

# The role of traffic violations in police-reported bicycle crashes in Queensland

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## Abstract

Media articles have promoted the view that cyclists are risk-takers who disregard traffic regulations, but little is known about the contribution of cyclist risk-taking behaviours to crashes. This study examines the role of traffic violations in the 6774 police-reported bicycle crashes in Queensland between January 2000 and December 2008. Of the 6328 crashes involving bicycles and motor vehicles, cyclists were deemed to be at fault in 44.4% of the incidents. When motorists were determined to be at-fault, 'failure to yield' violations accounted for three of the four most reported contributing factors. In crashes where the cyclist was at fault, attention and inexperience were the most frequent contributing factors. There were 67 collisions between bicycles and pedestrians, with the cyclist at fault in 65.7%. During the data period, 302 single-bicycle crashes were reported. The most frequent contributing factors were avoidance actions to miss another road user and inattention or negligence.

## Keywords

Bicycle crashes, Traffic violations

## Introduction

Cycling provides substantial health, environmental and economic benefits [1-3]. Despite the benefits associated with cycling, many cyclists are injured in road crashes, and significant conflict can develop between bicyclists and other road users. This is one of the major deterrents to cycling participation. Cyclists comprised 14.6% of all road users admitted to hospital as a result of road vehicle traffic crashes in Australia in 2006-07 [4], an increase from 12.8% in 2003-04 [5].

The negative opinions drivers have of cyclists are frequently reported in the popular media, and responses to news reports on public forums highlight the gulf between cyclists' and drivers' opinions. Some drivers believe that they are the victims of cyclists and that cyclists are putting themselves and other road users at risk [6]. Most drivers believe cyclists are inconvenient, with approximately 20% of drivers annoyed by cyclists because they impede drivers [7]. While UK research found that drivers believe cyclists should not be allowed on public roads due to the fact that they pose a risk to themselves and others [7], only 43% of the Australian drivers surveyed believed that cyclists should not ride on the same roads as cars [8]. Australian research demonstrates that many drivers (63%) believe that cyclists have no respect for road rules [8]. This

supports research which found that the primary reason drivers had a negative perception of cyclists was cyclists' perceived failure to adhere to road rules [7].

However, there has been little quantitative research into the level of adherence to road rules by cyclists in traffic situations. Some observational research into cyclist behaviour in general traffic situations has been conducted. Research from the US indicates that bicyclists who wear helmets are significantly more likely to use legal hand signals to indicate turns and come to a complete stop at an intersection, compared with non-helmeted riders [9]. It is difficult to draw conclusions from this research in the Australian context as helmets are not mandatory in US jurisdictions.

Compliance with traffic signals has been examined in the Australian context, with data collected at points along a prominent bicycle commuter route. Observations found that 7% of cyclists disregarded red traffic lights and proceeded through the intersection, and this behaviour was more frequent during the afternoon peak [10].

Crash analysis has examined the role of traffic violations in bicycle crashes in international contexts, with a focus on collisions between bicycles and motor vehicles. Research into bicycle-motor vehicle collisions found that at least one traffic violation was involved in 50% of bicycle fatalities in the UK [11], although there was no indication of the unit at fault. Other research has demonstrated that failure to yield was the most frequent single crash type leading to bicycle-vehicle collisions, with the cyclists at fault in 35.9% of crashes [12]. While useful, this research does not provide information with respect to other crashes in which bicycles are involved.

Road user behaviour is commonly considered to be determined by several factors, including risk perception and sensation seeking [18]. Research has also shown that a willingness to commit traffic violations is linked with traffic incident involvement [19]. The majority of the research has focused on motor vehicle operators. This has shown that greater predilection for sensation seeking increases the likelihood of a vehicle operator committing a traffic violation [20], which is unrelated to age or kilometres travelled [21].

