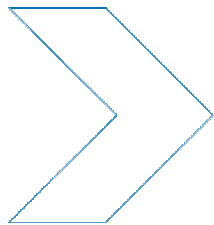


# ➤ Centre for Automotive Safety Research



## Pedestrian and cyclist crashes in the Adelaide Metropolitan Area

TP Hutchinson, VL Lindsay

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## TITLE

Pedestrian and cyclist crashes in the Adelaide Metropolitan Area

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## ABSTRACT

**Datasets employed.** In-depth at-scene investigations of motor vehicle road crashes in the Adelaide Metropolitan Area were conducted in the period April 2002 to October 2005. The database from that study is used to throw light upon pedestrian and pedal cyclist crashes. The database of routinely-reported crashes is also utilised in respect of pedestrian and cyclist fatalities. **Results.** As pedestrian casualties are more numerous than cyclist casualties, the majority of results concern the former. In the 81 cases in the in-depth series, many different types of pedestrian accident can be identified. Of the 40 pedestrian fatalities in 2003-2006, 29 fell into at least one of the following three categories: at night, pedestrian was drunk, or pedestrian was elderly. Two points to note about this contrast between the two series are that (1) the in-depth study concentrated on crashes in normal working hours, and thus nighttime crashes are underrepresented, and consequently so is drunkenness, and (2) it is an open question whether there really are only three types of central story that cover the majority of pedestrian fatalities, or whether this finding is a consequence of the lack of detail in routine police data. **Countermeasures.** Taking the several series of crashes together, seven issues are prominent, and are discussed from the point of view of possible countermeasures: nighttime; drunkenness of pedestrians; visual obstruction by traffic; visual obstruction by roadside objects; possible improvements to other details of the road; trucks (visibility from the cab, and side protection); speed. There is also consideration of the competing needs for space of environmentally-friendly modes and motorised modes of transport: perhaps users of power-assisted cycles (slow motorcycles) are a potential natural ally of pedestrians and pedal cyclists in the demand for urban space.

## KEYWORDS

Pedestrian, Cyclist, Traffic accident, Accident countermeasure, Urban area

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## Summary

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For some 40 years, the Centre for Automotive Safety Research (formerly the Road Accident Research Unit) at the University of Adelaide has been conducting in-depth investigations of road crashes. In the period April 2002 to October 2005, crashes in the Adelaide Metropolitan Area were studied. The present report uses the database generated in that study to throw light upon pedestrian and pedal cyclist crashes. Also utilised, in respect of fatalities, is the database of routinely-reported crashes, and there is discussion of possible countermeasures.

*Pedestrians, in-depth investigations.* In the 81 cases, many different types of pedestrian accident can be identified. In the present report, the various types are grouped as follows. (1) Types that are typical pedestrian accidents, and either the pedestrian's fault, or in circumstances where it is usual for the pedestrian to take chief responsibility (this includes most instances of crossing the road, though not all). (2) Types that are typical pedestrian accidents, and either the driver's fault, or in circumstances where it is usual for the driver to take chief responsibility; examples include driving unsafely, and when the pedestrian is crossing the road with a green light, when the pedestrian is stationary in the road, and on footpaths, in pedestrian zones, etc. (3) Types of crash that are not usually thought of as typical of pedestrian accidents.

*Pedestrian fatalities, routine police data.* Many were at night, or involved drunkenness of the pedestrian, or the pedestrian was elderly. Of the 40 pedestrian fatalities in 2003-2006, only 11 did not fall into at least one of those three types.

*Synthesis of results concerning pedestrians.* (1) The in-depth study concentrated on crashes in normal working hours, and thus nighttime crashes are underrepresented, and consequently so is drunkenness. (2) It is an open question at present whether it really is the case that only a very few types of central story do account for the majority of pedestrian fatalities, or whether this results from lack of detail in routine police data.

*Pedal cyclists, in-depth investigations.* There were 11 cases. Among these, the two most prominent types were motor vehicle turning left, and cyclist travelling fast.

*Pedal cyclist fatalities, routine police data.* In 1994-2006, there were 37 crashes in which a cyclist was killed. The most frequently occurring types were: same direction, motor vehicle into rear of cycle; same direction, side swipe (including cases of left-turning by the motor vehicle); cyclist turned or swerved unexpectedly into path of motor vehicle; cyclist emerged unexpectedly into path of vehicle from an intersection or footway; involvement of cyclist, or running over of cyclist, was secondary to something else.

*Priorities for countermeasures.* Taking the evidence from the several sets of crashes together, the following seven issues are prominent and are discussed from the point of view of possible countermeasures: nighttime; drunkenness of pedestrians; visual obstruction by traffic; visual obstruction by roadside objects; possible improvements to other details of the road; trucks (visibility from the cab, and side protection); speed.

*Split of roadway space.* There is also discussion of how environmentally-friendly modes and motorised modes of transport both need road space. In particular, the proposal is made that users of power-assisted cycles (slow motorcycles) are a potential natural ally of pedestrians and pedal cyclists in the demand for urban space.

# Contents

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- 1 Introduction ..... 1
- 2 Databases..... 2
- 3 Classification of pedestrian crashes..... 5
- 4 Types of pedestrian crash in Group 1: Examples from the in-depth database..... 9
- 5 Types of pedestrian crash in Group 2: Examples from the in-depth database..... 19
- 6 Types of pedestrian crash in Group 3: Examples from the in-depth database..... 23
- 7 Pedestrian fatalities in the TARS database ..... 28
- 8 Cyclist accidents in the in-depth database..... 31
- 9 Cyclist fatalities in the TARS database ..... 35
- 10 Discussion ..... 37
- References ..... 47

# 1 Introduction

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For some 40 years, the Centre for Automotive Safety Research (formerly the Road Accident Research Unit) at the University of Adelaide has been conducting in-depth investigations of road crashes. In the period April 2002 to October 2005, crashes in the Adelaide Metropolitan Area were studied. The chief aim of the present report is to exploit the data from that study to throw light upon pedestrian and pedal cyclist crashes. The database of routinely-reported crashes is also utilised in respect of pedestrian and cyclist fatalities, and there is discussion of possible countermeasures.

The report will be organised as follows.

Section 2 describes the databases. The in-depth investigations are most important, but routine police data will also have a part to play.

Pedestrian crashes are much more numerous than cyclist crashes, in these datasets as in motor vehicle crashes more broadly, and it has been necessary to classify them. Section 3 outlines how this was done for the purpose of describing the 81 cases in the in-depth database.

Sections 4-6 deal with three groups of types of pedestrian crash. Summaries are given of what happened in 28 of the cases.

Section 7 summarises what was found in the text descriptions of fatal pedestrian accidents (40 in number, 2003-2006) in the database of crashes routinely reported to the police.

Section 8 discusses the 11 pedal cyclist crashes from the in-depth database, and Section 9 the 37 fatal cyclist crashes in the routine database (1994-2006).

The discussion in Section 10 has three parts to it. First, the rather different results from the in-depth and routine series are reconciled. Second, there are comments on possible countermeasures related to seven well-known issues in road safety. Third, the question is raised of the split of roadway space between environmentally-friendly modes and motorised modes of transport.

Related reports include the following.

Trends in South Australian road crashes generally: see Hutchinson et al. (2004).

Aspects of pedestrian crashes in South Australia, including trends: see Anderson (2008).

Regulation of vehicle design in respect of pedestrian protection: see McLean (2005).

Statistics on pedal cyclist crashes in South Australia, including trends: see Hutchinson et al. (2006, 2007a,b, 2008).

## 2 Databases

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Most of the data for the present report come from in-depth at-scene investigations, as described in Section 2.1. These data were supplemented by information in the mass accident database (TARS) concerning fatal pedestrian and cyclist crashes (see Sections 7 and 9). The TARS database is described in Section 2.2, and Section 2.3 sketches why results from that and the in-depth investigations might be expected to differ.

Even considering these two databases together will not give the total picture of pedestrian and cyclist crashes. Cyclist crashes are underrepresented in mass accident databases, and this will include alcohol-intoxicated cyclists. Off-road crashes are underrepresented, and this will include pedestrians hurt by reversing vehicles in car parks.

### 2.1 Database from in-depth at-scene investigations

From April 2002 to October 2005, CASR conducted in-depth at-scene investigations of 298 road crashes in the Adelaide Metropolitan Area. There were 81 pedestrian crashes in this series, and cyclist crashes.

As described in Baldock et al. (2005, Section 3.2), crashes eligible for inclusion were those occurring on public roads, to which an ambulance was called, and for which at least one person was transported to hospital. CASR found out about crashes either by monitoring the ambulance radio or by being notified by pager by the ambulance service. CASR staff were available to attend crash scenes during the day Monday to Friday, plus some evenings until midnight. The on-call team attempted to reach the scene of the crash before the vehicles involved were moved. It was not possible to achieve this in all cases. Occasionally, further investigation was abandoned if there was insufficient evidence available at the scene.

The information collected on each case included:

- Photographs of the crash scene and vehicles involved.
- Video record of the crash site in selected cases.
- Details of the road environment, including traffic control measures.
- A plan of the crash site and vehicle movements.
- Details and measurements of the vehicles involved.
- Interviews with people involved in the crash, witnesses, and police.
- Information recorded on the Vehicle Crash Report prepared by the police.
- Injury data for those who attended major Metropolitan hospitals.

In this series of investigations, crashes occurring at night were under-represented, and so crashes in which alcohol was a factor are under-represented.

#### Other reports

Anderson (2008, Section 5) gives information about 154 pedestrian crashes investigated in depth, 77 of which are included in the present series. Particularly interesting are results concerning what it was that the pedestrian's head and legs impacted (which parts of cars, or the roadway). There is also some information about characteristics of the sample, such as the distribution over the hours of the day, and the speed limits.

It will be readily appreciated that collecting in-depth data on a fully *representative* sample of crashes is considerably more expensive. But some time ago, in the 12 months from March

1976, staff of the Road Accident Research Unit, University of Adelaide, attended 304 randomly selected crashes and collected medical, engineering, and sociological data. For the 40 pedestrian crashes, see McLean et al., 1979a, and for the 22 pedal cyclist crashes, see McLean et al., 1979b.

## Classification of crashes and selection of summary narratives

The method of classifying pedestrian crashes for the purpose of this report is described in Section 3. The classification has crash causation as its basis, but is broader, and seeks to communicate the central story of the crash.

Sections 4-6 include summary narratives of what happened in some crashes. Reasons for selecting a particular case included it being typical of a category of crash, or alternatively it having an interesting feature that is not typical. Reasons for choosing not to select particular cases included considerations of privacy, or only limited information being available. The summaries of crash events given in this report are based upon accounts written as part of the in-depth investigations. Care has been taken to observe the requirements of confidentiality and privacy of the people involved, but in omitting identifying information, nothing has been left out that would render the crash description misleading.

## 2.2 Database of crash data routinely collected by police

In South Australia, police attend some road crashes, and later enter the data into their database. Other crashes are reported when one or more of the people involved attend a police station some hours or days later, and provide information that is then entered into the database. The police transmit records of road crashes to the State roads authority (Department for Transport, Energy and Infrastructure) in electronic form. The procedures, the difficulties faced by the police, and the limitations with the resulting dataset are similar to those elsewhere in the developed world, see Hutchinson (1987).

The South Australian database of road crash information is known as TARS (Traffic Accident Reporting System). The database includes a text field for each crash, where a brief summary is given of what happened. For this report, text fields of fatal pedestrian (2003-2006) and cyclist (1994-2006) crashes were read. The results (Sections 7 and 9 below) showed a contrast to the results from the in-depth database. In particular, crashes at night were prominent, and in a substantial proportion of these, the pedestrian was drunk.

This report will generally refer to someone being “drunk” rather than being “affected by alcohol”. The reason is that in many of the accident cases, inappropriateness of behaviour and blood alcohol concentration were really extreme, and we feel the description “drunk” conveys this better. Moreover, someone could easily be “affected by alcohol” in the sense that an effect on perceptual or cognitive or motor skills could be detected in the laboratory, without that being detectable by a casual observer.

## 2.3 Reasons for differences between the in-depth and routine databases

There are some reasons why we would expect the in-depth and TARS-fatal databases to differ from each other.

The in-depth investigations were largely of crashes occurring on Monday to Friday in daytime, and so crashes in darkness and alcohol-related crashes are very much underrepresented.

The descriptions of crashes in TARS, even of fatal ones, are very brief, and it is possible that if more details were known, many different categories would become evident.

Neither database presents a complete picture, therefore. Discussion of this is continued in section 10.1.



## 3 Classification of pedestrian crashes

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### 3.1 Basis of method of classification

The methods of classifying pedestrian crashes that are used routinely in police reports are necessarily heavily influenced by what it is practicable for the police to find out and record. For the methods used by various jurisdictions, see Hutchinson (1987, Section 6.4.5, item 13 in Table 6.5, and item 13 in Table 6.14). The location of the pedestrian and the movements of the pedestrian and the vehicle are the chief elements. However, in-depth investigations are used for the present report, and classification can go beyond the movements of those involved.

