	5.0	40	0.8	4.9	35	0.7
Articulated truck-involved	1.5	23	1.6	6.4	78	1.2
Passenger car-involved	104.6	274	0.3	67.9	408	0.6

Source: Table 17 in BITRE (2016)

A study of heavy vehicle crashes in Western Australia during 2001-2013 by Zhang et al. (2014) showed fewer crashes of articulated heavy vehicles occurring in regional and remote WA compared to metropolitan WA. Around 68% of fatal crashes and 58% of crashes requiring hospitalisation occurred in regional and remote areas compared to around 35% of property damage and 38% of medical attention (not hospital) crashes.

As evident in Table 2.2, the crash rates for heavy vehicles remains higher than the crash rates for passenger vehicles.

3. Information Processing

Road users need to be able to receive information in a way that they are able to receive, interpret and act on it in a timely manner. These inputs can come from explicit information such as signage and line marking or may be implicit in the road design such as lane widths, kerbside parking, and land use. This section discusses components of the information processing sequence that may impact road user behaviour by effectively communicating (or failing to effectively communicate) the desirable behaviours.

3.1. Receiving Information

Drivers develop a set of expectations that allow them to anticipate events. There are three types of driver expectancy (Naatanen & Summala 1976):

- **Continuation expectancy** – the events of the immediate past will continue, e.g. the straight road will continue straight; the car in front will continue at its previous speed.
- **Event expectancy** – events which have not happened will not happen, e.g. A driver may feel that a pedestrian will not be crossing at a given crossing location as they have not seen any pedestrians there in prior experiences.
- **Temporal expectancy** – where events are cyclic (e.g. at traffic signals) the longer a given state occurs, the greater the likelihood that change will occur, e.g. drivers may speed up to avoid an anticipated red signal.

When information is provided in a consistent manner, driver expectation enhances performance. However, where the information is inconsistent with driver expectations, driver error and resultant crashes are more likely.

The term ‘reaction time’ is used to describe the period between the occurrence or appearance of a ‘signal’ (usually a visual stimulus) and the driver’s physical reaction to it. As discussed above, expectancies reduce reaction times because drivers respond through familiarity and habit.

3.1.1. Implicit information – self-explaining roads

The self-explaining roads concept is based on the driver’s perception of the road to influence their behaviour (Austroads 2015).

By having a consistent application of standards, drivers respond and modify their behaviour to align with their perception of the road environment, which results in speed choices consistent with the safe speed for that function and design (Austroads 2015).

Recognition of the current road function, and to predict road elements, requires the following three features (Austroads 2015):

- clear design, marking and signing
- recognisable road categories
- design elements for each road category that are uniform.

Table 3.1 lists a number of road features that influence driver behaviour implicitly to encourage high or low speed choices (Austroads 2018).

Table 3.1: Road Infrastructure elements and their influence on speed

Road Elements	Accelerators (intuitively elicit a high speed)	Decelerators (intuitively elicit a lower speed)
Tangents	Long tangents	Short tangents
Physical speed limiters	Physical speed limiters not present	Physical speed limiters present
Openness of the situation	Wide and open road surrounding	Narrow and closed road surrounding
Road width	Wide road	Narrow road
Road surface	Smooth road surface	Rough road surface

3.1.2. Explicit information

Explicit information is purposefully designed with the intention to communicate with road users.

They may take the form of signage, pavement markings, or other forms of control that have regulated usage and are used to communicate with road users (such as traffic signals).

The guidance provided in this section generally relates to the design of explicit information interfacing with the road user.

3.2. Accuracy / Clarity

Information provided to the road user should be accurate and clear. Where ambiguity exists in the information provided, unnecessary cognitive loading is imposed on road users.

Figure 3.1 shows an example where the installation of incorrect signage has resulted in a situation which may be confusing for an oncoming motorist. The “Give Way” sign is facing the wrong direction and is inconsistent with the line marking. Vehicles approaching along the priority road are therefore faced with an incorrect sign and vehicles approaching along the yielding road are provided with less information than intended.

Figure 3.1: Incorrectly Installed Signage

3.3. Timeliness

The point at which information is presented to the road user should also be considered. Information that is presented too early is required to be stored in memory by road users for a greater period of time than necessary and increases cognitive loading. Information presented too late may result in road users failing to process and response to directions.