This research also demonstrated that there is a difference between committing driving violations and other driver errors (mistakes, inexperience and lack of attention) [20]. It is important to keep in mind that it is often difficult to distinguish between driver errors and traffic violations. Driver errors are frequently identified as driver conditions in Queensland crash data. In the case of failure to yield, it may be a result of either

factor, and it is possible that the consequence of one is exacerbated by the other [18].

There are several issues that make analysis of bicycling data difficult. Data regarding the distance travelled by bicyclists, or even the number of cyclists, is not currently available. It is also difficult to conduct accurate analysis of bicycle crashes or collisions, because bicycle crashes have the lowest reporting rate in official road statistics, with less than 10% of single vehicle bicycle crashes reported [22]. While it is recognised that bicycle injuries are under-reported in police statistics, crashes involving other road users are more likely to be included due to incidents usually occurring on roadways and being more serious in nature [23]. Because of these reporting issues, bicycle crashes are examined with respect to the recorded collision partner (single vehicle, motor vehicles, pedestrians and other bicyclists).

The primary focus of this paper is to investigate the role of traffic violations in bicycle crashes. The data examines the 'at fault' status and contributing factors, with a focus on traffic violations, in bicycle crashes reported to police in Queensland. In Queensland, the police have a strong focus on the 'Fatal four' – speeding, alcohol, fatigue and seat belts – to reduce road trauma. As seat belt usage is not an appropriate issue to examine for bicycles, helmet use will be examined instead. These will be examined, in addition to other traffic violations, for their relevance to bicycle crashes. Separate analyses are presented of crashes between motor vehicles and bicycles and of single bicycle crashes, given the expected high level of under-reporting of the latter.

## Methodology

All crashes involving a bicycle between January 2000 and December 2008 inclusive were extracted from the Queensland Crash Database. Bicycle crashes included single-unit (bicycle) crashes and multiple-unit crashes. Multiple-unit crashes included motor vehicles, animals, other objects and pedestrians. Motor vehicles included motorcycles, special purpose vehicles, articulated vehicles, road trains/B-doubles, trucks, car/station wagons, utility/panel vans a bus/coaches. Unit types that were not included in the motor vehicle category were towed device, railway rolling stock, wheeled recreational device and other (undefined units).

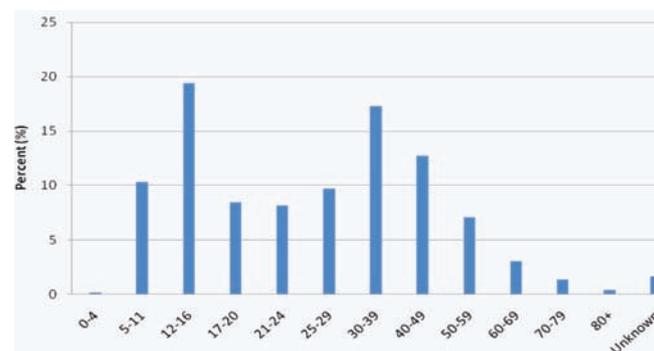
In Queensland, crashes on a public road that result in injury or property damage of greater than \$2500 or a vehicle being towed away are required to be reported to police. Contributing circumstances are included in the crash reports data extracted from the database. These circumstances are assigned by police to one of seven general categories: traffic violations, vehicle defects, lighting conditions, atmospheric conditions, road conditions, driver conditions and miscellaneous factors.

'Inattention/negligence' and 'undue care and attention' appear to be similar contributing factors; however, there are differences as determined by police from the statements of involved parties and witnesses [24]. 'Undue care and attention' is a violation that includes careless driving, listening to the radio and lack of concentration. 'Inattention/negligence' is a driver condition,

not a violation, and includes being on the wrong side of the road and pedestrians not looking before crossing the road. Driver conditions include the following factors: fatigue, inattention, inexperience, medical conditions, age, distraction, taking avoiding action and miscellaneous driver conditions.