The specification for this project referred to “causal factors”, and causation is the basis for the method of classification below. However, there is longstanding criticism of the usefulness of causation in road safety research — the link of cause with result is often weak, the link of other factors with result is often appreciable, it is often difficult to establish objective facts, the reports of participants may be coloured by self-interest, and so on. Thus the classification is rather broader than causal factors alone, and seeks to communicate the *central story* of the crash. The chief use of this classification is to assist with communicating what happened in these crashes, and what lessons can be learned.

### 3.2 Two questions

Studying road accidents, one inevitably notices both that many crashes are stereotypes that have been familiar for decades, and also that there is another group that are unusual or even freakish. Thus one question posed about each of these pedestrian crashes was whether it was of a type that will probably be found repeatedly when examining a series of 100 or 200 crashes, or was it unusual. If it is one of the types that occur repeatedly, a second important question is whether it was the pedestrian’s fault or the driver’s. Those questions lead to the following as a first approximation to a grouping of crashes:

Types of pedestrian accident that occur commonly; the pedestrian’s fault.

Types of pedestrian accident that occur commonly; the driver’s fault.

Types of pedestrian accident that are not typical or common.

### 3.3 More precise definition of three main groups of crashes

Just as “cause” is an important but unsatisfactory concept, so is “fault”. Use of the road is a social activity, and most of the time, pedestrians and drivers behave according to well-recognised rules and predictable habits. It is (usually) clear whose is the chief responsibility for avoiding collision. Consequently, the three groups are broadened as below.

- Types of crash that are typical pedestrian accidents, and either the pedestrian’s fault, or in circumstances where it is usual for the pedestrian to take chief responsibility for avoiding an accident. This includes most instances of crossing the road, though not all.
- Types of crash that are typical pedestrian accidents, and either the driver’s fault, or in circumstances where it is usual for the driver to take chief responsibility for avoiding an accident. Driving unsafely falls into this group, and other examples include the pedestrian crossing the road with a green light, some cases of the pedestrian being stationary in the road, and the pedestrian being on a footpath, in a pedestrian zone, etc.
- Types of crash that are not usually thought of as typical of pedestrian accidents.

Each of these groups is split further. Group 1 has four second-level and 18 third-level categories, Group 2 has three second-level and 10 third-level categories, and Group 3 has 17 third-level categories. The categories were mostly generated from the crashes that actually occurred in the database, but in case this classification is useful to others, some types that were not observed in this series have also been included (as they are known to occur, and some appear in other systems of classification). The third-level categories have been assigned three-digit reference numbers.

The categories are not mutually exclusive: often a particular crash could be included in any of two or more. In such cases, the more specific category rather than the less has been used, or the more dramatic or unusual feature has been given priority.

It is necessary to be cautious about attempting to classify crashes according to cause: it is often possible to establish that the pedestrian was, say, drunk, and yet not have positive specific evidence that this was the cause of the crash. For example, if a crash is listed under category 131 below, this should not be taken to mean that there was positive specific evidence that alcohol (or drugs) was causative.

### 3.4 Group 1, types of crash that are typical pedestrian accidents, and either the pedestrian's fault, or in circumstances where it is usual for the pedestrian to take chief responsibility

This Group of pedestrian accidents includes most instances of crossing the road, though not all.

#### Visual factors

111 Visual obstruction from traffic (stationary or moving)

112 Visual obstruction from roadside object (e.g., street furniture, vegetation)

113 Darkness

114 Other visual factors (e.g., glare)

#### Factors associated with the vehicle and its driver

121 Unnecessary change of lane by vehicle

#### Long- or short-term states of the pedestrian

131 Pedestrian drunk or affected by drugs

132 Impairment of pedestrian (in body, mind, or senses)

133 Pedestrian is a child, 9 years old or less

134 Pedestrian is elderly (aged 70 or more)

#### Momentary conditions of the pedestrian

141 Pedestrian temporarily distracted

142 Pedestrian is unaccustomed to traffic driving on the left

143 Pedestrian wrongly thinks traffic has a red signal

144 Mutual misunderstanding by pedestrian and driver

145 Pedestrian, in a group, is indecisive (influenced by others)

- 146 Lack of attention by pedestrian, not otherwise specified
- 147 Misjudgment by pedestrian, who contacted the side of the vehicle
- 148 Deliberate bad behaviour by pedestrian such as disobedience of signals and crossing through stationary traffic
- 149 Recklessly bad behaviour by pedestrian such as skylarking and playing chicken

### 3.5 Group 2, types of crash that are typical pedestrian accidents, and either the driver's fault, or in circumstances where it is usual for the driver to take chief responsibility

Examples that would fall within this Group of pedestrian accidents include driving unsafely, and when the pedestrian is crossing the road with a green light, when the pedestrian is stationary in the road, and on footpaths, in pedestrian zones, etc.

#### Visual factors

- 211 Visual obstruction from traffic (stationary or moving)
- 212 Visual obstruction from roadside object (e.g., street furniture, vegetation)
- 213 Darkness
- 214 Other visual factors (e.g., glare, fogged vehicle window)

#### Long- or short-term states of the driver

- 231 Driver drunk or affected by drugs
- 232 Impairment of driver (in body, mind, or senses)

#### Momentary conditions of the driver

- 241 Driver temporarily distracted
- 246 Lack of attention by driver, not otherwise specified
- 248 Deliberate bad behaviour by driver (excluding recklessness)
- 249 Recklessly bad behaviour by driver

### 3.6 Group 3, types of crash that are not usually thought of as typical of pedestrian accidents

- 301 Pedestrian on footpath struck by a projection of the vehicle (including mirrors)
- 302 Pedestrian in roadway struck by a projection of the vehicle (excluding mirrors of small vehicles)
- 303 Pedestrian's foot is run over
- 304 Part of pedestrian (e.g., head or arm) was inside vehicle when it moved
- 305 Worker on the road

- 306 Struck by two or more vehicles
- 307 Loss of control of vehicle, pedestrian (whether on or off road) is struck
- 308 Vehicle reversing
- 309 Pedestrian came into the path of the vehicle inadvertently (e.g., tripped)
- 310 Failure to control a pedestrian vehicle (e.g., wheelchair, skateboard)
- 311 Involvement of pedestrian, or running over of pedestrian, is secondary to something else (and is the most important event)
- 312 Involvement of pedestrian, or running over of pedestrian, is secondary to something else (but is not the most important event)
- 313 The person was in, or on, the vehicle (and may by some criteria not be considered to be a pedestrian)
- 314 Action of an animal is relevant
- 315 Suicide, attempted suicide, and acts that appear similar
- 316 Assault or murder using motor vehicle, and acts that appear similar
- 317 Information about the vehicle and its driver is unavailable

### 3.7 The categories that occur most frequently

The figures below are of some interest as describing this series of crashes, but of course statistical information about the totality of crashes should be sought in other sources of data, and in any case it is rather artificial to put a crash into one single category.

Of the 81 pedestrian crashes in this series, 50 have been classified to Group 1, 14 to Group 2, and 17 to Group 3. Further, of the 81 crashes, 43 have been classified to the six most frequently-occurring categories, as follows.

- 111 Visual obstruction from traffic (stationary or moving) .... 14 cases
- 131 Pedestrian drunk or affected by drugs .... 7 cases
- 132 Impairment of pedestrian (in body, mind, or senses) .... 5 cases
- 141 Pedestrian temporarily distracted .... 5 cases
- 146 Lack of attention by pedestrian, not otherwise specified .... 5 cases
- 315 Suicide, attempted suicide, and acts that appear similar .... 7 cases

## 4 Types of pedestrian crash in Group 1: Examples from the in-depth database

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The method of classifying pedestrian crashes has been described in Section 3 above.

The present Section is concerned with crashes in Group 1 — that is, types of crash that are typical pedestrian accidents, and either the pedestrian's fault, or in circumstances where it is usual for the pedestrian to take chief responsibility (this includes most instances of crossing the road, though not all).

### 4.1 Category 111, Visual obstruction from traffic (stationary or moving)

Number of cases that primarily come under this heading: 14.

Number of additional cases that could have been included here: 1 (included in category 123).

#### Example

Road characteristics. Multi-lane divided approaching a signalised intersection.

Narrative. Car approached intersection in the second lane from the kerb. There was a long line of stationary vehicles in three of the four lanes and a relatively uncongested lane on the left. The driver moved into the left lane and continued toward the intersection at the same time as two teenaged schoolchildren from a group of 15 or 20 moved into the lane from the vehicle's right. Eyewitness accounts suggest that the car had accelerated as it entered the left lane. On seeing the approaching vehicle, the first pedestrian froze in position while the second jumped in an attempt to avoid being struck. The driver of the car braked but was unable to avoid the collision. The first pedestrian was struck by the centre right of the vehicle. The pedestrian was thrown forward, landing on his right side next to a Stobie pole on the western edge of the carriageway. It is unlikely that the pedestrian struck the Stobie pole as he came to rest. The second pedestrian was struck on his left side by the front right headlight of the vehicle and was thrown forward, coming to rest on his right side in the centre of the left lane. The car came to rest with the front left wheel against the kerb approximately five metres short of the final positions of the pedestrians.

Comments. (a) The car was a powerful old sedan, the driver was in his 20's. (b) This is not the only crash in which there was an unnecessary change of lane by a vehicle. See also discussion in Section 10.2.

### 4.2 Category 112, Visual obstruction from roadside object (e.g., street furniture, vegetation)

Number of cases that primarily come under this heading: 2.

See also category 212.

Number of additional cases that could have been included here: 1 (included in category 111).

#### Example 1

Road characteristics. Multi-lane divided.

Narrative. At the crash site, the left lane becomes a service road into a produce market and the remaining two lanes continue as a through carriageway. The service road and the through carriageway are separated by a raised island that has a metal railing along the centre of it to discourage pedestrians from crossing. An elderly pedestrian walked from the produce market and crossed the service road before coming onto the raised island between

the end of the metal railing and a large hazard marker board. The pedestrian stepped into the left lane and moved in a north westerly direction, coming into the direct path of the westbound car. The front right bumper of the car struck the right side of the pedestrian. The vehicle came to rest approximately two metres from the point of impact. The pedestrian's upper torso came onto the front of the bonnet before the pedestrian fell to the carriageway directly ahead and to the right of the car. Both the driver and the pedestrian were unaware of each other until immediately prior to the collision. The large hazard marker board situated on the raised island is very likely to have created a visual obstruction for both the driver and the pedestrian.

## Example 2

Road characteristics. Multi-lane divided and single lane divided at signalised intersection.

Narrative. A child pedestrian was standing on the northern corner of the intersection with a group of primary school children and their teachers. The group was intending to cross the intersection at a pedestrian crossing and were waiting for the pedestrian signals to change to green. While a car was turning left, the young pedestrian left the school group and began moving across another pedestrian crossing in a south easterly direction, moving toward the turning vehicle. The pedestrian was struck by the front left corner and front left wheel arch area of the car as it turned across the pedestrian crossing. The pedestrian's ankle came in front of the left front wheel of the car and was run over. The pedestrian fell to the carriageway and came to rest immediately northeast of the pedestrian crossing line, between the vehicle and the kerb. The pedestrian footpaths at the intersection are surrounded by dense foliage growing to a height of 800 mm. This foliage is very likely to have created a visual obstruction between the young child pedestrian and the driver of the car in the lead up to the crash.

## 4.3 Category 113, Darkness

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 6 (included in categories 131, 131, 134, 132, 311, and 131).

For cases occurring in darkness, see also category 213.

### Example

Lighting conditions. Dark with street lighting.

Road characteristics. Single lane two way.

Narrative. A teenage pedestrian was engaged in social activities with peers on the northern footpath when she attempted to cross a local road to follow a friend who was crossing to the southern side. The lead pedestrian reached the southern footpath without incident. The following pedestrian (wearing a black t-shirt and jeans) walked approximately three quarters of the distance across the carriageway before coming to a stop. A four wheel drive (Unit 1) was travelling west on the carriageway at a speed reported by the elderly driver to have been approximately 45 to 50 km/h when he became aware of the lead pedestrian on the carriageway approximately 200 metres ahead of him. The driver of the four wheel drive slowed to a self-reported speed of approximately 35 km/h as he approached, and watched the pedestrian reach the footpath. Failing to see any other pedestrians, the driver began to accelerate, reaching a speed of approximately 50 to 55 km/h. The front centre of the four wheel drive struck the left side of the stationary pedestrian in the southwest bound lane. The pedestrian came onto the bonnet of the vehicle and struck the centre to centre right area of the trailing edge. The driver of the four wheel drive braked heavily on impact and came to rest in the westbound lane an estimated 23 metres beyond the impact point. The pedestrian was thrown forward of the vehicle and came to rest approximately three to five

metres ahead of the four wheel drive. She was found to be deeply unconscious at the scene. She was admitted to hospital but met the criteria for brain death the following day.

#### 4.4 Category 114, Other visual factors (e.g., glare)

No cases.

For cases where other visual factors such as glare may be relevant, see also category 214.

