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Understanding the fear of bicycle riding in Australia

by E Fishman[1], S Washington[2], N Haworth[1]

[1]Centre for Accident Research and Road Safety – Queensland (CARRS-Q), Queensland University of Technology, Kelvin Grove, Queensland

[2]Faculty of Built Environment and Engineering and Centre for Accident Research and Road Safety – Queensland (CARRS-Q), Faculty of Health, Queensland University of Technology, Brisbane

Abstract

Rates of bicycle commuting currently hover around 1 - 2% in most Australian capital cities, although 17.8% of Australians report riding at least once per week. The most commonly stated reason for choosing not to ride a bicycle is fear of motorised vehicles. This paper sets out to examine the literature and offer a commentary regarding the role fear plays as a barrier to bicycle riding. The paper also provides an estimate of the relative risk of driving and riding, on a per trip basis. An analysis of the existing literature finds fear of motorised traffic to be disproportionate to actual levels of risk to bicycle riders. Moreover, the health benefits of bicycling outweigh the risks of collision. Rather than actual collisions forming the basis of people's fear, it appears plausible that *near collisions* (which occur far more frequently) may be a significant cause for the exaggerated levels of fear associated with bicycle riding. In order to achieve the Australian Government's goal of doubling bike riding participation, this review suggests it will be necessary to counter fear through the creation of a low risk traffic environment (both perceived and real), involving marketing/promotional campaigns and the development of

a comprehensive bicycle infrastructure network and lower speed limits.

Keywords

Bicycle-riding, Fear, Risk, Safety, Sustainable transport

Introduction

Concerns over fear and safety have frequently been reported as significant barriers to bicycle riding [1-5]. The term 'fear' is used in this paper to describe an unpleasant emotion caused by the threat of road traffic danger; this is distinct from 'lack of safety' which relates to objective measures of actual risk, rather than perception of risk. In order to achieve increased levels of bicycle riding, community concern regarding safety will need to be addressed. The fear associated with bicycling typically relates to the perceived possibility of injury resulting from a collision with a motor vehicle. Perceptions of personal security can also act as a barrier to bicycling [6]. Finally, the fear of actually being part of what has been described as an *out-group*, or even *deviant* may also create a fear of bicycle riding [6, 7]. Little work within the existing literature has specifically explored fear and evidence-based approaches to overcoming this major barrier to bicycle riding.

Background

Governments in developed countries have begun highlighting the benefits of bicycle riding as a method of increasing physical activity, reducing air and noise pollution, as well as easing traffic congestion and addressing climate change [8, 9]. With these benefits in mind, the Australian Government recently announced its goal to double cycling participation between 2011 and 2016 (National Cycling Strategy [10]). However, the parameters by which changes in participation would be measured (e.g. commuting, age categories, frequency) have not been articulated.

Bicycle riding rates in Australian cities are low compared to Europe [2]. Whilst a number of factors explain the significant difference in cycling rates in Australia and many other parts of the world, issues of safety and fear have consistently been reported as major impediments to the uptake of bicycle riding [11].

Bicycle riding participation in Australia

The Australian Bicycle Council, as part of the National Cycling Strategy 2011 – 2016, recently undertook the largest survey of bicycle riding participation in Australia [12]. This baseline data has been developed to measure national progress towards the goal of doubling bicycle riding over the next five years [10]. A telephone survey of 9661 households, comprising 24,858 individuals, asked questions about bicycle ownership and participation. The results show 17.8% of the Australian population rode a bicycle in the week prior to the survey, rising to over 60% for children aged 5 – 9 years. A little over 10% of adults (aged 18 years and over) reported cycling in the previous week [12].