## Results

Between January 2000 and December 2008, 6774 crashes involving bicycles were recorded in the Queensland Crash Database. This does not include crashes occurring on private property and areas not considered part of the road reserve. The majority of cyclists involved in crashes were male (82.3%), and cyclists aged 12-16 or 30-49 accounted for approximately half of all cyclists (49.4%) in crashes (see Figure 1). Most crashes involving bicycles occurred between 6am and 9am and between 3pm and 6pm, and in clear atmospheric conditions (95.2%). Very few crashes occurred on arterial (0.1%) or sub-arterial roads (9.2%). This profile may reflect the riding patterns. Most crashes involving bicycles resulted in injuries requiring medical treatment (40.6%) or hospitalisation (34.8%) or minor injury (23.1%). There were very few fatal (0.9%) or non-injury crashes (0.5%).



**Figure 1. Age group of cyclists involved in police-reported crashes**

The 'Fatal four' were reported to be involved in only 3.7% of all bicycle crashes. Speed was a factor in 1.1% of all reported bicycle crashes, with 'excessive speed for circumstances' accounting for 94.7% of contributing circumstances in speed-related crashes (primarily excessive bicycle speed).

Alcohol was involved in 2.4% of all reported bicycle crashes. Of the crashes where alcohol was involved, the majority were classed as 'under the influence of liquor/drug' (62.8% of alcohol involvement), rather than illegal blood alcohol content. Drivers and cyclists were equally likely to be under the influence of a substance.

Fatigue was nominated by police as contributing to 0.2% of reported bicycle crashes. Crashes identified as fatigue-related by the Queensland Transport Definition accounted for 15.4%, while 'driver fatigue/fell asleep' was recorded for 84.6% of fatigue crashes. Fatigue was primarily a factor attributed to drivers.

Helmets were not worn by cyclists in 12.0% of police-reported bicycle crashes. Helmet non-compliance was more likely for cyclists aged 20 years or younger (see Figure 2). While the percentage of cyclists aged 0-4 not wearing a helmet was 53.3%, this figure may not be reliable since it corresponds to only 15 of 7293 cyclists.

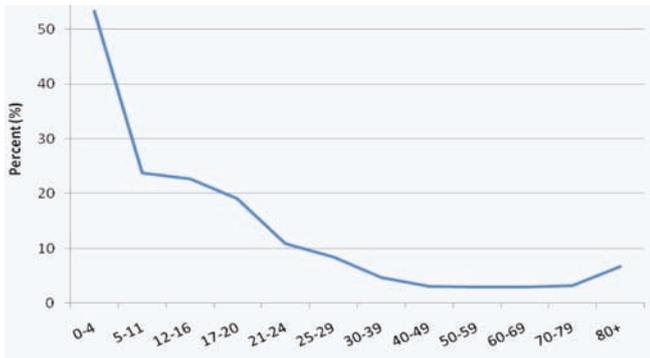


Figure 2. Percentage of cyclists not wearing helmets in police-reported crashes, by age

Further analysis of vehicle operator actions as contributing factors was examined in relation to the types of crashes: bicycle-motor vehicle crashes, single-vehicle crashes, bicycle-pedestrian crashes and multiple-bicycle crashes.

### Bicycle-motor vehicle crashes

From 1 January 2000 to 31 December 2008, there were 6328 crashes reported to police involving bicycles and motor vehicles, comprising 93.4% of police-reported bicycle crashes. The bicyclist was deemed the at-fault vehicle in 2809 instances (44.4%). Younger cyclists (16 years or younger) and elderly cyclists (80+ years) were more likely to be the at-fault unit, while cyclists aged 30-69 were at fault in less than 30% of bicycle-motor vehicle crashes (see Figure 3).

In general, injury severity was much greater for cyclists than motor vehicle occupants (operators or passenger) (see Table 1). Motorcyclists contributed approximately 60% of all serious injury (fatality and hospitalisation severity crashes) cases for motor vehicle occupants.