The intersection design shown in Figure 3.2 obstructs visibility of pedestrians approaching a crossing. Information regarding the presence of pedestrians is therefore received and processed by motorists later than intended, reducing the time available for them to react appropriately.

Figure 3.2: Vegetation obstructing driver or rider's view of potential conflict

3.4. Complexity

Signs which are too complicated, poorly designed or try to convey too much information will exceed the information-processing abilities of drivers. The lane designation direction sign shown in Figure 3.3 is too complex and squashed together for its information to be processed within the time available.

Figure 3.3: Poorly designed sign

Figure 3.4 depicts a lane designation sign that is far more likely to achieve the designer's objective of providing a similar amount of information to drivers. This is because it limits and groups information into separate, simple and well-spaced blocks which can be comprehended at a glance.

Figure 3.4: Example of a lane designation direction sign

Source: Safe System Solutions Pty Ltd

3.5. Cognitive Loading

'Self-explaining' roads minimise the amount of explicit information a driver must process, easing the driving task. Excessive signposting can lead to information overload, and lead to drivers failing to process all messages conveyed. Information overload can even lead to driver stress, resulting in an increased risk of driver error.

4. Road User Error

Unsafe road use contributes to crashes across urban, regional and remote environments, though the crash risk and injury severity associated with performance failures or risk taking can be more severe in non-urban areas because of factors such as high speed road environment and unprotected roadsides. This section summarises various types of road user errors that increase the risk of crashing and the risk of injury in the event of a crash.

A research report on the nature of errors made by drivers (Austroads 2011b) confirmed the utility of the Reason (1990) error classification system when applied to road user that categorises their errors as slips, lapses, mistakes and violations. According to Reason (1990), slips are the most common error type and represent errors in which the intention or plan was correct but the execution of the required action was incorrect. In a driving context, examples of slips would be a driver pushing the accelerator when intending to brake, or a driver activating the windshield wiper stalk instead of the indicator stalk.

Lapses involve a failure of memory that may not manifest itself in actual behaviour (Reason 1990); they typically involve a failure to perform an intended action or forgetting the next action required in a particular sequence. For example, a lapse when driving would be failing to change from reverse gear when attempting to drive forward after reversing the vehicle.

Mistakes reside in the unobservable plans and intentions that people form and occur when people intentionally perform a wrong action. Mistakes therefore originate at the planning level, rather than the execution level (Reason 1990), and are categorised as an inappropriate intention or wrong decision followed by correct execution. According to Reason (1990), mistakes involve a mismatch between the prior intention and the intended consequences and are likely to be more subtle, more complex, less well understood, and harder to detect than slips. An example of a mistake when driving would be deciding to change lane or gear at an inappropriate time or deciding to enter a roundabout at an inappropriate time.

Another, more complex category of error, is violations, which are categorised as any behaviour that deviates from accepted procedures, standards and rules. Common in road transport, violations can be either deliberate, whereby individuals deliberately break rules, or unintentional, whereby individuals unknowingly break rules (Reason 1990). An example of a deliberate violation would be when a driver intentionally breaks the speed limit, whereas a non-intentional violation would be when a driver breaks the speed limit unintentionally, being unaware of the current speed limit, or their own current speed, or both. A summary of Reason's error classification scheme, along with road user examples, is presented in Table 4.1.

Table 4.1: Reason's slips, lapses, mistakes and violations classification scheme

Error type	Definition	Road User example
Slips	Action execution errors	• Driver pushes the accelerator when intending to brake • Diver activates the windshield wiper stalk instead of the indicator stalk • Driver changes the 5th gear instead of 3rd gear
Lapses	Failure to perform a task	• Driver fails to change to first gear from reverse gear when attempting to pull away after reversing • Driver fails to check blind spot when changing lane
Mistakes	Inappropriate intention or wrong decision	• Driver decides to take the wrong turning • Driver decides to change lane at an inappropriate time • Driver decides to enter a roundabout at an inappropriate time
Violations	Behaviour deviating from procedures, standards or rules	• Driver knowingly exceeds the speed limit (intentional violation) • Driver unknowingly exceeds the speed limit (unintentional violation)

Source: Austroads (2011b)