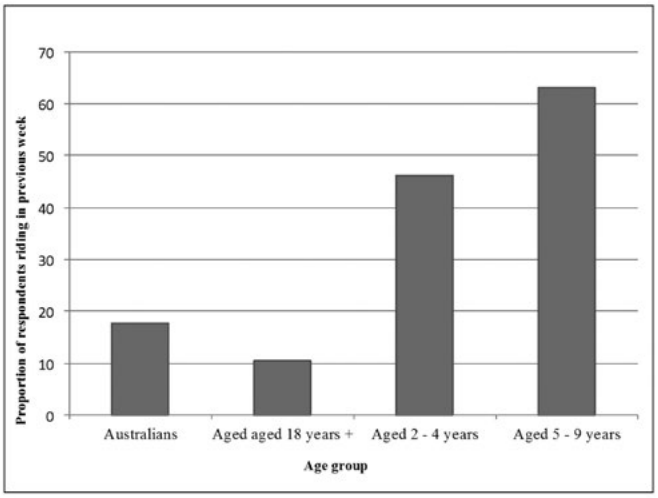

Figure 1. Bicycle riding participation in Australia
Source: Munro [12]

A significant proportion of those surveyed (39.6%) reported riding at least once in the past year, with a little over one quarter (26.5%) indicating they rode a bicycle in the last month [12].

Commuting to work by bicycle in Australian cities varies; 3.4% cycle to work in Darwin, 2.6% in Canberra, and between 1.1% and 1.8% in Melbourne, Perth and Brisbane, with only 0.7% of Sydney workers commuting by bike [13]. These rates are significantly lower than the proportion of Australians claiming to have ridden in the previous week, as previously identified. This difference may be due to a variety of factors, including strong recreational cycling rates, as well as short utility trips outside the journey to work category. Whilst bicycling is only a modest contributor to the commuting mode share, almost all cities in Australia have demonstrated a growth in bicycle commuting rates between 2001 and 2006 [13]. Considerable variation in the use of bicycles for transport can be seen even within the same city. In inner areas of Melbourne, up to 10% of trips are completed by bicycle, while in outer suburban areas, the rate is almost always below 0.5% [2]. Internationally, all Australian cities fall well behind the bicycle-friendly cities of the Netherlands and Denmark. In Amsterdam and Copenhagen, some 34% and 36% of workers commute by bicycle respectively [8, 14]. The contrast in participation rates may reflect

significant differences related to helmet legislation, parking and driving costs, as well as the quality of bicycle infrastructure.

Fear

One of the most frequently cited reasons for the low levels of bicycle riding in Australia is fear of collision with motorised traffic [3, 5, 15], despite evidence demonstrating that the benefits of cycling outweigh the risks [16]. Fear of cycling is not restricted to Australia. In the UK, some 47% of adults strongly agree with the statement 'the idea of cycling on busy roads frightens me', with a further 27% agreeing [6]. Similar results are found in the United States [14]. It has also been found that one of the most common reasons leisure bicyclists do not ride for transport is fear of motorised vehicles [17-19]. Important gender differences are also apparent. Women, at least in the United Kingdom, express greater safety concerns than men [6]. This greater sense of fear expressed by females may explain (at least in part) why only around three in ten commuter bicycle riders in Australia are female [5]. Gender differences vary widely, however, with an approximately equal mix in countries with comprehensive bicycle programs such as the Netherlands and Denmark [20].

Horton, Rosen and Cox [6], in their examination of the societal influences on cycling, describe fear not as an inevitable emotional response, or even necessarily an individual choice. Rather, they argue the fear of bicycle riding is something *produced* by a complex interaction of the media, the automobile sector, the transport environment and even government safety campaigns. Moreover, to understand modal choice, the sense of identity, self-expression and lifestyle connotations embedded in our transport decision-making need to be appreciated [21]. These wider influences on our attitudes to transport provide a helpful basis upon which to understand fear as a barrier to bicycling.

Horton et al. [6] contend that part of the reason people are fearful of cycling is that society has become more fearful generally, despite being safer in an objective sense. Horton et al. dissect the fear of cycling into different components. At a simple, direct level, there is a road traffic fear (fear of a crash). They also describe a fear of actually becoming a 'cyclist' and all the associations such an identity might mean in a society in which cyclists are seen as an 'out-group' - a term used by Basford et al. [7] to describe how motorists view people who ride bicycles. Whilst bicycling may have increased in popularity since Basford et al. carried out their study, it remains a minor mode of transport in many segments of the Australian population. Garrard [22] has built on the work of Basford and Horton to identify several components of risk perception – highlighting how they differ between driving a car and riding a bicycle (see Table 1).