#### 4.5 Category 121, Unnecessary change of lane by vehicle

There were several cases involving a change of lane by a vehicle. Some were unnecessary in the sense that the vehicle only achieved a slightly faster speed or travelled only a little further before queueing. These are mostly included in category 111.

#### 4.6 Category 131, Pedestrian drunk or affected by drugs

Number of cases that primarily come under this heading: 7.

Number of additional cases that could have been included here: 2 (included in categories 311, 113).

Some cases under this heading may have been suicide or attempted suicide.

##### Example 1

Lighting conditions. Dark with street lighting.

Road characteristics. Multi-lane two way.

Narrative. A pedestrian, in an intoxicated state (BAC 0.206), staggered across a main arterial road, from left to right as seen by the drivers. A van was forced to veer into the left lane to avoid collision. The driver of a car in the right lane was unaware of the pedestrian and driving at a self-reported speed of 60 km/h. The front left bumper and headlight area of the car struck the pedestrian within the right northbound lane. The pedestrian came onto the bonnet of the vehicle before his head struck the upper left side of the windscreen and the A pillar. The driver of the car braked on impact, coming to rest in the right lane. The pedestrian fell to the left lane and was found to be deeply unconscious.

##### Example 2

Lighting conditions. Dark with street lighting.

Road characteristics. Multi-lane divided.

Narrative. A teenage pedestrian in a highly intoxicated state (BAC 0.3) attempted to cross three (one way) lanes from right to left as seen by the traffic. A car was travelling in the centre lane at a speed reported by the driver to have been 60 km/h when the driver was suddenly confronted with the pedestrian directly ahead of him. There was little time for the driver to take evasive action prior to the impact. The front left of the car struck the left side of the pedestrian. The pedestrian was thrown onto the left side of the bonnet before her head struck the windscreen directly over the left windscreen wiper. The driver braked on impact and came to rest 18 to 20 metres from the estimated impact point. The pedestrian was thrown forward of the vehicle and came to rest in the centre lane of the carriageway 1.5 metres ahead of the car in final position. The pedestrian was deeply unconscious at the scene. The pedestrian was wearing dark clothing at the time of the collision, which is likely to have made her less visible to the driver of the car. She has a long history of self-harm and other mental health issues, including substance abuse, and it is possible that this could have been a deliberate attempt on her own life.

## 4.7 Category 132, Impairment of pedestrian (in body, mind, or senses)

Number of cases that primarily come under this heading: 5.

The nature of the impairment in these cases was as follows:

Significant cognitive deficits (had absconded from sheltered workshop supervision in the hours preceding the crash).

Cognitive and visual (has refused to carry identifiers to alert people to her visual impairment).

Poor impulse control, with explosive, violent, and antisocial behaviours.

Early dementia.

Vision and hearing impairments, was not carrying any identifiers to alert other road users of his visual impairment.

Number of additional cases that could have been included here: 1 (included in category 248).

In the cases in category 315 (suicide, attempted suicide, and acts that appear similar), the pedestrian often has some impairment of the mind.

### Example

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. A utility was travelling in the right of three eastbound lanes through a signalised intersection. The elderly driver was travelling on a green signal, at a self-reported speed of approximately 30 to 35 km/h. A pedestrian, who had originally been on the southern kerb, attempted to cross northward over the carriageway in the centre of the intersection between two marked pedestrian crossings. The pedestrian moved across the intersection against the pedestrian signals, coming into the right of two westbound lanes in front of an uninvolved vehicle that had slowed awaiting to turn right at the intersection. The pedestrian moved forward, entering the eastbound lane and came into the path of the utility. The pedestrian was struck on his left elbow by the right side mirror of the utility as it passed through the intersection. The pedestrian fell to the carriageway following the impact. The pedestrian was known to have significant cognitive deficits and had absconded from sheltered workshop supervision in the hours preceding the crash. His cognitive deficits were such that he would have been incapable of making an appropriate assessment of traffic conditions. He was unable to explain how he came to be in the vicinity or his actions in crossing the busy intersection.

## 4.8 Category 133, Pedestrian is a child, 9 years old or less

It should be noted that although one might suspect that the pedestrian being a young child is a relevant factor in the causation of the crash, that often cannot be established with any degree of certainty.

Number of cases that primarily come under this heading: 4.

In all four cases, an adult was with the child. In three of the cases, the child had reached the centre of a divided road, and should have waited there. Some further information about what the child did is as follows.

Young child ran into the right lane in front of the vehicle. The mother called to the child who then stopped, turned back and then stopped again, facing the vehicle.



Young child, who was believed to have been upset by a conflict between adults, left his mother and was attempting to join his siblings on other side of the road, and came into the direct path of a car

Adult male and a young child were on the median; both began to move into the right westbound lane to cross once the car had passed; suddenly, the young child ran into the direct path of the car.

Adult planned to stop on the median but did not communicate her intention to the children; a child broke free from the adult and ran into the path of a bus; the child may have become scared by the close proximity of the bus and panicked.

Number of additional cases that could have been included here: 1 (included in category 112).

### Example

Road characteristics. Single lane two way.

Narrative. An adult and two children attempted to cross a road in a north easterly direction. The adult was holding the right hand of the youngest child. The pedestrians walked toward the rumble stripped median with the intention of stopping to allow a bus coming from their left to pass. The bus was travelling at a speed reported by the elderly driver to have been approximately 50 km/h when the driver observed the three pedestrians who were looking in his direction. As the bus neared the pedestrians, the driver observed the young pedestrian break free from the adult and run into the path of his vehicle. The driver veered to the left and braked heavily but was unable to avoid the collision. The front centre of the bus's bull bar struck the pedestrian near the centre of the southeast bound lane. The pedestrian was thrown forward of the vehicle and came to rest on the carriageway approximately two to three metres in front of the bus. It is estimated that the speed of the bus was approximately 5 km/h at the time of impact. The adult planned to stop on the median but did not communicate her intention to the children. She believed that the child, who had never crossed the carriageway in this manner before, may have become scared by the close proximity of the bus and panicked, leading her to flee from the adult to avoid the perceived danger. The crash site is close to shops and there is known to be regular pedestrian activity. There are no safe pedestrian crossing facilities provided.

## 4.9 Category 134, Pedestrian is elderly (aged 70 or more)

It should be noted that although one might suspect that the pedestrian being elderly is a relevant factor in the causation of the crash, that often cannot be established with any degree of certainty.

Number of cases that primarily come under this heading: 3.

There were several other cases in which the pedestrian was aged 70 or more. In some, the pedestrian's age seems to have been irrelevant, but for others (such as those in categories 141, 147, or 315) the pedestrian's age is likely to be considered relevant.

There were further cases in which the pedestrian was aged under 70 but was showing age-related decline.

### Example

Road characteristics. Multi-lane two way.

Narrative. A car was travelling in the left of two lanes at the front of a platoon of vehicles and was approaching a signalised intersection approximately 120 metres ahead. The elderly driver reported that she was travelling at a speed of approximately 55 km/h and stated that her attention was directed toward the traffic signals that she had anticipated would change

to red before her arrival. An elderly pedestrian had alighted from a bus a short time earlier and attempted to cross the busy carriageway from the driver's left. Failing to see the approach of the car, the pedestrian began to walk across the left lane and walked into the left side of the car. The pedestrian struck the front left corner of the car before being struck by the left side mirror. The pedestrian fell to the carriageway following the impact, coming to rest in the bicycle lane adjacent to the kerb. The driver of the car stated that she heard a noise and then saw a brown shadow to the left side of her vehicle but was unaware of what she had struck until seeing the pedestrian in her rear vision mirror. She braked and brought the vehicle to a parked position against the eastern kerb. The pedestrian is a local resident and is known to cross the carriageway at this site on a regular basis.

## 4.10 Category 141, Pedestrian temporarily distracted

Number of cases that primarily come under this heading: 5.

In these five cases, the nature of the distraction was as follows.

Pedestrian was being chased.

Pedestrian was looking for traffic in the wrong direction. There were two such cases, and in both, the vehicle driver had some suspicion that the pedestrian had not looked in the right direction.

Pedestrian was hurrying to help someone.

Pedestrian was inspecting damage to his vehicle from a collision a moment before.

Number of additional cases that could have been included here: 2 (included in categories 133, 131).

### Example

Road characteristics. Multi-lane divided.

Narrative. There were two parts to this crash. Injury occurred in the second. A truck was attempting a U-turn, a car attempted to move around it to the right, but collided and rotated. The young driver of the car alighted from the vehicle, becoming a pedestrian, and came into the road to inspect the damage. A utility towing a trailer was travelling in the left lane as it approached the car and the pedestrian. The driver of the utility braked but was unable to avoid a collision. The front left corner of the utility struck the front left door of the car before continuing toward the pedestrian who was directly ahead. The front centre of the utility struck the pedestrian on his left side. The pedestrian's head made contact with several poly pipes that were secured to a metal roof rack support before the pedestrian came onto the centre bonnet area of the vehicle. The utility came to rest with the left side of his trailer next to the left side of the car. The pedestrian was thrown forward and came to rest on the carriageway approximately one metre ahead and to the left of the utility in final position.

Comments. This case has been included under "Pedestrian temporarily distracted" because that was probably the reason for the second incident, the one that caused injury.

## 4.11 Category 142, Pedestrian is unaccustomed to traffic driving on the left

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 3 (all included in category 111).

## Example

Road characteristics. Multi-lane divided.

Narrative. Car turned right and moved into the left lane. A pedestrian on the car's left looked to his left but not toward the right. The pedestrian began to cross and walked into the left side of the car. Damage to the vehicle would suggest that the first contact between the vehicle and the pedestrian occurred immediately in front of the A pillar. The pedestrian is believed to have been struck on his right shoulder by the left side of the windscreen, before impacts with the left side mirror and a sun visor attached to the front left windscreen frame. The pedestrian was forced back from the impact and came to rest on the carriageway near the kerb, while the car was brought to a stop immediately past the pedestrian's final position. The pedestrian is an international student and it is possible that he looked in the wrong direction prior to crossing because he was accustomed to vehicles travelling on the right side of the road in his country of origin.

### 4.12 Category 143, Pedestrian wrongly thinks traffic has a red signal

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 0.

#### Example

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. A car was travelling in the left of two eastbound lanes and approaching a signalised intersection where the driver intended to continue straight ahead. The driver was travelling at a self-reported speed of 50 km/h. The driver noted on his approach that the traffic signals for his direction of travel had turned to green and that the platoon of vehicles ahead of him was accelerating into the intersection. As the driver neared the intersection, he noticed a stationary pedestrian on the raised triangular median on the north western corner of the intersection. The driver assumed that the pedestrian was waiting for the pedestrian signals to change. As the car approached the painted Stop line at the intersection, the driver observed the pedestrian attempt to cross the road in a southerly direction, moving into the direct path of his vehicle. The driver of the car braked hard but was unable to avoid the collision. The front centre to front right of the car struck the right side of the pedestrian within the limits of the pedestrian crossing. The pedestrian was thrown forward of the vehicle and came to rest on his side in the right eastbound lane, approximately three metres from the impact point. The car came to a stop in the intersection with the right side of the vehicle adjacent to the pedestrian. The driver of the car stated that there was a large gap between his vehicle and those in the platoon that had been ahead of him. As a consequence, several westbound vehicles executed filter right turn manoeuvres in this gap prior to the car reaching the intersection. Possibly the pedestrian saw these vehicles turning and mistook their actions as indicating that the signals for the car's direction of travel had changed to red, but this could not be confirmed.

Comments. It is uncertain whether "Pedestrian wrongly thinks traffic has a red signal" is appropriate for this crash.

### 4.13 Category 144, Mutual misunderstanding by pedestrian and driver

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 0.

#### Example

Road characteristics. Multi-lane divided.

Narrative. A car was travelling in the right of three lanes in relatively light traffic when the young driver noticed an elderly pedestrian on the left footpath. The driver observed the pedestrian enter the left lane and begin to cross. The driver of the car reported that he braked on seeing the pedestrian enter the carriageway. The pedestrian then turned around to head back to the footpath. Seeing the actions of the pedestrian, the driver of the car began to accelerate. As the vehicle came closer to the pedestrian's position, the driver noticed the pedestrian suddenly turn back and move quickly across the carriageway, coming into the path of the vehicle. The driver braked hard and locked the brakes before skidding into the pedestrian who had turned to face away from the vehicle. The pedestrian was struck by the front centre to front right of the vehicle within the right lane. The pedestrian travelled onto the bonnet with the back of his head striking the lower right corner of the vehicle windscreen. The pedestrian slid off the vehicle and fell to the carriageway immediately in front of the car, which had now become stationary.

Comment. Pedestrian was admitted to hospital overnight, released, but two months later was re-admitted for a serious head injury that initially had not been apparent.

#### 4.14 Category 145, Pedestrian, in a group, is indecisive (influenced by others)

Number of cases that primarily come under this heading: 0.

Number of additional cases that could have been included here: 1 (included in category 133).

#### 4.15 Category 146, Lack of attention by pedestrian, not otherwise specified

Number of cases that primarily come under this heading: 5.