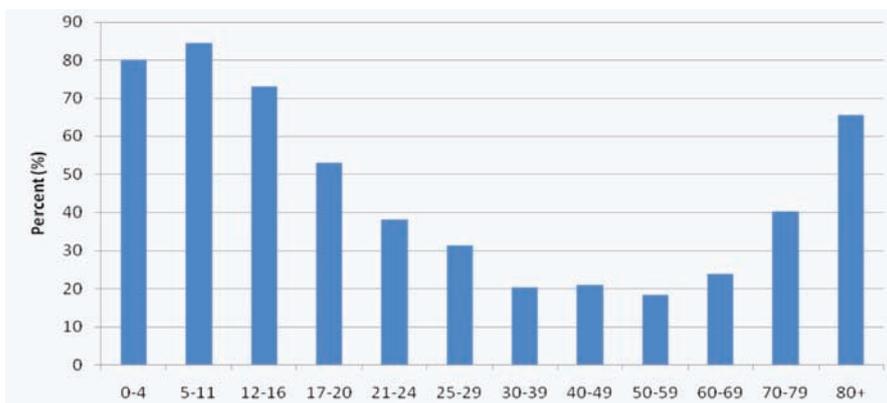


Figure 3. Percentage of bicycle-motor vehicle crashes in which the cyclist was deemed at fault, by cyclist age

Table 1. Injury severity reported for bicycle-motor vehicle crashes, by road-user type

	Cyclist (n=6328)	Motor vehicle occupant (n=6328)
Fatality	0.9%	0.0%
Hospitalisation	33.9%	0.4%
Medical treatment	40.8%	0.5%
Minor injury	23.9%	0.9%
No injury reported	0.5%	98.2%

The role of traffic violations as contributing factors changed according to the unit at fault (see Figure 4). When the motorist was at fault, traffic violations were recorded in 85.4% of crashes and driver conditions were recorded for 16.4% of crashes. When the cyclist was at fault, traffic violations were recorded in only 28.1% of bicycle-motor vehicle crashes.

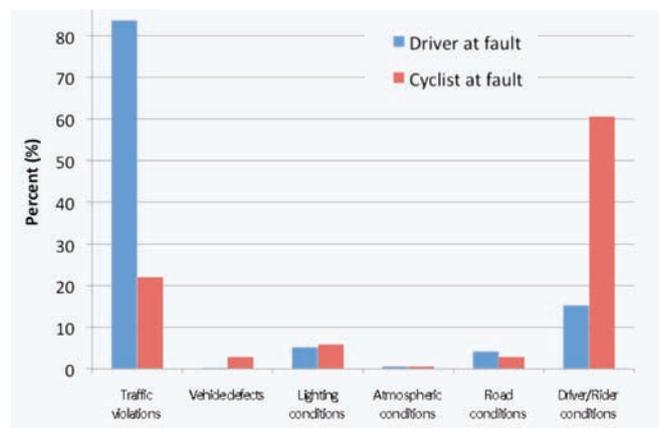


Figure 4. Contributing factors in police-reported bicycle-motor vehicle crashes, by unit deemed to be at fault

The types of traffic violations also differed according to the unit deemed to be at fault (see Figure 5). When the driver was at fault, the most frequently recorded traffic violations were ‘undue care and attention’ (22.4%), ‘disobey give way sign’ (19.1%), ‘fail to give way’ (15.3%), ‘turn in the face of

oncoming traffic' (11.9%) and 'open car door causing danger' (5.9%). Only 'inexperience/lack of expertise' (5.9%) and 'age (lack of perception; power or concentration)' (3.7%) were frequently noted driver conditions when a driver was at fault. For crashes where the bicyclist was at fault, the most frequently recorded traffic violations were 'disobey traffic light' (6.4%), 'fail to keep left' (5.1%) and 'fail to give way' (4.7%). The contributing factors most likely to be indicated when a cyclist was the at-fault vehicle were 'inattention/negligence' (34.7%) or 'inexperience/lack of expertise' (26.5%).