Table 1. Components of risk perception. Source: Garrard [22]

Components of risk perception	Driving	Riding a bicycle
Sense of personal control	High	Low
Trust in other road users ('are they looking out for me?')	Yes	No
Common/unusual	Common	Unusual
Discrimination	In-group	Out-group
Social cues	"Everyone is doing it"	"Not many people are doing it"
Vulnerability	Low (protective shell)	High (no protective shell)
Consequences	Usually minor	Potentially serious

Table 1 presents a simplified and contrasting set of components forming risk perception for driving a motor vehicle and riding a bicycle. Although the situation will vary for different riders and different environments, Table 1 illustrates why the decision to drive is not typically accompanied by the fear that many in the community associate with bicycle riding.

Figure 2 illustrates the reasons current bicycle riders do not ride more frequently (n = 158), as well as why non-riders interested in cycling choose not to ride (n = 515). Commissioned by the Cycling Promotion Fund and the Heart Foundation, and using a randomly selected base sample of 1000 adults [11], the online survey results show that issues related to fear of motorised traffic predominate; the most common issues were unsafe road conditions, speed/volume of traffic, and lack of bicycle lanes/trails. Furthermore, over 40% of non-riders reported they *don't feel safe riding* as a key reason they chose not to ride a bike, compared to just over 25% for current riders. These findings are supported by recent Canadian research [23] investigating the deterrents to and motivators of bicycle use. In their survey of 1402 current and potential bicycle riders in the Vancouver area, the most common deterrents were unsafe surfaces, interactions with motor vehicles and high speed of motor vehicles. Major motivators, unsurprisingly, were routes away from traffic noise and pollution, attractive scenery, and paths separated from motor vehicle traffic. Recent research using focus groups in Brisbane found that fear of motorised traffic is a major deterrent to bicycle riding [24].

Horton et al. [6] note that the reason people choose or decline bicycling as a mode of transport is often more complex than for motorised transport. This is in part because additional factors are at play, including the expenditure of human energy, as well as the nature of the physical environment.