Number of additional cases that could have been included here: 0.

##### Example 1

Road characteristics. Multi-lane two way.

Narrative. A vehicle was travelling south on the carriageway when the driver brought the vehicle into a parking space along the eastern kerb. The driver alighted from, and stood alongside, his vehicle, and looked left and right for traffic. Failing to see the approach of any vehicles in either direction, the pedestrian began to walk briskly across the carriageway in a westerly direction. A car was travelling in the right of two southbound lanes at a speed reported by the driver to have been approximately 60 km/h, when the driver was confronted with the pedestrian moving toward the right lane ahead of him. The driver of the car had little time to take evasive action, stating that he braked at approximately the same time as the impact occurred. The front left headlight area of the car struck the right side of the pedestrian as he walked into the path of the vehicle. The pedestrian moved up the left side bonnet area of the car before striking the windscreen with his head. The pedestrian was thrown in front of the vehicle as it braked to a stop over both southbound lanes facing southeast. The pedestrian came to rest on his right side in front of the vehicle. The pedestrian was very familiar with the road as both a driver and a pedestrian and was unable to explain why he failed to see the vehicle before he elected to cross.

Comment. This puzzling type of case is not uncommon. It is not clear whether "Lack of attention by pedestrian" is an appropriate description or not.

##### Example 2

Road characteristics. Multi-lane divided.

Narrative. A car was travelling in the right of two northbound lanes and approaching a signalised T-junction where the driver intended to continue north. The junction was displaying a red signal for the car's direction of travel and the driver was travelling at a self-reported speed of 30 km/h as he approached. As the driver neared the junction, he observed a pedestrian move in an easterly direction from the western kerb approximately six metres ahead. The teenage pedestrian was looking in a north easterly direction as she crossed the left northbound lane. The driver of the car stated that he sounded his horn and moved his vehicle right toward the raised median. The pedestrian entered the right northbound lane and walked into the front left panel of the car between the front headlight area and the front left wheel. The pedestrian came onto the bonnet and possibly struck her head on the passenger side windscreen of the vehicle before falling to the carriageway. The car came to rest near the point of impact, with the front right wheel resting on the edge of the raised median. The pedestrian stood unaided and walked to the side of the carriageway. It is understood that the pedestrian's left foot may have been momentarily trapped under the front left wheel at the time of the impact and she was seen to be limping at the scene.

#### **4.16 Category 147, Misjudgment by pedestrian, who contacted the side of the vehicle**

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 2 (included in categories 132, 302).

##### **Example**

Road characteristics. Multi-lane two way.

Narrative. A young pedestrian was walking south as he approached a wide city intersection with the intention of crossing from north to south. The pedestrian was in a hurry and crossed through traffic rather than wait for the pedestrian signals, which were a short distance away. The pedestrian stepped onto the carriageway behind a stationary passenger bus and entered the centre eastbound lane without checking for oncoming traffic. A utility was travelling in the centre eastbound lane toward a signalised intersection that was showing a green signal. The driver of the utility did not see the pedestrian until he moved into the vehicle's path. The left side mirror of the utility, which was mounted to the left door in an adjustable bracket, struck the pedestrian's right side as the vehicle was passing. The mirror bracket was forced back against the door and window of the vehicle, causing paintwork damage across the door panel and the passenger side window to shatter into the cabin space. The left side of the metal cargo rail mounted in the utility's tray top then struck the right side of the pedestrian's face and the pedestrian fell onto the carriageway alongside the stationary bus. The driver of the utility braked on impact, coming to a stop in the pedestrian crossing approximately 12 metres east of the impact point.

Comments. As with some instances of category 146, walking into the side of a moving vehicle is quite a common type of crash that is rather puzzling. Is it the result of a "misjudgment", that does not require further explanation? Or is there some subtle interference between different mental processes? (The mental processes referred to might perhaps be perception of exactly where the vehicle is, evaluation of the degree of danger and whether further information is needed, and command of bodily movement.)

#### **4.17 Category 148, Deliberate bad behaviour by pedestrian such as disobedience of signals and crossing through stationary traffic**

This category has not been used. There were such cases, but other categories (particularly 111, Visual obstruction from traffic) have been used instead.

#### 4.18 Category 149, Recklessly bad behaviour by pedestrian such as skylarking and playing chicken

No cases.

## 5 Types of pedestrian crash in Group 2: Examples from the in-depth database

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The method of classifying pedestrian crashes has been described in Section 3 above.

The present Section is concerned with crashes in Group 2 — that is, types of crash that are typical pedestrian accidents, and either the driver's fault, or in circumstances where it is usual for the driver to take chief responsibility; examples include driving unsafely, and when the pedestrian is crossing the road with a green light, when the pedestrian is stationary in the road, and on footpaths, in pedestrian zones, etc.

### 5.1 Category 211, Visual obstruction from traffic (stationary or moving)

Number of cases that primarily come under this heading: 0.

For cases involving visual obstruction from traffic, see also category 111.

### 5.2 Category 212, Visual obstruction from roadside object (e.g., street furniture, vegetation)

Number of cases that primarily come under this heading: 1.

For cases involving visual obstruction from roadside object, see also category 112.

Number of additional cases that could have been included here: 0.

#### Example

Road characteristics. Multi-lane divided and commercial driveway.

Narrative. Car turned left into a narrow commercial driveway. Pedestrian in wheelchair was crossing the driveway from right to left (from the driver's viewpoint) and was close to the left footpath when first seen by the driver. The driver of the car braked on seeing the pedestrian but was unable to avoid the collision. The centre front of the car collided with the left side of the wheelchair, knocking the wheelchair and the occupant to the ground in front of the vehicle. The occupant, still in the wheelchair, was lying on his right side against the sealed surface at rest. The wide paved area to the side of the carriageway is characterised by a large plantation of vegetation to approximately one metre in height. It is possible that the height of the vegetation created a visual obstruction for both the driver and wheelchair occupant until just before the car entered the driveway.

### 5.3 Category 213, Darkness

Number of cases that primarily come under this heading: 0.

For cases occurring in darkness, see also category 113.

Number of additional cases that could have been included here: 1 (included in category 246).

### 5.4 Category 214, Other visual factors (e.g., glare, fogged vehicle window)

Number of cases that primarily come under this heading: 3.

In all three cases, the vehicle was turning right at traffic signals.

Number of additional cases that could have been included here: 2 (included in categories 134, 246).

### Example

Road characteristics. Multi-lane two way and single lane two way at signalised T-junction.

Narrative. A car was travelling west and approaching a signalised T-junction where the driver intended to turn right. The junction was displaying a red signal for this direction of travel and the driver brought the vehicle to a stop as the lead vehicle. An elderly pedestrian was aboard a motorised gopher waiting at a pedestrian crossing intending to cross from west to east. The signals at the junction changed, providing a green pedestrian signal for the gopher rider, and a green orb and a red right turning arrow for vehicles in the stem of the junction. The gopher rider began to cross within the confines of the pedestrian crossing and travelled across the left northbound lane. As the gopher was entering the right northbound lane, it was struck by the front centre to front right of the car that was undertaking a right turn against the red right turning arrow. The pedestrian was pushed forward in his seat by the impact, causing him to fall to the left of the gopher and partially to the roadside. The gopher remained upright in the collision. Both the car and the gopher came to rest near the impact point. The gopher rider stated that he was aware of the presence of the turning vehicle prior to the collision but expected that the car would give way to him as he travelled through the crossing on the green pedestrian signal. It was noted that the sun at this time of day, and time of year, is directly aligned with the traffic signals at this junction and is likely to have been a significant contributor to this collision. Those working in businesses adjacent to the intersection have observed that many vehicles have disobeyed the red arrow at this intersection, suggesting that its position may make it less obvious for drivers undertaking a right turn at this site. The junction has a crash history that includes eleven pedestrians being struck by turning vehicles in the past ten years. Ten of these eleven collisions occurred between 1500 hrs and 1600 hrs and commonly during the winter months, each under the same circumstances.

Comment. Some jurisdictions might not regard a gopher rider as being a "pedestrian".

## 5.5 Category 231, Driver drunk or affected by drugs

Number of cases that primarily come under this heading: 0.

Number of additional cases that could have been included here: 1 (included in category 307).

## 5.6 Category 232, Impairment of driver (in body, mind, or senses)

Number of cases that primarily come under this heading: 3.

The three cases were as follows.

Impairment of consciousness arising from epilepsy; car mounted left footpath.

Intellectual impairment; car failed to stop at traffic signals. (Uncertain whether the intellectual impairment is relevant or not.)

Dizziness, arising from sleep disturbance due to chronic pain; car mounted left footpath.

Number of additional cases that could have been included here: 0.

### Example

Road characteristics. Multi-lane divided.



Narrative. Driver became ill, attempted to pull up at the side of the road, but collided with a bus shelter where there were three pedestrians, trapping and injuring them (one seriously). The driver had a history of epilepsy and it is probable that this collision occurred as a result of an epileptic-type event. Her driver's licence was suspended for a minimum of twelve months following this crash, pending further assessment.

## 5.7 Category 241, Driver temporarily distracted

Number of cases that primarily come under this heading: 2.

In both cases, the drivers were turning right at signalised intersections; their attention may have been directed to oncoming traffic rather than to the possibility of pedestrians crossing. (See category 214 for other cases of collisions with pedestrians when turning right.)

Number of additional cases that could have been included here: 0.

### Example

Lighting conditions. Dusk.

Road characteristics. Multi-lane two way at signalised intersection.

Narrative. A pedestrian, walking north on the western footpath, entered the pedestrian crossing at the same instant that the pedestrian signal changed from green to a flashing red signal. A four wheel drive turned right from the north arm of the intersection to the west arm. The centre front of the four wheel drive's bull bar struck the right side of the pedestrian. The pedestrian was forced to the ground and came to rest on her left side immediately in front of the vehicle, which had come to rest in the pedestrian crossing, facing west. The driver of the four wheel drive stated that she was distracted by oncoming vehicles in the lead up to the crash and had been unaware of the pedestrian's presence until immediately prior to impact. The pedestrian was wearing dark clothing and is very likely to have been less visible to the driver in the twilight conditions.

## 5.8 Category 246, Lack of attention by driver, not otherwise specified

Number of cases that primarily come under this heading: 2.

There were several possible reasons for the first of these two crashes, but no definite evidence for any. For the other, sun glare on a dusty windscreen was a possible contributory factor.

Number of additional cases that could have been included here: 0.

### Example

Lighting conditions. Dark with street lighting.

Road characteristics. Multi-lane two way.

Narrative. An elderly pedestrian was attempting to cross a busy multi-lane carriageway from east to west in peak hour conditions. The carriageway is characterised by two northbound and two southbound lanes divided by a broken centre line. The pedestrian crossed both southbound lanes of the carriageway without incident and was standing on the centre line of the carriageway before attempting to cross to the western footpath. Presumably the pedestrian's attention would have been directed to the south. A car was travelling in the right of the two southbound lanes, at a speed reported by the driver and witnesses to have been approximately 50 km/h. The front right corner of the vehicle struck the pedestrian while she remained stationary on the centre line. The pedestrian came onto the bonnet over the front right edge before her head struck the right side of the windscreen. The pedestrian

was thrown forward of the vehicle and landed on the centre line of the carriageway approximately nine metres south of the impact point. The driver of the vehicle, who stated that she had not seen the pedestrian until the impact, braked and moved into the left lane following the collision, coming to rest approximately 28 metres southeast of the impact point. The pedestrian died at the scene. Although street lighting is present at the crash site, large street trees and the distance between the lights decreases its effectiveness. It is possible that the poor illumination may have made the pedestrian less visible to the driver of the car. Some witnesses to the crash stated that the pedestrian was clearly visible on the carriageway while others stated that they had not seen her until the collision occurred. The driver is known to have consumed a quantity of alcohol in the hours preceding the crash. She had a legal blood alcohol concentration of 0.039.

Comments. (a) It does sometimes happen that in busy traffic pedestrians wait on the centre line. As drivers should appreciate this, this crash has been considered an example of circumstances where it is usual for the driver to take chief responsibility, i.e., appropriate to be included in Group 2. Nevertheless it is arguable that this crash should instead be in Group 1. (b) This was a fatality, yet the key reason for the crash remains uncertain.

## 5.9 Category 248, Deliberate bad behaviour by driver (excluding recklessness)

Number of cases that primarily come under this heading: 3.

In two of the cases, the vehicle turned right from a shopping centre across a painted median. This manoeuvre is probably legal, and so to refer to it as bad behaviour is not quite right, but these cases are included here as the manoeuvre probably would not be expected by other road users. In the third case, the car was speeding.

Number of additional cases that could have been included here: 3 (included in categories 134, 141, 141).

### Example

Road characteristics. Single lane two way.