While younger (16 years of age or younger) or older (60 years of age or older) cyclists are more likely to be at fault, contributing factors in these crashes are unlikely to be attributed to traffic violations. The most common contributing factors identified are age- or skill-related ('inexperience/lack of expertise' or 'age: lack of perception, power or concentration') and attention-related ('inattention/negligence').

There were similar rates of inattention cited for younger and older cyclist crashes (35.5% and 27.6%, respectively). Age-related factors were also cited in a similar proportion for younger and older cyclist crashes. 'Inexperience/lack of expertise' was nominated as a contributing factor in 47.6% for younger cyclist crashes (no older cyclist crashes). 'Age: lack of perception, power or concentration' was nominated as a contributing factor in 51.0% of older cyclist crashes.

**Bicycle-pedestrian crashes**

There were 67 reported crashes involving bicycles and pedestrians. The majority of collisions occurred without traffic controls (79.1%), but 14.9% occurred at traffic lights and 3.0% occurred on pedestrian crossings. In general, the level of injury to the pedestrian was greater than to the cyclist (see Table 2).

The cyclist was at fault in 65.7% of all bicycle-pedestrian crashes, and traffic violations were recorded in 26.9% of these crashes (see Figure 6). The most common reported violation was 'disobey a traffic light' (recorded for 8 crashes, with the bicycle at fault in 6), followed by 'undue care and attention'

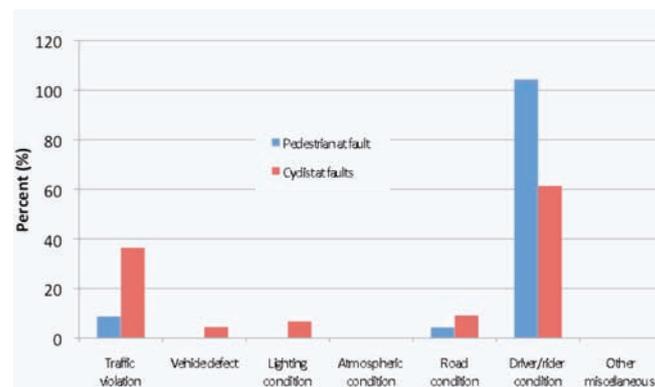
(6 occasions, all with the bicycle at fault). In crashes where the pedestrian was at fault, the most nominated contributing circumstances were 'inattention' and 'inexperience' (age factor).

**Table 2. Injury severity reported for bicycle-pedestrian crashes, by road user type**

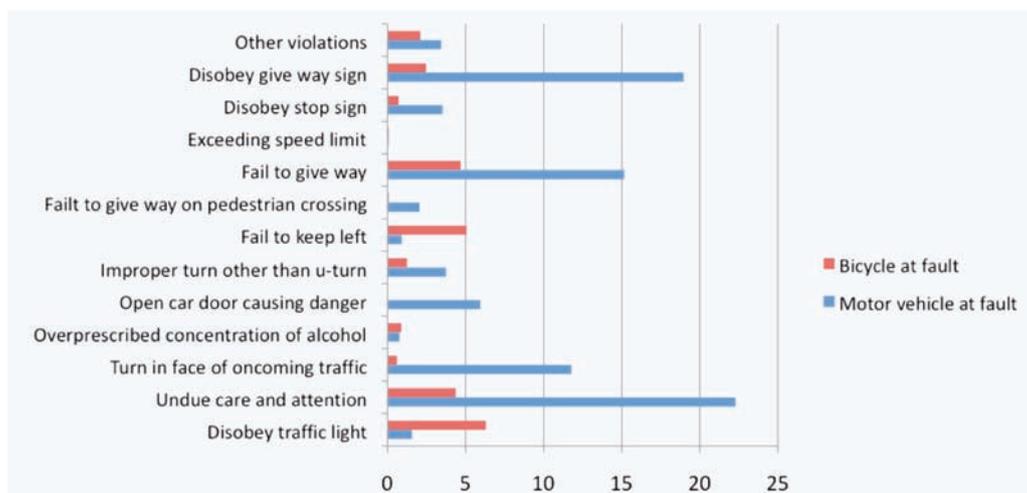
	Pedestrian (n=67)	Cyclist (n=67)
Fatality	3.0%	0.0%
Hospitalisation	43.3%	19.4%
Medical treatment	38.8%	13.4%
Minor injury	13.4%	17.9%
No injury reported	1.5%	49.3%