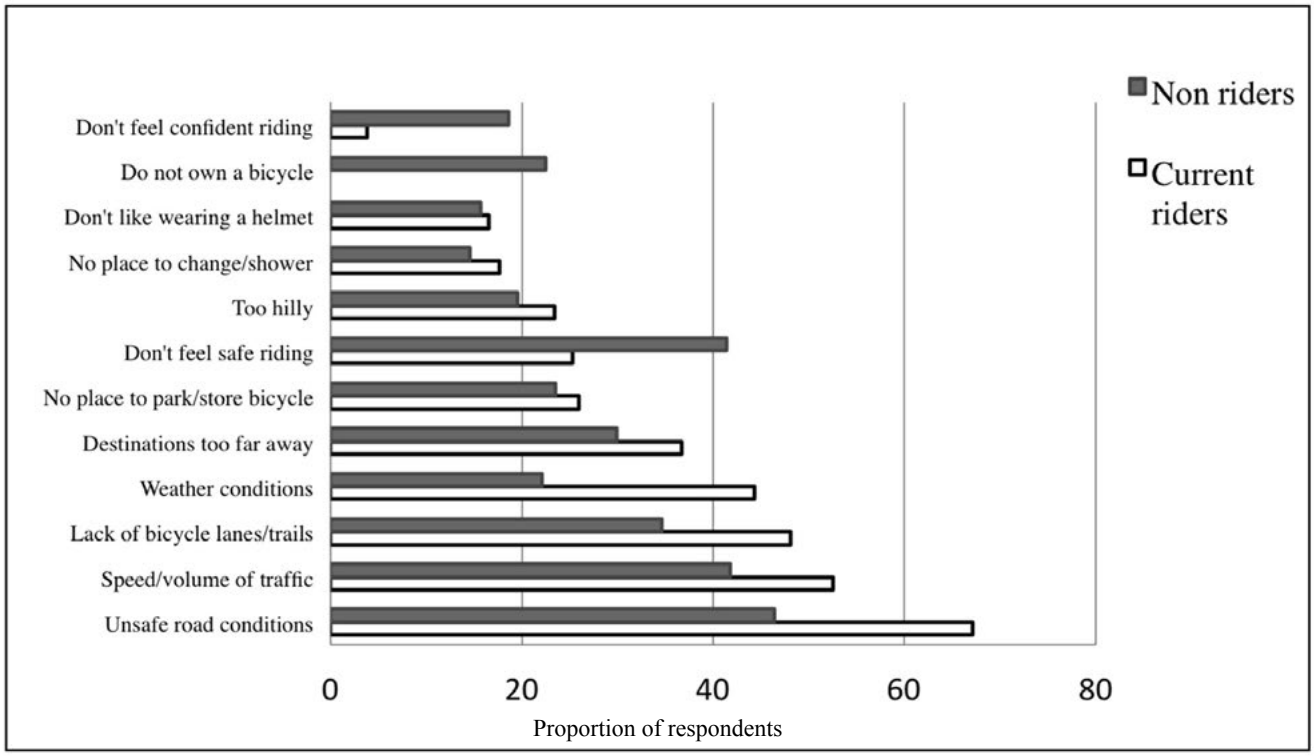

Figure 2. Reason for not riding for transport
Source: Cycling Promotion Fund [11]

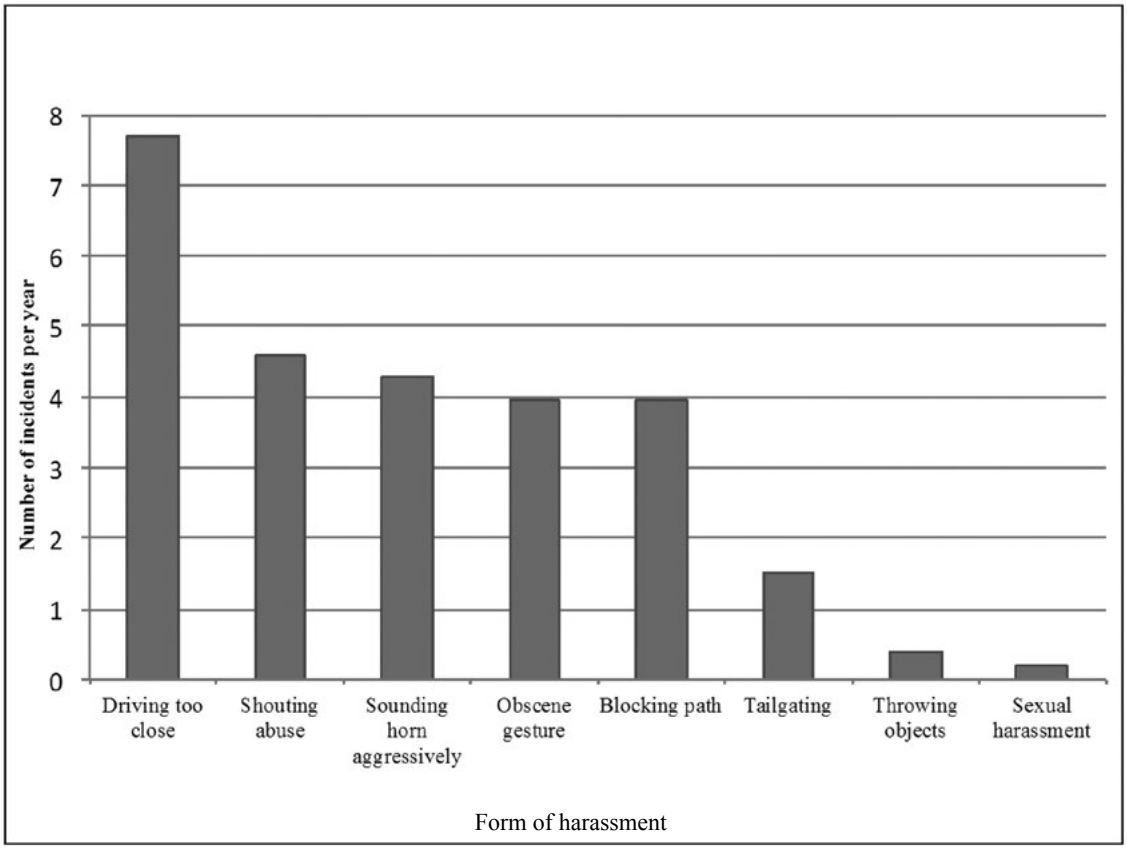

Figure 3. Harassment experienced by people riding bicycles
Source: Garrard et al. [5]