Narrative. A car turned right from a shopping centre, across a painted median, to go northwest. (The driver had noted that the pedestrian crossing, eight metres northwest of her position, was not being used by pedestrians at that time and that a green signal was displayed for vehicles.) However, the driver then became aware of an elderly pedestrian directly in her path. The driver braked as the front of the vehicle struck the pedestrian, coming to a stop almost immediately. The pedestrian fell to the ground in front of the stationary vehicle. She had been attempting to cross the road in a north easterly direction prior to the collision and was not using the pedestrian crossing. She had sustained a penetrating eye injury in the weeks preceding the crash that resulted in considerable visual compromise and so may not have seen that a car was turning onto the carriageway.

Comments. Unexpected vehicle manoeuvre, unexpected place for a pedestrian to cross, and the pedestrian's vision impairment may have been relevant.

## 5.10 Category 249, Recklessly bad behaviour by driver

No cases.

## 6 Types of pedestrian crash in Group 3: Examples from the in-depth database

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The method of classifying pedestrian crashes has been described in Section 3 above.

The present Section is concerned with crashes in Group 3 — that is, types of crash that are not usually thought of as typical of pedestrian accidents.

### 6.1 Category 301, Pedestrian on footpath struck by a projection of the vehicle (including mirrors)

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 0.

#### Example

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. Pedestrian who was standing on the footpath between a traffic signal pole and a traffic signal control box, close to the kerb, was struck by the mirror of a passing bus. (There was another bus travelling in the next lane to the right, and thus the striking bus was forced to keep well to the left.) The pedestrian had been looking in the opposite direction to the bus and was unaware of any potential danger. The left side mirror of the bus struck the back of the pedestrian's head causing the support arm of the mirror to be pushed backwards. The pedestrian remained standing following the impact.

Comments. It was a low-floored bus, on which the mirror is often mounted lower than usual.

### 6.2 Category 302, Pedestrian in roadway struck by a projection of the vehicle (excluding mirrors of small vehicles)

Number of cases that primarily come under this heading: 3.

Very briefly the three cases were as follows.

Teenage girl ran into side of a trailer and was struck by part of it.

Two cases in which a person standing to the right of a parked vehicle was struck by a passing vehicle.

Number of additional cases that could have been included here: 1 (included in category 141).

#### Example

Road characteristics. Multi-lane divided.

Narrative. A driver parked his van against the kerb and stood alongside the driver's side door with the intention of crossing the carriageway. A large four wheel drive vehicle towing a caravan was travelling in the left of two southbound lanes and approaching the pedestrian's position. On seeing the pedestrian alongside the van, the driver of the four wheel drive braked hard, locking the wheels. The four wheel drive drifted to the left of the lane toward the pedestrian and the parked van. Fearing that he would be crushed between the two vehicles, the pedestrian attempted to move quickly ahead of the van but was unable to avoid being struck. The front left of the four wheel drive's bull bar struck the pedestrian's

raised right arm. The pedestrian was pushed ahead of the four wheel drive before falling to the road surface ahead of his vehicle and rolling to rest.

Comment. In that the vehicle drifted to the left under heavy braking, this might be counted as a crash where a vehicle defect is a contributing factor.

### 6.3 Category 303, Pedestrian's foot is run over

No cases.

### 6.4 Category 304, Part of pedestrian (e.g., head or arm) was inside vehicle when it moved

No cases.

### 6.5 Category 305, Worker on the road

No cases.

### 6.6 Category 306, Struck by two or more vehicles

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 1 (included in category 307).

#### Example

Lighting conditions. Dark with street lighting.

Road characteristics. Multi-lane divided.

Narrative. There were two parts to this crash. First, a car struck a pedestrian. Second, the pedestrian, lying in the road, was run over by another car. A car was travelling in the right of three northbound lanes. Traffic conditions were light, with only one other car travelling a distance behind but in the centre lane. The speeds of the vehicles, according to the drivers, were approximately 50 to 55 km/h. A pedestrian ran from the western footpath into the left side of the first car at the same time as the driver braked. The pedestrian's head struck on the left A pillar and adjacent windscreen, and he fell backwards across the centre lane of the carriageway in what appeared to be an unconscious state. The driver of the second car did not see the pedestrian on the carriageway. The pedestrian was run over by both the front and rear wheels of Unit 2. The pedestrian was wearing dark clothing and may have been less visible to the car drivers, who were elderly. The pedestrian was found to have a blood alcohol concentration of 0.331, which is highly likely to have impaired his judgement. The pedestrian died at the scene as a result of his injuries.

### 6.7 Category 307, Loss of control of vehicle, pedestrian (whether on or off road) is struck

Number of cases that primarily come under this heading: 2.

Number of additional cases that could have been included here: 2 (both in category 232).

#### Example

Weather. Light rain.

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. While turning right, rear wheels of car lost traction on the wet surface causing the vehicle to begin to rotate clockwise. The young driver stated that he panicked and over-corrected the vehicle to the left. The driver braked hard and lost control of the vehicle. The vehicle rotated approximately 180 degrees anti-clockwise as it travelled across the left lane. The vehicle mounted the kerb and the driver's side door struck a large tree. A group of pedestrians were standing on the footpath adjacent to the tree while waiting for a bus. The car rotated clockwise around the tree following the impact and struck one of the pedestrians. The pedestrian was struck by the front right of the vehicle before being deflected backward and landing on the footpath. The car came to rest straddling the footpath and the left lane. Although the rain was light at the time of the collision, there had been a heavy downpour of rain in the minutes preceding the crash. The right rear tyre of the car had very low tread depth, which is likely to have contributed to the diminished traction.

## 6.8 Category 308, Vehicle reversing

It is likely that a substantial number of crashes in which a vehicle was reversing occur on private property such as residential driveways and commercial car parks. Datasets, such as ours, that are restricted to crashes on public roads are likely to understate the dangers of reversing vehicles.

Number of cases that primarily come under this heading: 2.

Number of additional cases that could have been included here: 0.

### Example

Road characteristics. Multi-lane divided.

Narrative. The driver of a four wheel drive vehicle attempted to reverse into a parking space more than 20 metres to the rear. An elderly pedestrian was attempting to cross the road from the vehicle's offside to its nearside, that is, from the median strip to the footpath. The rear of the four wheel drive struck the right side of the pedestrian, knocking her to the carriageway. The pedestrian experienced head injuries as a result of the collision and died later that day. The driver was unaware of the pedestrian's presence until the impact.

Comments. The speed at which the vehicle was reversing is not known.

## 6.9 Category 309, Pedestrian came into the path of the vehicle inadvertently (e.g., tripped)

Number of cases that primarily come under this heading: 1.

Number of additional cases that could have been included here: 0.

### Example

Road characteristics. Multi-lane divided.

Narrative. Van moved into left turn lane at a speed estimated by the driver to have been approximately 40 km/h. A pedestrian moved quickly from a shopping centre car park across the footpath into the left turn lane in front of the van. The driver of the van braked heavily but was unable to avoid collision. The front left corner of the van struck the right side of the pedestrian near the centre of the turning lane. The pedestrian's right shoulder or elbow struck the lower left corner of the windscreen while his right hip area made contact with the left panel and headlight immediately below the windscreen. The pedestrian fell to the carriageway in front of the van but was able to stand and move to the side of the carriageway with assistance. The driver perceived the pedestrian's movements as a deliberate attempt to cross the carriageway but the pedestrian stated that he was looking for a bus and tripped into the turning lane as he reached the edge of the carriageway.

## 6.10 Category 310, Failure to control a pedestrian vehicle (e.g., wheelchair, skateboard)

Number of cases that primarily come under this heading: 0.

Number of additional cases that could have been included here: 1 (the pedestrian was using a skateboard; included in category 111).

There was also a case in category 214 in which the pedestrian was using a gopher, but there was no "failure to control".

## 6.11 Category 311, Involvement of pedestrian, or running over of pedestrian, is secondary to something else (and is the most important event)

Number of cases that primarily come under this heading: 0.

Number of additional cases that could have been included here: 3 (included in categories 232, 306, 141).

## 6.12 Category 312, Involvement of pedestrian, or running over of pedestrian, is secondary to something else (but is not the most important event)

No cases.

## 6.13 Category 313, The person was in, or on, the vehicle (and may by some criteria not be considered to be a pedestrian)

No cases.

This category is for cases in which the person was in, or on, the vehicle that injured him or her, yet seems more appropriately described as a pedestrian than a vehicle rider or occupant. Cases in which a person is using a pedestrian vehicle such as a wheelchair or skateboard are not included here. See category 310 for cases in which a person fails to control a pedestrian vehicle.

## 6.14 Category 314, Action of an animal is relevant

No cases.

## 6.15 Category 315, Suicide, attempted suicide, and acts that appear similar

Number of cases that primarily come under this heading: 7.

Elderly pedestrian with cognitive deficits; into left side of car.

Pedestrian with a long-standing mental illness and had expressed suicidal intentions in the hours leading up to the crash; stood in front of a truck.

Pedestrian known to have experienced mental health problems over a long period of time and had absconded from inpatient mental health care in the lead up to the collision; lunged in front of a truck.

Pedestrian absconded from a mental health unit in the hour before the collision took place; lunged in front of a truck.

Pedestrian had a long history of mental health issues (including psychosis involving command hallucinations); ran in front of a bus.

Pedestrian lay down in front of a utility, which stopped and the pedestrian was uninjured. However, he then ran and stood in front of a truck.

Elderly pedestrian known to have been under considerable stress related to health and social issues; stepped in front of car.

Number of additional cases that could have been included here: 2 (included in category 131).

## **6.16 Category 316, Assault or murder using motor vehicle, and acts that appear similar**

No cases.

## **6.17 Category 317, Information about the vehicle and its driver is unavailable**

No cases.

## 7 Pedestrian fatalities in the TARS database

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It was intended that this study concentrate on information from the in-depth database. As a check on what was found there, the accounts of pedestrian fatalities in the Adelaide Metropolitan Area that are given in the TARS database (crashes routinely reported to the police) were examined.

- Rather a different story emerged. In contrast to the many different categories found in the in-depth database, many of the fatalities fell into three groups: at night, or involved drunkenness of the pedestrian, or the pedestrian was elderly. In 2003-2006, 40 pedestrian fatalities occurred. Of these, only 11 did not fall into at least one of those three types. (Statewide, there were 49 pedestrian fatalities in 2003-2006.) For reasons why the in-depth and TARS-fatal databases differ from each other, see Sections 2.3 and 10.1.
- It is worth considering how adequate is information in TARS, including the text field, for identifying the significant features of what happened. Response to this is necessarily subjective. We fear, however, that for pedestrian accidents, quite a lot may have been omitted. The features that have already been noted -- nighttime, drunkenness of the pedestrian, or the pedestrian being elderly -- are factual in nature, and likely to be valid. But we do not know whether something important may have been missed. The pedestrian is dead, and cannot tell their side of the story. For example, inattention or minor speeding by the motor vehicle driver might not be known about.

The purpose here is to supplement the in-depth database, rather than give a full account of pedestrian fatalities, and no attempt was made to seek other sources of information, such as a report prepared for the Coroner, or a newspaper report.

### 7.1 Brief summaries of pedestrian fatalities 2003-2006

In 3 of the 40 cases, information about the motor vehicle was not known. All of these were at night, and the pedestrian was drunk.

In 2006, there were 11 pedestrian fatalities, as follows.

drunk pedestrian lying on road, night

night, drunk pedestrian walking on road

drunk pedestrian

walking on road at night, struck, run over by another vehicle (visual obstruction by traffic)

car speeding, elderly pedestrian

left-turning truck, elderly pedestrian

night, elderly pedestrian

night

night, speeding motorcycle; motorcyclist also died (fell off and was run over)

drunk pedestrian

night



In 2005, there were 7 pedestrian fatalities, as follows.

unoccupied bus moves, runs over its driver

drunk pedestrian, night

station wagon reversing

tram (at intersection of tram tracks with road)

elderly pedestrian; vehicle (utility) failed to give way at crossing when turning left

elderly pedestrian; speed

pedestrian misjudged?

In 2004, there were 9 pedestrian fatalities, as follows.

drunk pedestrian sitting on road, night, visual obstruction by traffic

child in a group, possible visual obstruction from traffic

elderly pedestrian, teenaged motorcyclist, night

drunk pedestrian at night was struck, then run over by another car

elderly pedestrian, night

elderly pedestrian, night

drunk pedestrian

teenager, reason for collision not clear

night (pedestrian walking on road)

In 2003, there were 13 pedestrian fatalities, as follows.

drunk pedestrian (possibly sitting on road), night

young child, visual obstruction from traffic

teenager into side of trailer of truck

drunk pedestrian, night

lying on road drunk, night, possible high speed of vehicle

elderly pedestrian

night, motorcycle

elderly pedestrian, from between traffic, impact with slow vehicle

elderly pedestrian

night, possible lack of attention by the pedestrian

elderly pedestrian

night, freeway, mental illness of pedestrian

drunk pedestrian, night

## 7.2 Statistics on the disproportionate number of pedestrian fatalities at night

The above list suggests that pedestrian fatalities present quite a different picture from pedestrian casualties as a whole. Further examination of the TARS database found that whereas 57 per cent of pedestrian fatalities were at night, the figure for pedestrian casualties was 26 per cent. That refers to the Adelaide Metropolitan Area for the period 2003-2006.