**Multiple-bicycle crashes**

Only 38 multiple-bicycle crashes were reported between January 2000 and December 2008; only one resulted in a fatality (3%), and less than half resulted in hospitalisation (47%). Medical treatment was required in 29% of multiple-bicycle crashes, while 21% resulted in minor injury. There were no 'property damage only' crashes involving multiple bicycles.



**Figure 6. Contributing factors in police-reported bicycle-pedestrian crashes**



**Figure 5. Traffic violations in police-reported bicycle-motor vehicle collisions according to unit deemed to be at fault**

The most frequently reported contributing factor in multiple-bicycle crashes was inattention and negligence (29.0%). Vehicle defects, road conditions and lighting conditions combined were involved in 21.1% of all crashes, while traffic violations were involved in 26.3%. ‘Fail to keep left’ was the highest reported (four crashes), followed by ‘undue care and attention’ (three crashes). ‘Follow too closely’, ‘dangerous riding’, ‘over prescribed concentration of alcohol’ and ‘under the influence of alcohol’ were all involved in one crash.

### Single-bicycle crashes

In the period 1 January 2000 to 31 December 2008, there were 302 single-bicycle crashes reported to police. The majority involved male cyclists (84.4%), which was slightly higher than the total population of bicycle crashes. Off-carriageway crashes and out-of-control crashes were common (see Figure 7). Crashes defined as ‘Other’ within the Definition for Coding Accidents (DCA) group include all undefined actions (for all DCA groups), as well as ‘fell in/from vehicle’. The highest percentage of single-vehicle crashes resulted in hospitalisation (45%), followed by medical treatment required (39%), minor

injury (13%) and fatalities (3%). There were no ‘property damage only’ crashes.

Traffic violations were the fifth most common contributing factor associated with single-bicycle crashes behind rider conditions, road conditions, other miscellaneous factors and vehicle defects (see Figure 8). Only two traffic violations were recorded: ‘undue care and attention’ (5.3%) and ‘over prescribed concentration of alcohol’ (2.7%). However, ‘under the influence of liquor/drug’ (but not exceeding BAC limit) was recorded as a contributing factor in 6.6% of crashes. The most common contributing factors were ‘taking avoiding action to miss another road user’ (29.8%) and ‘inattention/negligence’ (15.9%).

### Discussion

The analyses reported here show that the motor vehicle was at fault in 65.6% of bicycle–motor vehicle crashes, with traffic violations recorded against 85.4% of these drivers. This contrasts sharply with the media articles and surveys portraying cyclists as risk-takers who disobey traffic regulations.