It is a common community perception that the road safety problem is associated with extreme behaviours involving speeding, impaired driving and high levels of risk taking. Media coverage of crashes often reinforces this perception and often it is only the police who are asked to provide comment on the crash, usually from an enforcement and behavioural perspective. While such behaviours contribute to the road safety problem, they by no means explain the full extent of the problem. (Austroads 2018)

No matter how well trained or skilled road users are, it must be acknowledged that errors are inevitable when using the road system. It is unrealistic to expect road users to be operating at peak performance all of the time and many of us can relate to being tired, distracted, emotional, stressed, inexperienced or unwell when using the road system. (Austroads 2018)

Estimates on the contribution of ‘human error’ to road traffic crashes vary, but typically suggest that anywhere from 75% (Medina et al. 2004) to 90% (Treat et al. 1979) of all road traffic crashes involve some form of human error. Research into the concept has led to significant safety gains in a range of safety critical domains, including aviation, healthcare and nuclear power (British Medical Journal 2000). However, despite receiving significant attention in road transport, similar safety gains have not yet been achieved through error-related applications (Austroads 2011b).

5. Education

An insufficient level of education regarding road safety and regulations may contribute to a crash. This section presents information on unlicensed drivers, and also notes some other factors that may lead to insufficiently educated road users.

Unlicensed drivers are a well-known risk-taking group (Watson et al. 2015b) who feature prominently in fatal and serious injury crashes, particularly in non-urban areas (Siskind et al. 2011; Palamara, Kaura & Fraser 2013; Austroads 2013). They are known to engage in behaviours that increase their risk of crash involvement due to their increased incidence of drink driving (Palamara, Kaura & Fraser 2013; Watson et al. 2015a), drug driving (Palamara, Broughton & Chambers 2014), and high range speeding (Watson et al. 2015b). If involved in a crash, unlicensed drivers have a high risk of being killed or seriously injured (Austroads 2013) because they also have a high likelihood of being unrestrained (Palamara, Kaura & Fraser 2013).

Unlicensed drivers are also generally more likely to be involved in crashes that occur outside urban areas of Queensland (Siskind et al. 2011) and Western Australia (Palamara, Kaura & Fraser 2013). Australian data (Table 2.4: Austroads 2019b) highlights the higher incidence of unlicensed driving in fatal crashes in remote areas (18.5%) in 2016, compared with fatal crashes in major cities (9%) and regional areas (3%).

The circumstances leading to unlicensed driving may vary and, as a consequence, have implications for the countermeasures that are likely to be most effective. For example, approximately 43% of unlicensed drivers involved in a crash resulting in death or serious injury in remote Western Australia during the period 2005-2009 had never held a licence as opposed to having a licence suspended or cancelled. This could be associated with Aboriginal status, given that this population group in regional locations has considerable difficulty in obtaining a licence and are more likely to be involved in fatal and serious injury crashes (refer to Table 2.1).

Although a licencing system is used to create a base level of education and understanding regarding the operation of traffic, road users that meet all regulatory requirements still may not be properly educated to navigate specific scenarios. This may occur when road rules are changed as there is no requirement for relicensing, when new or changed vehicle technologies are implemented that road users may be unfamiliar with operating, or when awareness of location-specific rules and regulations are not required to meet regulations such as through the use of international licences.

6. Use of Facilities

It is accepted that the incorrect use of facilities provided leads to an increased risk of crashes. The incorrect use of facilities may include driving on the shoulder or across a median. Currently, there is limited information available regarding scenarios and their specific effects on crash risk. It is intended that this section will be expanded as new information becomes available on the subject.

Note that improper use of facilities is not limited to vehicles only and include jay walking, pedestrians crossing on a red light when there are no vehicles present, and cyclists riding on footpaths.

7. Alcohol and Illicit Drug Use

Alcohol and illicit drugs are two commonly used substances that have the capacity to impair drivers and increase the risk of crashing and injury. In regard to alcohol, Australians residing in remote and very remote areas (36.7%) compared with major cities (24.2%) consume alcohol at very risky levels on a monthly basis (i.e., 11 or more standard drinks in a single session in the preceding 12 months) (Australian Institute of Health and Welfare 2017).