Hostile behaviour from other road users towards cyclists may also be a cause of fear. In a large online survey of Bicycle Victoria members (n = 2406), over 65% of riders reported some form of harassment over the previous 12 months [5]. Figure 3 details the types and prevalence of this harassment. On average, people riding bicycles experience a form of harassment every two weeks. Although this harassment does not often result in any physical injury, it raises fears associated with bicycling and, for many, acts as a deterrent to riding a bicycle [22].

Focus group results from Brisbane suggest regular riders were generally dissatisfied with the level of awareness and respect shown to them from motor vehicle drivers [24]. With recent evidence demonstrating the low level of injury and fatality but relatively frequent near collision events [25], Garrard [22] has proposed an iceberg analogy to illustrate that although the tip of the iceberg is represented by the serious injuries and fatalities, the more substantive component of fear and anxiety is caused by the near collisions and harassment experienced by those riding bicycles. The relatively high prevalence of low severity crashes might also increase perceptions of risk. This analogy may be supported by work produced by scholars in the field of risk analysis. Here, it has been established that problems in risk communication can arise through 'social amplification' [26] which involves the transfer of information about a risk and the way society responds to information. This transfer may be facilitated through the experience of bicycle riders but, perhaps more importantly, when drivers (and perhaps their passengers) experience a *near miss* with a person on a bicycle. Research conducted in Queensland found that as kilometres cycled increased, there was a reduction in injury likelihood, on a per kilometre travelled basis, as well as a reduction in perceived risk [27]. According to a survey of bicycle riders in Queensland, the frequency of self-reported crash injuries (includes falls both on and off-road) is approximately 0.5 per year per bicycle rider, although most of the crash-related injuries resulted in low severity outcomes (did not require admission to hospital) [27]. Additional Queensland research, using a sample of 1976 Bicycle Queensland members found 31% had experienced a bicycle injury in the last year (includes non-collisions, such as falls due to skidding, but not muscle strains). Those cycling more frequently, for less than five years and for recreation or competition had a greater likelihood of injury [28].

Road safety and bicycle riding

People riding bicycles comprise 2.3% of road deaths (when taking the average number of bicyclist and overall road fatalities from 2002 to 2011) [29] and 14% of serious road traffic injuries in Australia [30]. According to Garrard [22], there are 1.2 serious injuries in Melbourne for every million kilometres cycled. Someone bicycling 5000 kilometres