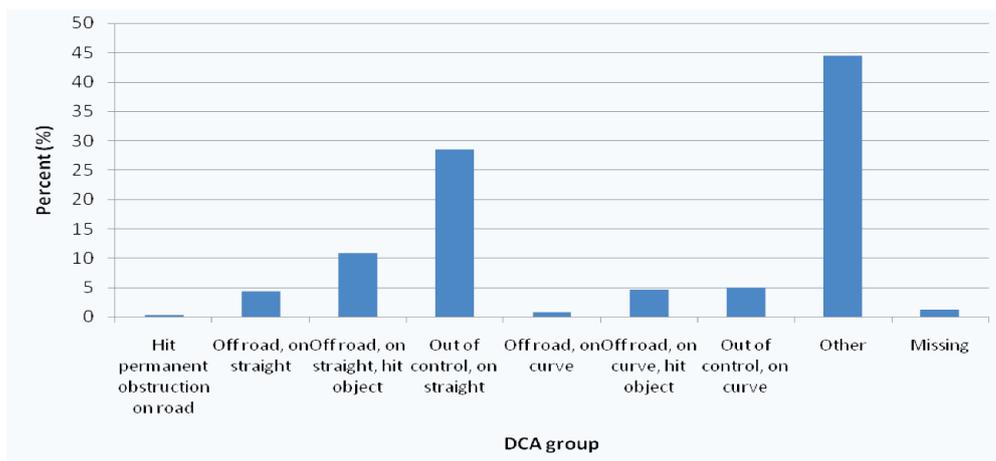


Figure 7. DCA (Definition for Coding Accidents) group for police-reported single-bicycle crashes

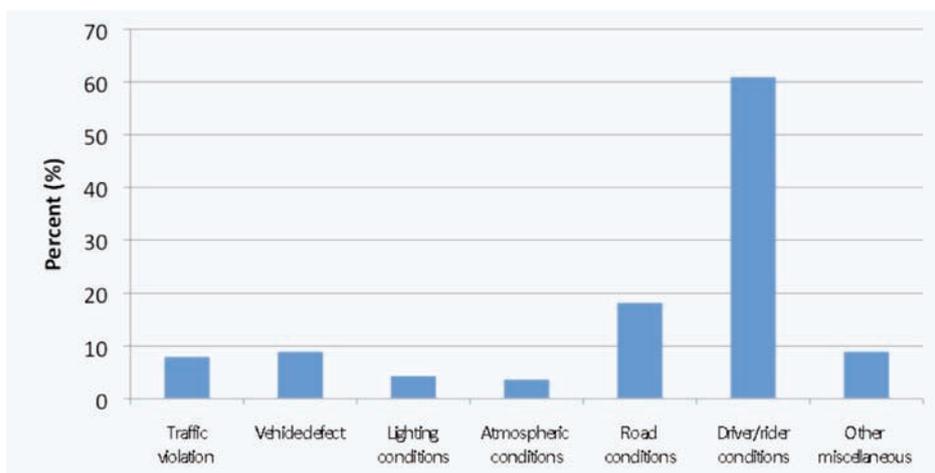


Figure 8. Contributing factors in police-reported single-bicycle crashes

The traffic violations committed by motor vehicle drivers largely related to various forms of failing to give way to cyclists: ‘disobey give way sign’, ‘fail to give way’, ‘turn in the face of oncoming traffic’. The crash data does not provide any information about whether these behaviours resulted from a failure to notice the cyclist, poor judgement of the speed of the cyclist or some more aggressive intent.

While the motor vehicle was at fault in the majority of bicycle–motor vehicle crashes, this was not the case for riders aged under 21 (particularly those under driver licensing age) and the very small number of riders aged 80 and over. Riders aged under 21 were also less likely to wear helmets. Given that 12–16 year olds comprised one of the largest groups of riders in bicycle crashes overall, it appears that the focus in addressing risk taking and violations by cyclists should perhaps focus on this group.

When cyclists were at fault in bicycle–motor vehicle crashes, the contributing factors were more often rider conditions (‘inattention/negligence’ or ‘inexperience/lack of expertise’) than traffic violations (28.1%). As well as being less common, the nature of the traffic violations by cyclists differed from those of drivers. ‘Disobey traffic light’ was the most common for cyclists, followed by ‘fail to keep left’, but these were rarely recorded for drivers. The former suggests some basis for the driver view that cyclists do not respect red lights (supported by [12]), and the latter may reflect cyclists’ unwillingness to ride to the far left of the road.

While the 67 bicycle–pedestrian crashes comprised only 1% of police-reported bicycle crashes, the bicycle rider was considered at fault in two-thirds of these crashes and the pedestrian was generally injured more severely than the cyclist. Cyclists received traffic violations for ‘disobey a red light’ and ‘undue care and attention’. It was unclear in the data whether the crash occurred on a footpath or road.