National survey data show that particular groups are more likely to drink at risky levels: these groups include males, younger age persons and Aboriginal people (National Rural Health Alliance 2014). Using data from a variety of sources, the Australian Transport Council (2011) estimated that illegal levels of alcohol were the main contributing factor in the crashes of approximately 30% of Australian drivers and riders killed, and 9% of total serious injuries during the 2008-2010 base-line period for the 2011-2020 National Road Safety Strategy. Other data indicates that these percentages were higher for drivers and riders killed in regional (11.2%) and remote (14.7%) areas, compared with major cities in Australia (8.3%) (Table 2.4: Austroads 2019b).

Within regional and remote Australia, it is clear that certain population groups also have a high risk of involvement in an alcohol-related crash. For example, up to 65% of Aboriginal road fatalities in the Northern Territory were reported to be alcohol related compared with 35% for non-Aboriginal (Job & Bin-Sallik 2013). Age (17-39 years), gender (male) and licensing status (unlicensed) have also been found to be significant risk factors for involvement in an alcohol related fatal/serious injury crash across all Western Australian regions, the odds ratios were somewhat higher for all three groups who crashed in regional and remote WA during the period 2005-2009, compared with those who crashed in metropolitan Perth (Palamara, Kaura & Fraser 2013).

Illicit drugs are reportedly used less frequently than alcohol in the general Australian population (Australian Institute of Health and Welfare 2017), though their use by drivers is now widely recognised as a source of potential impairment and risk factor for crash involvement and injury (Organisation for Economic Co-operation and Development 2010). There is also evidence to show that illicit drugs are used in combination with illegal levels of alcohol (Palamara, Broughton & Chambers 2014; Wundersitz & Raftery 2017), a pairing which can exacerbate the driver's level of impairment (Organisation for Economic Co-operation and Development 2010).

At the jurisdiction level, illicit drugs in fatally injured drivers has been reported to be as high as 24% in South Australia (2012-2016) (Department of Planning, Transport and Infrastructure 2017); 23% in Western Australia (2000-2012) (Palamara, Broughton & Chambers 2014), and 20.6% in NSW (July 2015-June 2016) (New South Wales Centre for Road Safety 2017). In New Zealand, the presence of illicit drugs in fatal crashes is reported in association with alcohol. For the period 2014-2016, the combination was judged to be a factor in approximately 29% of fatal crashes (Ministry of Transport 2017).

Unfortunately, there is limited, incomplete data at the national level on the incidence of illicit drugs among fatally injured drivers by region of crash. In select jurisdictions, the incidence of illicit drugs in fatally injured regional drivers varies between 20% for regional Western Australia compared with 25.6% for metropolitan Perth (Palamara, Broughton & Chambers 2014) to 68% in all other areas outside of Sydney, Newcastle, Wollongong (New South Wales Centre for Road Safety 2017). In New Zealand, approximately 20% of fatal injury crashes occurring on open roads are reported to involve a combination of alcohol and illicit drugs (Ministry of Transport 2017).

As is the case for drink driving, certain drivers have a greater risk of involvement in a fatal, illicit drug related crash. This includes males and drivers less than 40 years of age; drivers with a BAC in the range of 0.050gm% - 0.149gm%; unlicensed drivers, and drivers positive for the use of opioids and benzodiazepines (Palamara, Broughton & Chambers 2014). These findings have been adjusted for region of crash.

8. Seat Belt and Child Restraint Use

The use of seat belts and other restraints by adult and child vehicle occupants has been shown to be an effective safety measure. However, the effectiveness of these treatments is dependent on road user compliance and correct usage.

These safety devices are central to reducing road injury, especially in regional and remote areas. Research into the effectiveness of seat belt use has estimated that the risk of fatal injury for front-seat occupants in light vehicles could be reduced by 45% to 50% and by about 25% for rear-seat passengers (Elvik & Vaa, 2004). Child restraint systems have similarly been shown to be highly effective in reducing injury severity for crash involved children. Klinich, Manary and Weber (2012) reported that death and serious injury could be reduced from 54% to 82% respectively, depending on the type of restraint used and its configuration (e.g., forward versus rearward facing child seat; boosters used in conjunction with adult belts).