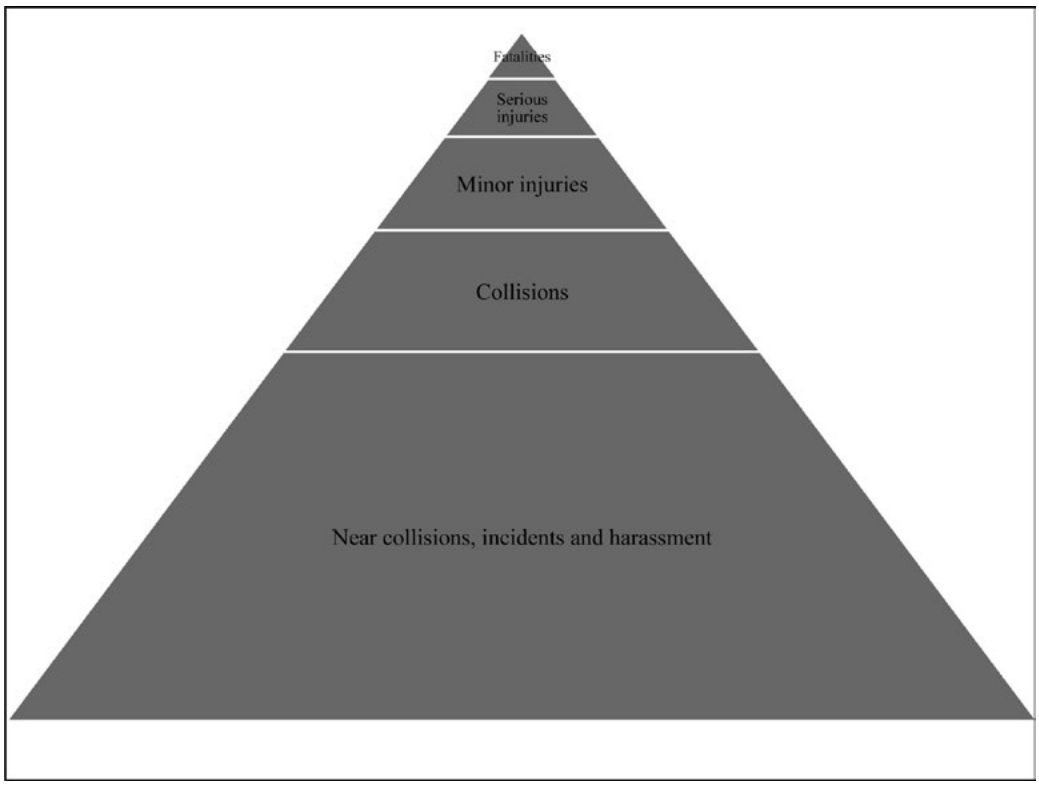

Figure 4. The Fear Iceberg of Bicycle Riding
Source: Garrard [22]

annually could expect to sustain one serious injury for every 167 years of riding (assuming the risk remains the same over the next 167 years). In terms of relative risk (using Melbourne data), a person riding a bicycle has 13 times the risk of sustaining a serious injury compared to a motor vehicle driver covering the same distance. Put simply, a journey of 13 kilometres driven has the same risk of serious injury as one kilometre cycled [22]. Given the vastly greater distances travelled by car, Garrard argues the level of fear associated with bicycle riding is disproportionate relative to the fear (or lack thereof) associated with travelling by car [22]. Combining national data collected by Austroads [31] with Victorian data on median trip distance and journey for driving and riding [32], it is possible to compare fatality and serious injury rates on a per trip and per hour basis. On a per trip basis, the analysis reveals the risk of fatality for the median car journey is half that of the median bike trip.

Without a detailed understanding of the quantitative risks associated with different modes of transport, it is plausible for individuals to form their views on road safety risk by what feels safe or unsafe. Garrard argues [22] bicycle riding feels unsafe to most Australians and this explains, to a large degree, the common finding of safety concerns acting as a barrier to the uptake of cycling. This view is supported by research undertaken by the Monash University Accident Research Centre. A study by Johnson et al. [25], in which six cyclists wore helmet mounted video cameras, found no incidents over the 46 hours of riding recorded but found there were 36 'near collisions' – averaging 0.76 per hour. Interestingly, female near collisions occurred at the rate of 0.38 per hour, while male near collisions occurred 1.13 times per hour.

The authors attributed this significant difference to the fact that females had a stronger preference for off-road riding in which motor vehicles were not present. It should also be noted that whilst fear of collision with a motor vehicle is the major safety concern when riding, according to Haworth et al. [33], half the bicycle injuries in Queensland resulting in hospitalisation occurred outside of the public road network, suggesting at least half do not involve a motor vehicle. Moreover, in an analysis of serious injuries due to land transport accidents, Henley and Harrison [30] found approximately half of all serious bicycle injuries in 2006-07 occurred off the public road network and therefore without the involvement of a motor vehicle.

Closing the gap between perception/ reality and improving road safety for people bicycling

Bicycle riding has been increasing for several years in Australia, as previously noted, yet concerns regarding safety continue to be a major barrier. Garrard et al. [34] suggest that the issue of safety for those riding bicycles is something of a road safety 'blind spot'. Many of the in-car safety advancements over recent years have helped to reduce car occupant injury and death, but relatively little action has taken place with regard to the safety of bicyclists. Motor vehicles are also equipped with seatbelts, airbags and other measures that create a more forgiving in-car environment in the event of an incident or near miss. Bicyclists are not afforded the same degree of protection and are therefore more exposed to external conditions, such as weather and road user behaviour [34]. Elvik [35], however, found that large shifts from motorised to active transport can lead to a reduction in the total number of transport injuries. As such, road safety policy could seek to achieve mode shifts to active transport on the grounds of lowering rates of road traffic injuries.