It is difficult to draw many conclusions about risk taking and disobeying traffic regulations in the single-bicycle crashes. It may be that riding too fast contributed to some of these crashes, but this was not reported by police and there were few traffic violations noted. In addition to the overall likely under-reporting of these crashes, it may be even less likely for cyclists to report single-vehicle crashes if they had been taking risks or disobeying traffic regulations.

This research has demonstrated the diverse ages of people cycling in Queensland. The results indicate that the majority of cyclists involved in crashes have reached an age where they can hold a drivers licence. However, a substantial portion (29.9%) are younger than 16, with 10.5% aged 11 or younger.

While no data is available in crash data on the licence status of cyclists involved in police-reported crashes, data from the Australian Bureau of Statistics estimates approximately 85% of Queensland residents who own a bicycle also hold a drivers licence [25]. This information indicates that the majority of

cyclists involved in crashes should be aware of the road rules. These results suggest that a lack of knowledge of road rules (for those cyclists younger than the legal driving age) and age-related cognitive abilities [26, 27], as well as risk-taking behaviours, are involved in bicycle crashes. All factors should be considered when developing interventions.

A major limitation of this study is the low reporting of bicycle crashes. Almost 90% of bicycle crashes go unreported, and are therefore not included in road crash statistics [28]. While injuries sustained in bicycle–motor vehicle crashes are more likely to result in serious injury and are therefore more likely to be reported, it is possible that the results for bicycle–pedestrian, multiple-bicycle and single-bicycle crashes are not truly representative of the number and actual circumstances of these crashes.

While driver perceptions are of cyclists being mavericks on the road, the crash data does not support this position. Driver opinions may be formed by anecdotal evidence, and further research could be conducted of road user behaviour to evaluate the general attitude towards the road rules by bicyclists. However, this research demonstrates that a cyclist is unlikely to commit a traffic violation that results in a single-vehicle crash or collision with another road user.

Policies have been proposed to increase the safety of cyclists as vulnerable road users. This has often been hindered by the divergent policies expressed by different departments within a single administrative unit. The Queensland Cycling Strategy and the Queensland Road Safety Strategy both have opposing views on the treatment of cyclists as road users [29]. Road safety interventions implemented as part of the Road Safety Strategy are designed to benefit vehicle occupants, while there are few benefits for cyclists and vulnerable road users in general.

This research demonstrates that to improve the safety of cyclists, several strategies could be beneficial. Younger bicycle riders could benefit from improved education regarding the road rules, and possibly improving skills when riding with traffic. A greater understanding of the impact of poor road surfaces on cycling safety may also reduce the risk of injury to cyclists. Rigorous enforcement of minor traffic offences for all road users, such as observing stop and give way signs, may result in greater improvements in cyclist safety in on-road situations. General education campaigns for all motorists emphasising the importance of focusing on the road and of obscure traffic regulations (for example, the requirement to open a car door safely) could also improve the safety of cyclists and other road users.

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## Painting a designated space: Cyclist and driver compliance at cycling infrastructure at intersections

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### Abstract

This study evaluated cyclist and driver compliance at cycling infrastructure at signalised intersections to determine the effectiveness of the infrastructure in creating a designated space for cyclists. A cross-sectional observational study was conducted during peak travel times at six sites in Melbourne in March 2009. Three types of infrastructure were observed: 1) bicycle storage box in front of left lane, 2) bicycle storage box in front of centre lane and 3) continuous green-painted bicycle lane. Two sites were observed for each infrastructure type, one morning and one early evening. A covert fixed position video

camera was used to film all road users, and the behaviour of cyclists and drivers who stopped at the intersection during the red light phase was coded. In total, 2670 cyclists and 1243 vehicles were observed. Compliance was highest at the continuous bicycle lane sites for cyclists (95.4%) and drivers (97.7%). At bicycle storage box sites, cyclists (60.4%) were more compliant than drivers (49.6%). The placement of bicycle storage boxes may contribute to lower rates of driver compliance and cyclists' perceptions of safety and subsequently cyclist compliance. Driver and cyclist education campaigns may increase compliance.