The disproportionate number of fatalities at night is a feature that is becoming stronger. For pedestrian fatalities, the daytime number in 2003-2006 was 23 per cent of what it was in 1981-1984, but the nighttime number was 38 per cent. That is, the reduction over the subsequent two decades in the nighttime number was not as great as for daytime.

Another way of looking at the figures is that from 1981-1984 to 2003-2006, the proportion of pedestrian fatalities occurring at night increased from 44 per cent to 57 per cent. (There was no similar increase for car driver fatalities: the proportion at night was 49 per cent in both 1981-1984 and 2003-2006.)

The proportion of fatalities among total casualties is a measure of the severity of a class of accidents. For pedestrians, this fell from 3.7 per cent in 1981-1984 to 1.4 per cent in 2003-2006 for daytime accidents, and from 9.6 per cent to 5.2 per cent for nighttime accidents.

According to the TARS records, 10 of the 23 pedestrian nighttime fatalities were drunk. So on this evidence, there are many pedestrian nighttime fatalities that cannot be ascribed to pedestrian drunkenness. As in other jurisdictions, procedural complications mean that it is possible for blood alcohol concentration to be missing from a dataset, but it seems unlikely that this could account for anything like 13 out of 23 cases. Concerning blood alcohol concentrations of pedestrian fatalities, see also Anderson (2008, Section 2.4).

## 8 Cyclist accidents in the in-depth database

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There are 11 crashes in the in-depth database, rather too few to draw firm conclusions from. The descriptions of the cases below will be organised as follows.

Four cases involving a motor vehicle turning left.

Bicycle from footpath into side of left-turning trailer of truck.

Left-turning truck struck cyclist on its inside.

Car turning left at an unexpected place struck cyclist on its inside.

Left turn by van struck cyclist on its inside.

Three cases of a fast cyclist.

Fast cycle into rear of parked car.

Truck turned right across path of oncoming cyclist; visual obstruction; speed of cyclist.

Fast cycle into rear of stationary car that had intruded into the bicycle lane.

Four other cases.

Car failed to give way to cycle at roundabout.

Cyclist struck by towed caravan as they passed parked vehicle.

Car moved to left at same time as cyclist moved to right.

Cyclist acting as a pedestrian disobeyed red pedestrian light; visual obstruction.

Among these, a visual obstruction was relevant in Example 2 of Section 8.2 and Example 4 of Section 8.3.

Section 9 below will supplement these cases with some notes on fatal cycle accidents in the period 1994-2006.

As acknowledged above, 11 cases is rather few. Hutchinson et al. (2006, 2007a,b, 2008) give a statistical account of pedal cycle crashes in South Australia. For example, the most common category of crash type is "right angle", accounting for 70 per cent of child cyclist and 37 per cent of adult cyclist crashes (see Tables 2.10 and 3.10 of Hutchinson et al., 2006).

### 8.1 Motor vehicle turning left (4 cases)

#### Example 1

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. Articulated truck turned left at traffic lights, from eastbound to northbound. Teenage cyclist riding eastbound on the footpath somehow went under the left front wheel of the trailer, and was killed.

#### Example 2

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. A large garbage truck was travelling in the left lane intending to turn left at a signalised intersection. The signals were red and the truck stopped as the lead vehicle at the intersection. A cyclist became stationary at the red signal alongside the cabin section of the truck, with the intention of continuing straight ahead once the signals changed. When the signals turned to green, the truck commenced the left turn, coming into the direct path of the cyclist who had started to move forward through the intersection. The front left corner of the truck collided with the cyclist. The cyclist toppled and fell under the left side of the truck and continued to tumble under the truck until it stopped, 20 metres from the impact point. The cyclist and bicycle came to rest under the truck with the cyclist's left foot trapped beneath one of the left dual rear wheels and bicycle under the right rear wheels. The driver of the truck stated that he had his left indicator on while stationary at the intersection. He was unaware of the cyclist at any time prior to undertaking the turn.

### Example 3

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. Signals were green as the cyclist approached in the bicycle lane, intending to continue across the intersection. Car turned left across her path. The car had passed a left turn slip lane and was turning at an unexpected place. (It is unknown whether the driver was familiar with the road layout.) The front wheel of the bicycle struck the front left door of the car. The cyclist struck the left side mirror and was thrown over the front edge of the roof and onto the bonnet of the vehicle following the impact. The cyclist landed in the centre of the pedestrian crossing 10 metres beyond the impact point. The bicycle struck the front left corner of the vehicle as it continued forward and slid across the carriageway.

### Example 4

Road characteristics. Multi-lane two way.

Narrative. From the right of two lanes, a van turned left into a petrol station. The van crossed a cycle lane, and a collision with a bicycle occurred. It seems that the driver's decision to enter the petrol station was a sudden one. He stated that he looked in his left mirror for vehicles before turning but did not see the cyclist. Also, the cyclist was looking over his right shoulder, preparing to move to the right to avoid an obstruction ahead. The front wheel and handlebars of the bicycle struck the left rear panel of the van immediately above the rear wheel. The cyclist moved forward from the impact and struck the vehicle with his helmet before falling to the driveway surface.

## 8.2 Fast cyclist (3 cases)

The fast speed of the cyclist was a common factor in these three cases. (The speeds were reported as 40 km/h, 30 km/h, and 55 km/h.) Though it is convenient to group them together because of this, in each case some other factor was also relevant: misjudgment by the cyclist, possible visual obstruction, and intrusion of a car into the bicycle lane.

### Example 1

Road characteristics. Multi-lane two way.

Narrative. Teenage cyclist, travelling in a bicycle lane at about 40 km/h, struck the rear of a (legally) parked car. The cyclist was aware of the car, but had not moved to the right because of traffic. He stated that he had misjudged the distance of the vehicle and/or his speed as he approached. The front wheel of the bicycle collided with the centre rear of the parked vehicle. The rider was thrown forward over the handlebars on impact and onto the boot of the vehicle. The cyclist's head and left shoulder then collided with the vehicle's rear window, which shattered on impact. The cyclist came to rest with his head and torso over the rear seat and rear window ledge with his leg extended over the boot.

## Example 2

Road characteristics. Multi-lane divided and single lane two way at signalised T-junction.

Narrative. A removalist truck was turning right into a side road at traffic signals. An oncoming truck (not involved in the actual collision) turned left into a service station exit immediately before the T-junction. The driver of the removalist truck, rather than actually coming to a stop, accelerated into the right turn. While negotiating the turn, the driver of the truck observed an oncoming cyclist in the bicycle lane. The truck driver accelerated in an attempt to move out of the cyclist's path, while the cyclist, on seeing the truck directly ahead, tried to avoid a collision by braking and steering to the right. The front wheel of the bicycle struck the left rear panel of the truck within the bicycle lane. The cyclist was thrown over the handlebars of the bicycle and struck the left side of the truck with her face and helmet. The cyclist and the bicycle fell to the carriageway following the collision while the truck came to a stop at the carriageway edge. The cyclist estimated her speed to be approximately 30 km/h prior to braking. The uninvolved truck may have hidden the cyclist and the removalist truck from each other.

Comments. As well as the cyclist's speed, the visual obstruction by other traffic seems relevant.

## Example 3

Road characteristics. Single lane two way.

Narrative. Car was stationary, partly in the bicycle lane and partly in the motor traffic lane, waiting for a bicycle behind it to pass before parking. The teenage cyclist, travelling at a self-reported speed of 55 km/h (down a slope), looked over his right shoulder. (He intended to turn right at the T-junction 100 metres further on.) The right handle bar of the bicycle struck the left rear lights and corner of the rear hatch of the car as the front wheel of the bike travelled along the left side of the vehicle. The cyclist was thrown forward from the impact and struck the right side of his bicycle helmet on the left rear panel of the vehicle before somersaulting over the left rear corner of the roof and falling to the carriageway near the left rear wheel of the car. The handlebars of the bicycle were found to have rotated clockwise as a result of the impact and struck the left rear panel of the vehicle before the bicycle fell to the carriageway on top of the cyclist. The rider stated that he had been unaware of the car ahead of him in the lead up to the crash, seeing the vehicle for the first time immediately prior to the collision. Both the driver and rider were familiar with the route.

Comments. This has been included under the heading of "Fast cyclist", but note that the car had intruded into the bicycle lane.

## 8.3 Others (4 cases)

### Example 1, car failed to give way to cycle at roundabout

Road characteristics. Single lane roundabout.

Narrative. A bicycle was travelling toward a roundabout where the rider intended to continue straight. A car was approached the roundabout from the cyclist's left. The car failed to give way to the right, with both vehicles entering the roundabout at approximately the same time. The bicycle struck the rear bumper of the car within the roundabout. The bicycle and cyclist fell to the road surface following the impact, coming to rest on the carriageway near the south eastern corner. The cyclist experienced a loss of consciousness at the scene. She has no memory of the impact or of seeing the car prior to the collision.

### Example 2, cyclist struck by towed caravan as they passed parked vehicle

Road characteristics. Multi-lane divided.

Narrative. An elderly cyclist and an unidentified vehicle towing a caravan attempted to pass parked vehicles simultaneously. The front left corner of the towed caravan struck the cyclist's right elbow and backpack as it proceeded past the bicycle. The cyclist was forced forward over the handlebars of the bicycle before landing on the road surface next to the right side of one of the parked vehicles. He came to rest on the carriageway facing oncoming vehicles. The unidentified vehicle drove on --- it is likely that the driver was unaware of the impact. The rider of the bicycle was an experienced cyclist but stated that he did not check behind him for traffic before undertaking the passing manoeuvre because this often made his riding unsteady.

### Example 3, car moved to left at same time as cyclist moved to right

Road characteristics. Multi-lane divided.

Narrative. A car was travelling in the centre of three lanes on a divided (one-way) carriageway at a speed reported by the driver to have been approximately 60 km/h. When the driver encountered traffic moving in the centre lane at a speed he estimated to have been approximately 50 km/h, he indicated and started to move into the left lane in order to overtake. A bicycle was being ridden in the same direction on the left edge of the carriageway when its teenage rider decided to move across to the right lane in preparation for an upcoming right turn into a side street. The rider checked for traffic and judged that he had time to move across the carriageway but he did not see the car starting to move into the left lane to pass the slower traffic. The rider commenced his move just as the car was moving into the left lane. The driver of the car braked but was not able to avoid collision. The right front of the car struck the right side of the bicycle in the left lane. The rider came onto the right side of the bonnet and struck the right A-pillar before being thrown onto the carriageway, landing in the left lane in front of the car. The bicycle continued across the carriageway to its final position next to the raised central median. The car was parked by the driver next to the kerb on the left side of the carriageway. The young driver had a history of three crashes in the previous five years, all of which were deemed by police to have been his fault.

### Example 4, cyclist acting as a pedestrian disobeyed red pedestrian light; visual obstruction

Road characteristics. Multi-lane divided at signalised intersection.

Narrative. Bicycle ridden by young school girl across pedestrian crossing at signalised intersection. After crossing one carriageway without incident, she passed in front of traffic in two lanes that was held stationary by a red turn arrow, and came into the path of traffic that had a green signal. A car (the driver reported its speed as 60 km/h) was approximately one to two metres from the pedestrian crossing when the driver was confronted with the cyclist travelling directly into her path. The driver of the car braked heavily but was unable to avoid collision. The centre front of the car struck the left side of the bicycle within the pedestrian crossing. The bicycle and the cyclist both moved up the bonnet of the vehicle before being thrown forward and separating. The car came to rest in the right lane in the pedestrian crossing. The young cyclist fell to the carriageway approximately one metre ahead and to the right of the car in its final position. The stationary vehicles in the two right turn lanes created a visual obstruction for both the cyclist and the driver of the car in the lead up to the collision.

## 9 Cyclist fatalities in the TARS database

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It was intended that this study concentrate on information from the in-depth database. However, as there are not many cyclist cases in the in-depth database, an examination was also made of the textual descriptions in the TARS records of cyclist fatalities in the Adelaide Metropolitan Area for 1994-2006. There were 37 crashes in which a cyclist was killed. Two cyclists were killed in one of these. (Statewide, there were 56 pedal cyclist fatalities in this period.)

For reasons why the in-depth and TARS-fatal databases differ from each other, see Sections 2.3 and 10.1.

At the beginning of Section 7, concern was expressed that for the pedestrian fatalities, the brief account in the TARS text field may often not have conveyed the true central story of the crash event. Our concern — again this is a subjective view — is rather less for this series of cyclist cases: in most, the description in the TARS text field seemed adequate to identify the significant features of what happened. However, as always with such a data source, it needs to be remembered that the cyclist is dead, and cannot tell their side of the story. It is likely that police would either not know about or not note inattention or minor speeding by the motor vehicle driver.

The purpose here is to supplement the in-depth database. No attempt was made to seek other sources of information, such as a report prepared for the Coroner, or a newspaper report.