Unrestrained vehicle occupants travelling on regional and remote area roads have an increased risk of death or serious injury in the event of a crash because of the higher speeds at which crashes are likely to occur. Nationally, approximately 35% of vehicle occupants fatally injured in remote area crashes in Australia in 2016 were unrestrained compared with 16% in regional area crashes and 7.9% in crashes occurring in major cities (Austroads, 2019b). While national data also shows that the proportion of fatally injured unrestrained occupants has declined since the baseline period of 2008-2010, larger percentage change was recorded for major city crashes (41% reduction) compared with a 26% reduction for remote area crashes and a 17% reduction for regional area crashes. Failure to use restraints thus continues to be a major issue in regional and remote areas.

Jurisdiction level research has identified a range of risk factors for adults being unrestrained in the event of a crash. These include male gender and occupants aged 17-39 years (Austroads 2009; Centre for Accident Research and Road Safety 2016); low socioeconomic status which also coincides with regional and remote residential status and the observed lower use among Aboriginal people (Austroads 2009); passengers rather than drivers, particularly those occupying a back seat position (Austroads 2009); drivers of older vehicles, 4WD and utility variants (Austroads 2009), and drivers who drink and drive and drive unlicensed (Palamara, Kaura & Fraser 2013). Other factors contributing to lack of seatbelt use include overcrowding due to a lack of vehicle ownership together with large distances to be travelled which make it inefficient to do multiple trips (i.e. socioeconomic and remote factors). Many community leaders also have a casual attitude to seat belt use and fail to reinforce the message that they are required to be worn (B Niemeier, personal communication, 12 December 2018). In addition, travel within the community is often at low speed and vehicle occupants hold a mistaken belief that seatbelt use is unnecessary when travelling at low speeds.

Compared with adult seat belt use, there is an absence of national information on the prevalence of the non-use of restraints among children and the known risk factors by region. At the jurisdiction level, nearly all children aged 0-12 years observed travelling in vehicles across New South Wales in 2008 were noted to be restrained, though more than three-quarters of ‘restrained’ children were noted to be using restraints that were incorrectly installed or inappropriate for their age/size (Brown et al. 2010). These findings underscore the notion that child restraint systems can be considerably more complex to install and use (Klinich, Manary & Weber 2012), particularly for parents/caregiver of low socioeconomic, non-English speaking groups (Keay et al. 2013; Hall et al. 2018).

9. Distractions

Distracted road users are subject to higher crash risk. Distractions are events and activities that divert driver attention away from the driving task such as dialling on a handheld phone or changing the radio channel.

A Naturalistic Driving Study (Dingus et al. 2016) found that talking on a handheld mobile phone while driving more than doubled crash risk, texting increased crash risk by a factor of 6, and dialling a handheld device increased crash risk by more than a factor of 12.

The operation of vehicle equipment such as radio and temperature controls, cognitively demanding conversations, and mobile phone use by pedestrians create additional distractions for road users. Further distractions may be created by the road environment due to events and incidents occurring on or near the road. A scenic drive for example may encourage drivers to take their eyes off the road.

A study (Austroads 2016a) was conducted into distracted pedestrians and found that up to 40% of pedestrians may be distracted by mobile phones when crossing the road. The likelihood of distracted crossing is greater at signalised intersections. Pedestrians distracted by mobile phones walk more slowly, change directions more often, acknowledge others less, look left and right less, are less likely to look at traffic before starting to cross, miss more safe opportunities to cross, take longer to initiate crossing, are more likely to cross unsafely into oncoming traffic, spend more time looking away from the road, and make more errors than pedestrians who are not distracted.

10. Skill / Ability

Road user errors may result from a lack of skill / ability to perform a specific action in the driving task. This lack of skill/ability may occur at any stage in the driving process. A guide for assessing fitness to drive notes that information about the road environment is obtained via the visual and auditory senses. The information is operated on by many cognitive processes including short- and long-term memory and judgement, which leads to decisions being made about driving. Decisions are put into effect via the musculoskeletal system, which acts on the steering, gears and brakes to alter the vehicle in relation to the road. The skills required for the driving function relies on ability in three main areas (Austroads 2017):

- sensory inputs such as vision, visuospatial perception, and hearing
- cognitive functions such as attention, memory, judgement, and reaction time
- motor functions such as muscle power and coordination.