Serious injuries for pedestrians, vehicle passengers and motor vehicle drivers have declined over recent decades, yet cycling fatalities reached a plateau and serious injuries have increased ([13, 30] cited in Garrard et al. [34]). For instance, between 2000 and 2007 serious injuries for bicyclists increased by 47%, whilst such injuries for other modes of transport remained the same or reduced [30]. There is some debate as to whether this is related to changes in cycling participation, with some reports showing no significant increase [34], whilst others illustrate a marked increase [36]. The lack of data on the distance Australians cover while bicycle riding, itemised for different trip purposes (e.g. leisure, competitive sport, non-work transport and commuting), makes it difficult to determine whether the increase in injuries is a consequence of increasing exposure (i.e. more bicycle riding).

In order to overcome the perception of risk associated with bicycling, it is necessary to implement measures targeted at the major influences governing risk perception. Parkin, Wardman and Page [37] have found each of the following to be significant contributors to the perception of risk while riding:

- volume, speed and type of traffic
- number of parked vehicles on the side of the road (car-door opening risk)
- type of intersections.

Reducing near collisions

Near collisions create a sense of vulnerability that prevent large sections of the Australian population from bicycling and act as a deterrent for current bicyclists to ride more often [22]. Over the last 15 to 20 years, Australian governments, to varying degrees, have begun to install bicycle lanes and paths; this has improved actual and perceived levels of safety. However, in relation to international best practice, the measures taken in Australia to promote bicycling can generally be described as 'picking the low hanging fruit' in which some of the easy options have been taken. Decisions regarding the relative priority

of sustainable modes of transport versus motorised modes have typically fallen in favour of the latter [38]. Whilst it is sensible to start with the 'low hanging fruit', such as installing a bicycle lane along a road with excessive width, the best fruit is often at the top of the tree. Competition for space on the road network in our growing cities means decisions will need to be made that challenge the primacy of the automobile in Australian society. To achieve the increased levels of bicycling required to successfully meet the challenges posed by climate change, obesity/diabetes, congestion and urban liveability [3], it will be necessary to re-evaluate the allocation of road space typical in the Australian city and regional centre. 'Probably the most visible commitment of a city to cycling is a comprehensive system of separated bicycle paths and lanes, providing a reserved right of way to cyclists and sending a clear signal that bicycles belong.' [2]

Rather than accepting the current allocation which marginalises bicycle infrastructure to a minority of roads, a systematic review underpinned by an acceptance and willingness to provide a road environment in which bicycling is safe and feels safe on all parts of the network by a majority of users, save the 100 km/h+ freeways, will be required. Indeed, it is this mindset that has enabled the Netherlands, Denmark and even some US towns (e.g. Davis, CA) to achieve the levels of safety in which a majority of the population feel safe to use a bicycle, and are, on a per kilometre basis, less likely to sustain a serious injury while riding [20, 39].

The over-allocation of space to motor vehicles may be contributing to Australia's relatively high levels of car use, when compared to other developed countries – even for relatively short journeys. In Australian cities and towns, the majority of car trips are less than five kilometres [40], a distance in which bicycle travel is often time competitive [10]. A reallocation of space creating a dedicated bicycle network will help create a real choice in an environment in which car ownership has to an extent become *forced*, in the sense that it is in many cases the only realistic option in many middle and outer suburbs [41].

The Netherlands have developed and implemented a comprehensive set of design guidelines aimed at creating the physical environment necessary to maximise the level of safe bicycling (perceived and actual). The critical elements include [42]:

- a coherent, comprehensive network of bicycle routes that connect origin and destination
- direct routes (avoidance of circuitous routes and prioritising the shortest practical route possible)
- attractive conditions that provide a pleasant environment
- safety (facilities are developed to minimise the risk of collisions with other road users, as well as considering issues of personal security)
- comfort (creation of facilities conducive to the efficient and comfortable flow of bicycle traffic).