### 9.1 Common types of cycling fatality

Longo (1997) identified the following most common types of cycling fatality:

- Motor vehicle attempting to overtake cyclist (mostly, impact to rear of cycle).
- Cyclist turned or swerved unexpectedly into path of motor vehicle.
- Cyclist rode into path of motor vehicle from an intersection or footway.
- No other vehicle involved.

Her report goes up to 1993, which is why 1994 was selected as the start date for the present series.

### 9.2 Brief summaries of cyclist fatalities 1994-2006

This method of classification was helpful when going through the present series of cases. The categories below were generated from the present series. Having an “other” category at the end means that the list is exhaustive.

- Same direction, motor vehicle into rear of cycle .... 7 cases (of which, 6 were at night).
- Same direction, side swipe .... 4 (of which, 3 involved a truck that was turning left, or was about to). In addition to these cases, there were others in which a truck was turning left, and/or the view to the nearside of a left-turning truck was possibly relevant, and/or the cyclist fell under the wheels of a truck.
- Cyclist turned or swerved unexpectedly into path of motor vehicle .... 4.
- Cyclist emerged unexpectedly into path of vehicle from an intersection or footway .... 13.

- Involvement of cyclist, or running over of cyclist, was secondary to something else .... 5.
- Single vehicle .... 2.
- Other .... 2.

Of the 37 crashes, 32 of them fall into (one or more of) the following four categories: children (0-15), elderly (60+), at night, or truck turning. There are only 5 other cases.

There were a number of cases in which the motor vehicle driver had had a number of previous crashes, and it is tempting to surmise that the motor vehicle driver bore some responsibility for the crash. However, it is difficult or impossible to know whether that is so, as a high number of crashes per ten years could be due either to a high rate per kilometre driven, or to a high number of kilometres driven. That is, drivers, whether of trucks or of cars, who drive a greater distance will be more likely both to appear in this sample of crashes and to have had other crashes.



## 10 Discussion

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This Section will be organised as follows. Section 10.1 attempts to reconcile the different results from the in-depth and fatality series of pedestrian accidents. Section 10.2 selects some conventional countermeasures for comment. Section 10.3 considers the split of roadway space between environmentally-friendly modes and motorised modes.

### 10.1 Summing-up of the different findings about pedestrians

In the introduction to the series of pedestrian fatalities (beginning of Section 7), the fatalities were contrasted with the in-depth series. Some reasons for differences might be considered relatively uninteresting: the story of any event can be told in lesser or greater detail, and a set of events may be organised using few categories or many. The descriptions of crashes in the TARS database are brief, and if information were available, it might seem appropriate to use more categories.

An important substantive difference between the databases is that the in-depth study concentrated on crashes in normal working hours, and thus nighttime crashes are underrepresented, and consequently so is drunkenness. The following synthesis is offered.

The in-depth investigations show that there are many different types of pedestrian accident, each of which is nevertheless sufficiently frequent to be recognisable and would probably occur at least once or twice in a series of a hundred or two pedestrian crashes.

This particular in-depth series cannot be expected to give good information on nighttime and drunkenness crashes. These are known from the fatal cases to be important, and should be added to, and perhaps placed ahead of, the types identified from the in-depth series.

This suggests the following.

- As regards countermeasures targetted at a particular type of pedestrian accident, there are many opportunities. However, each is likely to have only a small impact on the totality of pedestrian crashes.
- Nighttime and alcohol-related crashes are worthy of particular attention.
- Higher speed is very often what converts a near miss into an injury, or an injury into death. Reduction of vehicle speed (by, for example, reducing speed limits and enforcing them) would be expected to reduce deaths and injuries to all road users.

### 10.2 Countermeasures

Pedestrian accidents and cyclist accidents have some similarities and some differences. As regards conditions that promote safety across a broad front, good visibility, sobriety of the road user, and low speed of motor traffic are good for pedestrians, cyclists, and all other road users. For the car or commercial vehicle designer, both pedestrians and cyclists are exterior to the vehicle. But the cyclist typically shares the road with the motorist, whereas the pedestrian is an intruder on the roadway. Getting the cyclist off the roadway and on to a cycle path or footpath is an option long debated (Hutchinson et al., 2007b).

Sections 4-9 discussed four series of crashes: pedestrian accidents in the in-depth database, pedestrian fatalities in the TARS database, pedal cycle accidents in the in-depth database, and pedal cyclist fatalities in the TARS database. Taking these together, the following issues stand out.

Nighttime.

Drunkenness of pedestrians.

Visual obstruction by traffic.

Visual obstruction by roadside objects.

Possible improvements to other details of the road.

Trucks (visibility from the cab, and side protection).

Speed.

After discussion of these, some comments will be made on the concept and statistics of fault in pedestrian accidents.

## Night

Improvements to street lighting and making the pedestrian or cyclist more conspicuous are both likely to reduce accidents. Reviews by Retting et al. (2003) and Elvik and Vaa (2004, pp. 364-371) draw attention to very positive empirical effects of both lighting previously unlit roads and substantially improving existing lighting. (However, the literature that they review is from the period 1948-1993, so it is not clear whether it is still relevant.) For road lighting standards and practice in Australia, see Austroads (2004). Making road surfaces brighter is another measure mentioned by Elvik and Vaa, but there is no strong evidence about its effectiveness. Another strategy is to increase the conspicuity of the pedestrian or cyclist — by retro-reflective markings on clothing, for example. A review by Kwan and Mapstone (2006) found good evidence had been published for improved detection and recognition by drivers, but they were unable to locate any methodologically-satisfactory studies of accidents.

However, the conspicuity or ease of detection of an object is a many-faceted concept, as a review by Langham and Moberly (2003) makes clear. Further, it seems that as regards the driver, it is not known what type of visual performance should be measured in order to predict visual aspects of driving performance (Wood and Owens, 2005).

Accident information provides some guidance as to which aspects of conspicuity are most relevant and what countermeasures would be expected to work best.

- There is nothing to contradict the common sense idea that if pedestrians and cyclists wear conspicuous clothing, they are more likely to be seen. It is important, though, that pedestrians and cyclists not think they are more conspicuous than they really are.
- Regarding road users' lack of appreciation of their own inconspicuousness, it might be worth emphasising in publicity aimed at the young and youngish that the eyes of elderly drivers do not perform as well at night as their own eyes (Wood and Owens, 2005; Wood et al., 2005).
- In addition, it seems that in many of the cases for which pedestrian conspicuity might be relevant, the pedestrian is not crossing the road in a normal fashion. Instead, the (drunk) pedestrian is stationary in the road, or behaving erratically, typically at night on a lit road. Now, a driver at night is continually seeing irregular patches of dark on the road surface; it seems likely that the issue is not so much

seeing, but interpreting a patch as being a pedestrian and deciding that avoidance is required. This line of thought is not conclusive, but the countermeasures it suggests are that lighting should be sufficient for a pedestrian lying on the road to be instantly identifiable as such, that the possibility of a pedestrian lying on the road be publicised to drivers, and that driving speeds be reduced in order to lessen the distance travelled in a given reaction time.

## Drunkenness of pedestrians

A report by Austroads (1998) reviews research on alcohol-impaired pedestrians. There are not many recommendations under the heading of countermeasures, except that there is a proposal that sites with high pedestrian crash rates and locations with densities of pedestrians who are likely to have consumed alcohol should be subjected to a safety audit to identify deficiencies in the road environment that might lead to increased crash risk.

It is indeed difficult to think of plausible countermeasures. For motorists impaired by alcohol, it is possible to imagine fitting alcohol interlocks in all new cars, and thereby achieving a technological solution, but for pedestrians or cyclists impaired by alcohol, such an approach seems impracticable. What other options are there?

- It is desirable to promote awareness among drivers that pedestrians might be drunk and awareness among pedestrians that their judgment may be impaired (see Recommendation 8 of Austroads, 1998). Campaigns often have no detectable effect on crashes, but it is possible that there is an eventual gain in knowledge of dangers by the public, and a shift in attitudes and behaviours.
- Possibly the police could more readily intervene to protect someone from themselves who is observed drunk on the street. In South Australia, it is not an offence to be drunk, but police may take into custody a person who is drunk in a public place, and take the person home or to a police station or a sobering up centre (Legal Services Commission of South Australia, n.d.). (Being disorderly in a public place, e.g., being abusive to others, is an offence.) It is not likely that taking care of drunks is an activity that is popular with the police, any more than it is with anyone else, but the lack of many other ideas means this has to be listed. Before a question arises of what should police do with a drunk, the drunk needs to be detected, and video surveillance of public places is making that more and more likely. Indeed, it is far from clear how behaviour in public and relations between police and public will develop in coming years, as surveillance continues to increase.
- Licensed premises could provide a minibus to drive customers to and from their home, thus presumably reducing the traffic risk. Quite a number of venues in suburban Sydney, for example, do this.

## Visual obstruction by traffic

Another difficult problem, because traffic moves, is visual obstruction by traffic. We have three points to make in this context.

- Though a good view through a vehicle to the other side is often impossible, as good a view as possible is undoubtedly desirable. In the context of what should be the minimum light transmittance of car windows, this has been discussed by Baldock et al. (2004), who oppose a suggested reduction from 70 per cent to 35 per cent.
- Predictable behaviour by pedestrians is likely to help. For example, fences at the roadside or on the median can be used to channel pedestrians to particular crossing places.
- From the pedestrian's viewpoint, predictable behaviour by traffic helps, too. There were a number of cases in the in-depth series where there was an unnecessary

change of lane by a vehicle. In some such crashes, the pedestrian is reported as not having looked for traffic. A possible reason for accidents of this type is that the pedestrian does not look because he or she has looked three or four seconds previously — and relying on this is unsafe when vehicles change lanes. (Even in the case of in-depth investigations, however, it is impracticable to reconstruct what was visible in which lane at which instant.)

## Visual obstruction by roadside objects

First, although the word obstruction has been used in the heading above, it is possible that objects can have a camouflaging effect, in addition to simply obstructing view. Naturalistic experiments have shown that increased “complexity” of a street scene makes the detection of a pedestrian more difficult, both at night (Sayer and Mefford, 2004) and in daylight (Sayer and Mefford, 2005).

In the case of roadside objects that may obstruct or camouflage a pedestrian, the obvious thing to do is to remove them. Objects — lampposts, traffic signals, stobie poles, telephone poles, fences, directional signs, regulatory signs, commercial signs, parking meters, bicycle stands, bus stops, bus shelters, trees, bushes, housings containing electrical equipment, fire hydrants — are present for a purpose, whether utilitarian or aesthetic, and obviously many cannot be removed. But it is plausible that pedestrian pavements are under-managed. At p. 32 of Austroads (1995), there is a paragraph that begins “It is important that the line of sight not be obstructed by street furniture, such as poles, mailboxes, telephone booths, trees, decorative planters, etc.”. But it then continues, “however, minor obstructions, such as posts, poles, and tree trunks, less than 200 mm diameter within the line of sight may be ignored”. There is no evidence presented for this last statement — it could be that even narrow poles have a considerable camouflaging effect.

We doubt whether clear procedures are in routine use for assessing the roadside visual environment in respect to its impact on road safety, or even whether responsibility for this aspect of road safety lies unambiguously with one branch of government rather than another. If anything, this impression is strengthened by the success that has been achieved in a limited number of localities (e.g., some that cater to substantial numbers of tourists) in tidying up the footpath and removing clutter. Road authorities pay attention to the surface of footpaths, and should do also to visual clutter.

In-depth crash investigations, and perhaps individual review of routine police reports, can establish the relevance of visual obstruction in particular accidents. They probably would not establish distraction or camouflaging or an effect of visual complexity. Indeed, we are not aware of any method of measuring the visual environment at an accident site that captures the common sense meaning of “visual clutter” or “scene complexity”. This puts a substantial barrier in the way of research progress.

## Details of the roadway environment, other than visual obstructions

Good references on facilities for pedestrians and cyclists are Austroads (1995) and Austroads (1999).

An issue that receives rather little attention in Austroads (1995) is minimising the incentive for bad road crossing behaviour. In particular, crossing either against a red signal or at a little distance from a signal-controlled crossing are common behaviours by pedestrians. It is reasonable to expect they would be reduced by traffic signal settings that were friendlier to pedestrians.

- In specifying what the traffic signal phases at a junction should be, pedestrian movements need to be considered. For example, when a right turn is permitted through gaps in oncoming traffic rather than occurring during an exclusive phase, a combination of attentional and visual factors may mean the driver fails to see a pedestrian who has right of way.

- The green times for the different phases are presumably chosen so as to minimise delay to vehicles (while maintaining safety). In principle, it is straightforward to include delay to pedestrians in this optimisation — but, naturally, good information on pedestrian flows and vehicle flows is required. Inclusion of pedestrians in the equation will usually lead to shorter cycle times than otherwise.
- It seems sometimes that a signal fails to respond for an unreasonably long time to a pedestrian pushing the button.

Hatoyama and Kenzaki (2007) have recently discussed such ideas, albeit in the context of the rather long traffic signal cycle times customary in Japan.