11. Fatigue

Despite the noted difficulties in defining driver fatigue and quantifying its involvement in crashes (i.e. difficult to measure), it is widely acknowledged as a significant source of driver and rider inattention, impairment, and crash risk (Phillips 2015). The Australian Transport Council (2011) speculates that fatigue may be a contributing factor for between 20% and 30% of casualty crashes in Australia. Other Australian estimates for the involvement of fatigue in fatal crashes vary between 9.3% in Queensland (Department of Transport and Main Roads, personal communication, February 2019) and 17.5% of fatalities for the period 2009-2013 in Western Australia based on a combination of police assessments and the application of the ATSB proxy measure (Dobbie 2002) for fatigue (Palamara 2016). Historically, fatigue has been identified as a regional and remote road safety problem because fatigue-related crashes were more commonly 'observed' on high speed roads in these areas (Haworth & Rechnitzer 1993). These observations consequently influenced the development of the ATSB proxy measure (Dobbie 2002) to be restricted to particular single vehicle and head on crash types on roads rated ≥80km/hour (as well as other factors such as time of day of the crash and excluding certain driver conditions).

A number of driver risk factors have been noted for fatigue-related crashes (Palamara 2016). The incidence appears to be higher among younger to middle-aged drivers (i.e., 16 to 39 year of age). There is also reasonable evidence to conclude that males are more likely than females to be involved in fatigue-related crashes. Fatigue or sleepy/drowsy driving has also been noted to be a significant factor in the crashes of heavy vehicle drivers. The risk of fatigue driving among heavy drivers is thought to be due to a range of factors. These include workplace practices that result in long working hours; long driving distances; late night/early morning driving; extended periods of wakefulness and poor-quality sleep, and a high incidence of untreated obstructive sleep apnoea (see Palamara 2016, for a review).

A study into innovative measures to address fatigue notes that before a driver actually falls asleep at the wheel, their performance is already substantially impaired and several episodes of microsleeps (1 to 3 seconds of uncontrollable sleep, which the driver is usually unaware of) are likely to have occurred (Boyle et al. 2008). Although Reyner and Horne (1998) found that drivers who were drifting out of their lane were well aware of their level of sleepiness before any major incidents occurred, they had typically reached the stage of fighting sleep despite not being very good at estimating how likely they were to actually fall asleep. This is further supported with research by Kaplan, Itoi and Dement (2007) indicating that those who are sleep deprived cannot predict how likely they are to fall asleep at the wheel of a car. (Austroads 2011a).

12. Post-Crash Factors

Post-crash emergency response involves a series of events including crash discovery, emergency notification and activation, on-scene time, transport, and pre-hospital medical care (BITRE 2018; Wall et al. 2014). Considering the importance of time from the trauma to initial prehospital care, the vastness of the Australian regional and remote road network presents obvious issues for emergency response and trauma management in the post-crash phase (Croser 2003; Fatovich et al. 2011).

Human factors that may impact post-crash emergency response include:

- The ability to identify the crash location to be communicated to emergency response personnel. Although identifying the crash location may be straightforward in most urban environments, it can be difficult in rural areas.
- The ability to contact emergency services. This may be impaired by infrastructure deficiencies such as lack of mobile phone reception, or cognitive impairment resulting from post-crash trauma. This issue is also more likely in rural areas where infrastructure may be sparse and other road users may not be present for significant durations of time.
- Where other road users are present, their behaviour can impede or facilitate access from emergency response personnel. Where the crash results in damaged vehicles or injured road users on the carriageway, the ability for other road users to process and respond to the changed road conditions may impact the risk of secondary crashes.
- The level of injury sustained by individuals present may limit their physical and/or cognitive ability to contact emergency services. In cases where other people are not present to call emergency services, such as single vehicle crashes or hit-and-run crashes, they emergency response time may be delayed.
- The level of training and competence of emergency response personnel. If trauma management is incorrect or poorly administered, the severity of the injury incurred by individuals involved in the crash is likely to be worse than necessary. Training and competence of emergency personnel may also impact the risk of secondary crashes occurring at the crash site between through-traffic and emergency response personnel.

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Austroads' **Guide to Road Safety Part 4: Safe People** presents information on groups of individuals that are at increased risk of injury on the road network. Known categories of road user errors are also presented. Components of the information processing procedure are discussed.

Guide to Road Safety Part 4

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