The following recommendations are intended to respond to the safety concerns reported in the literature by both bicycle riders as well as those 'would be' riders deterred by fear of collision (or near collision) with a motor vehicle. These recommendations are not intended to be used as technical design specifications. However, they provide a strategic vision for the elements necessary to minimise the barriers and maximise bicycle riding participation. In addition to improving actual safety, the measures described below focus on reducing perceptions of risk.

- **Separated bicycle lanes.** On major arterial roads (at least two general traffic lanes in each direction), which often have the most suitable gradient for bicycling, separated bicycle infrastructure has been shown to increase actual and perceived levels of safety [23, 43]. Parkin et al. [37] found physically separated infrastructure to provide significant increases in perceived safety levels, a finding supported by earlier studies [44, 45]. In many cases, particularly in the urban environment, road corridors cannot be expanded and therefore it will be necessary to reallocate space from a general traffic lane to accommodate the greater width required for a fully separated bicycle lane.
- **Bicycle lanes.** On minor arterial roads, bicycle lanes are required to form a coherent, integrated network. Currently, even in relatively bicycle-friendly areas of Australian cities, bicycle lanes are typically found on a minority of roads. In many cases, bicycle lanes end at the approach to an intersection, which also coincides with the highest likelihood of interaction with motor vehicles [46]. By re-evaluating the allocation of road space with safety and sustainability as priorities, the creation of 'joined up' bicycle lanes becomes necessary and possible. The use of distinctive paint to increase awareness, particularly through intersections, has been shown to reduce collisions [47] and should be used in a targeted manner to reduce near and actual collisions between bicycle riders and motor vehicles.
- **Awareness campaigns.** Raising awareness of the increased presence of bicycle riders on roads may assist in reducing the 'looked but did not see' collisions and near collisions that typically occur when motorists do not expect bicyclists to be on the road [48, 49]. By targeting common near and actual collision situations, such as car door opening and left turning collisions, as well as general awareness raising about the increased popularity of bicycling, the actual and perceived safety of bicycling may increase [50].
- **Speed limit reductions.** By reducing the general speed limit in cities to 30 km/h, consistent with many

European countries, the perceived and actual risk of collision, near collision and severity of injury for actual collisions will be reduced [2].

Conclusion

This paper has examined the roles that fear and perceived risk play in reducing bicycle-riding participation in Australia – factors that may serve as significant barriers to the uptake of cycling. In order to significantly increase rates of bicycling, safety must be prioritised; at the same time, fear and common perceptions of road traffic crash likelihood that prevent people from cycling will need to be addressed. To adequately address community concerns, the road traffic environment will need to be made to *feel* safe. This can be achieved through measures such as the targeted reallocation of road space and the lowering of speed limits, along with awareness and education campaigns. Current evidence suggests that these measures will help to provide a road environment that is safer – and, importantly, one that is *perceived* to be safer – for bicycle riders.

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The effectiveness of wire rope barriers in Victoria

by Nimmi Candappa, Angelo D'Elia, Stuart Newstead and Bruce Corben, Monash University Accident Research Centre (MUARC), Melbourne

Abstract

Run-off-road crashes represent half of all fatal crashes in rural Victoria and many of these crashes involve collisions with fixed roadside objects. Wire rope barriers are proving to be highly effective in addressing this crash problem internationally. To date no comprehensive Victorian evaluation had been undertaken on the effectiveness of this barrier. A quasi-experimental 'before and after' study design was employed to evaluate the effectiveness of these barriers in addressing this crash problem. Results indicated that barriers were associated with statistically significant reductions program-wide. In addition, along two specific routes, reductions of up to 87% in targeted serious casualty crashes were indicated.

Keywords

Effectiveness, Evaluation, Run-off-road crashes, Wire rope barrier

Introduction

Single vehicle run-off-road crashes represent a major source of serious road trauma resulting from factors such as road curvature, excessive speed, driver fatigue and alcohol consumption [1]. In the five years to 2010, nearly 70% of all fatal and serious injury crashes in rural Victoria, Australia, were the result of vehicles being driven off the road or crashing into oncoming vehicles, accounting for nearly 5000 crashes. Of these, 60% involved collision