A second issue worth noting is that giving greater attention to pedestrians and cyclists probably requires greater attention to small things. Roughnesses of 1 cm may be dangerous, vegetation of 80 cm height may conceal a child, and a couple of poles of 5 cm diameter may camouflage a cyclist.

Parked motor vehicles are a source of danger to cyclists for a number of reasons. Indeed, they figured in three of the cases in Section 8. Considerable attention is paid in Austroads (1999, Sections 4.4.1 and 4.4.2) to how provision of bicycle lanes and on-road motor vehicle parking relate to one another. Cyclists sometimes feel that road authorities are inclined to favour motor traffic; as regards parking, though, cyclists often find that road authorities share their interest in promoting a smooth flow of traffic — the source of the desire to permit parking is the shops and residences along the road. Peak hour prohibition of parking is a possible compromise between complete prohibition and freedom to park.

Cyclists wishing to continue straight ahead at a signalised intersection are at risk from motor traffic turning left from beside them (e.g., Example 2 of Section 8.1). A cyclist who waits ahead of where motor traffic is stopped can more easily be seen, and a stop line for the cycle lane that is two metres in advance of the motor vehicle stop line encourages this (see Section 5.4.2.3 of Austroads, 1999).

## Trucks

Truck design is of particular importance to pedestrian and cyclist safety for three related reasons. Firstly, there are hard stiff projections from the sides of trucks that sometimes mean that an unprotected road user is killed or seriously injured, when contact with the side of a car would have led to no injury or only bruising. Secondly, a pedestrian or cyclist may be only nudged by a truck at low speed, yet as a result fall under the wheels and die. Thirdly, a factor in some such impacts is the limited visibility from the cab of the sides and rear of the truck by use of mirrors.

In principle, technological countermeasures are available: it would be possible for vehicle construction and use regulations to require that the sides of trucks be smooth, that there be side protection to prevent anyone falling under the wheels, and that video cameras covering the sides and rear be fitted and used. (As to mirrors, regulations are less useful than they might be because in practice drivers often do not set the angle of the mirror so that the field of view is optimised: see Zlotnicki et al., 1980, and Zlotnicki and Kendall, 1981, p. 63.)

There would probably be substantial resistance to such requirements from the industries involved in manufacturing and operating trucks. In part, it would be a resistance to the associated costs, and to change in the usual ways of doing things. Regulatory processes are well-accustomed to balancing the anticipated benefits and costs, and weighing the likelihood that a more stringent regulation will not unduly harm an industry because it will apply to everyone fairly. But it is likely that in part it would be more than this, it would emphasise the variety of different tasks that trucks and trucking industries perform, the alleged impracticability of (for example) requiring that the sides of trucks be smooth, the need for easy access to equipment mounted on the truck or to the load, and so on. A possible response to this argument would be a detailed assessment of the whole range of

designs of trucks that are used, and what they are used for: it might turn out that the impracticability argument appears plausible for only a small percentage of trucks.

## Speed

Faster traffic means more accidents, and accidents that are more severe. For example, analysis of detailed investigations of 176 fatal pedestrian crashes in the Adelaide area led McLean et al. (1994) to estimate that a 5 km/h reduction in vehicle travelling speeds would result in 30 per cent fewer pedestrian fatalities.

The reasons for public attitudes, and changes in attitudes, to such health issues as smoking, alcohol, and choice of driving speed are not well understood. The additional risk from a single cigarette or a single journey is minuscule, and the justification for enacting and enforcing laws on these matters is the cumulative risk, over time and over a population of people — something that is difficult or impossible for the individual smoker or driver to perceive directly. It is likely that at least two mechanisms of attitude formation play a part: response to information about crashes, whether that is propaganda or news reports in the mass media, and response to one's own behaviour, which in turn might be determined by other drivers obeying the speed limit or by fear of being caught breaking the speed limit. Adelaide has many straight divided arterial roads, and it is common for traffic to drive at exactly the speed limit of 60 km/h, so presumably there is a lot of public support for speed limits. The early history of speed limits, their enforcement, and public attitudes, is discussed by Spencer (1983), Emsley (1993), and Tranter (2005).

For pedestrian and cyclist safety, it is natural to give attention to areas where there are many pedestrians and cyclists, and a speed limit of 30 km/h or 40 km/h in such places would undoubtedly have benefits. However, maps of fatalities in the Adelaide Metropolitan area (e.g., that of fatal pedestrian accidents, 2000-2006, Figure 3.3 of Anderson, 2008) show plainly that these can occur anywhere and everywhere, though largely on arterial roads — this suggests the importance of lowering the present usual speed limit of 60 km/h on such roads. Would such a reduction need to be metro wide, or would an approach targeted to particular places be practicable? At present, the geographical scatter suggests targeting is not feasible. If it were desired to pursue the possibility, we think the point of departure should be the poor picture that routine accident data gives of the accident surroundings: it is conceivable that if categories of (for example) land use or traffic flow or density of intersecting driveways were available, some association with pedestrian fatalities would be seen.

## Comments on the statistics of fault

A recent study of fatal pedestrian crashes in Florida concentrated on the idea of fault, and found that the pedestrian only was at fault in 69 per cent of cases, the driver only was at fault in 13 per cent of cases, and both were at fault in 14 per cent of cases (Spainhour and Wootton, 2007). That study is notable for regression analyses that relate the probability of being at fault with characteristics of the pedestrian, driver, and environment.

That the pedestrian is usually at fault is far from a novel finding. Should it be dismissed as “blaming the victim”? We think not. While “fault” is an ordinary word and is imprecise, it captures an idea that is naturally prominent when studying accounts of road accidents, and suggests (to put it no more strongly) a direction for countermeasures.

It may readily be admitted that for fatal crashes, the pedestrian's viewpoint is often not well represented. Further, the motor vehicle driver typically has some control over what happens, in the limited sense that small changes in behaviour (choice of even a fractionally lower speed, for example) can reduce the probability of the pedestrian being killed.

But the pedestrian being at fault is commonly found in injury cases, as well as fatal cases. Thus McLean et al. (1979a, p. 51) commented on their series of 40 pedestrian accidents as follows. “Many of these pedestrians were involved in an accident because they were

careless or made a mistake. Almost all of the child pedestrians ran onto the road, the elderly very often did not see the vehicle approaching, and other pedestrians chose to stand in the centre of the road, or ran through banked up traffic. About one-eighth of the pedestrians were intoxicated at the time of their accident and they had a history of regular and heavy alcohol consumption." McLean et al. (1979a, p. 27) considered that in 7 of their 40 cases, the driver certainly contributed to the accident, and a further 10 drivers might have avoided colliding with the pedestrian "had they exercised greater care".

As to small changes in driving behaviour, drivers can hardly be said to be at fault if society as a whole does not teach them appropriately. After all, per kilometre or per trip, driving is very safe, and nearly anything the driver does turns out safely, nearly every time. Road deaths and injuries are of concern because the great number of kilometres driven means many deaths and injuries in total. Without personal experience of a bad outcome of a driving decision, drivers can only learn what is an appropriate choice of speed from other drivers and from what the speed limit is. Consequently, if it is thought wrong to blame the victim, the "fault" or "blame" should probably be shifted not to the individual driver but to society collectively. Society could choose to set speed limits lower, improve street lighting, reduce visual clutter, and make traffic signal settings friendlier to pedestrians.

### 10.3 Pedestrians, pedal cyclists --- and motorcyclists?

Many governments wish to encourage cycling (and walking also), as it is environmentally-friendly, gives people independent mobility, and is not unreasonably dangerous. Reasons of health are also adduced. However, cycling is perceived by many members of the public (notably, by habitual car drivers) as requiring physical fitness and as being dangerous. If the fitness issue were not seen as inherently limiting the popularity of cycling, investment in cycling safety would be more attractive. Guidelines for the planning, design, and construction of cycling facilities have been published by Austroads (1999). Options include a cycle lane separated from motor traffic by a painted line, a cycle lane separated from motor traffic by some form of physical barrier, a cycle path not following a road, or a path shared with pedestrians. (At this point, it should be noted that although separation of cyclists from motor traffic has the appearance of being good for safety, the empirical evidence for a reduction of accidents by either tracks for cycling and walking or cycle lanes is poor: see Elvik and Vaa, 2004, pp. 270-276.) Motorcycles share many of the environmental advantages of pedal cycles: the questions then arise of whether government should encourage their use, and whether motorcyclists are natural allies of pedestrians and pedal cyclists in demanding an allocation of road space at the expense of cars and larger vehicles. Others who have drawn attention to this include Oxford Systematics (2000, especially p. 52) and Haworth (2006).

Road safety is also important, however, and is unlikely to be compatible with fast cycling and fast motorcycling, no matter how environmentally-friendly those modes are. Firstly, protection of cyclists and motorcyclists is difficult, and secondly, fast cycling and fast motorcycling are incompatible with walking. Slow riding, on the other hand, seems worth further consideration. Suppose a powered cycle were limited (by lack of power, or by technical means) to a top speed of 25 km/h: being powered, it would have the potential of attracting car drivers who are deterred by the physical effort of cycling, and being slow, it could share path space with pedestrians and cyclists. Whether 25 km/h is an appropriate upper limit or whether either 12 km/h or 50 km/h would be a better choice is a detail that is not pursued here; the vehicle would need to be light in weight, and there could be debate also on what the upper limit should be. The central point is that if "cycling" refers to either pedal cycling or the use of a lightweight power-assisted bicycle, then its credibility as a mode of transport is greatly increased.

If this is accepted, then there is an important broad issue of how best can environmentally-friendly wheeled traffic (pedal cycles, power-assisted bicycles, and perhaps other technologies) be integrated into an urban area. Are the longstanding arrangements of

pedestrian pavement for pedestrians and road for everyone else still appropriate? Should, perhaps, more space be given to environmentally-friendly modes, and less to motor traffic?

Now, it is plain that any proposal to redesign the road environment for cycles (pedal or power-assisted) has to start from what already exists; and what exists (say) 2 km from downtown Adelaide differs from what exists 15 km out in the suburbs. Thus if there is a wish to encourage environmentally-friendly wheeled traffic without a great increase in road casualties, an important step is a detailed examination of the practicability of improving facilities everywhere in the Adelaide Metropolitan Area. More feasibly, this should be done at a random sample of places. ("Place" might not be the appropriate unit to be considered, but instead "road" or "route".)

Adelaide's present network of bicycle routes is about 307 km of off-road paths and 411 km of on-road bicycle lanes (see [http://www.transport.sa.gov.au/personal\\_transport/bike\\_direct/maps.asp](http://www.transport.sa.gov.au/personal_transport/bike_direct/maps.asp)). A substantial base of knowledge has been developed in connexion with that. But if it is assumed that power-assisted cycles would also use the facilities and that therefore many more people would share the benefits, much higher expenditure becomes justifiable and a much wider range of developments are worth considering.

It would be valuable to know at what proportion of places it would be difficult to improve provision for environmentally-friendly modes, and at what proportion it would be quite easy and cheap. Taking that further, here is a list of six types of facilities that might be introduced:

- (1) On-road cycle lane, separated from motor traffic by a painted line.
- (2) Cycle lane, separated from motor traffic by a kerb or other physical barrier.
- (3) Conversion of footpath to shared use by pedestrians and cyclists.
- (4) Priority for cycles on a secondary road parallel to an arterial route, with motor traffic limited to low speed and perhaps one way only.
- (5) Off-road cycle path.
- (6) Elevated cycle lane above road.

In each of these cases, one might consider designing for a speed of 12 km/h, 25 km/h, or 50 km/h, giving 18 possibilities. Now consider a circle around Adelaide city, about 5 km from the centre, and thus about 31 km in length. (To give perspective to this, it may be noted that to the north of the city, Regency Road is about 6 km away; to the east of the city, Portrush Road is about 4 km away; to the south of the city, Cross Road is about 4 km away; and to the west of the city, Marion Road is about 4 km away.) If South Australia wished to encourage environmentally-friendly modes of transport, how many of each of those 18 types of cycle facilities ought there to be crossing a cordon 5 km from the centre of Adelaide? (If spaced at 1 km intervals, there would be about 31 of them in total.) That is probably a more detailed question than can be answered at present, but would be well worth answering. Naturally, the same question could be asked for places 10 km, 15 km, and 20 km from the city. Results would be specific to Adelaide; it would be desirable for the process for arriving at them (how to take a random sample of places, how to decide on changes suitable for environmentally-friendly modes, how to estimate costs, and so on) to be transferable to other cities.

It is questionable whether pedestrians would consider sharing of footpaths with pedal cyclists and slow motorcyclists to be acceptable --- for discussion, see Hutchinson et al. (2007b, p. 9) --- but the possibility is worth following up, as across much of suburban Adelaide the simple fact is that at peak travel times, arterial roads are busy and the footpaths beside them are empty. We do not mean to imply that it is a foregone conclusion that shared paths would be an appealing strategy: it could instead be that at (say) 5 km from central Adelaide, space is at such a premium on arterial routes that option (4) in the list



above seems a better choice, and that at (say) 15 km from central Adelaide there is sufficient space that separate paths for pedestrians and cyclists are perfectly practicable.

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