Integrating Policy Approaches For Vulnerable Road Users

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1 Introduction

In road safety circles, pedestrians, pedal cyclists and motorcyclists are often referred to as 'vulnerable road users' because of the high severity of injury that often occurs in impacts between these groups and cars. In many parts of the world, vulnerable road users comprise the bulk of road fatalities (World Health Organization and World Bank, 2004). In 2005, a total of 497 pedestrians, pedal cyclists and motorcyclists were killed on Australian roads, comprising 30.4% of total road crash fatalities (Australian Transport Safety Bureau, 2006). The largest components of this total were motorcyclists (233) and pedestrians (223) with 41 pedal cyclists killed.

As Figure 1 shows, the long-term trends in road crash fatalities for the three groups of vulnerable road users have differed. The number of pedestrians killed has generally decreased from a high of 822 in 1970 to 220 in 2004. The number of motorcyclists killed increased in the early 1970s, fell during the 1980s and was reasonably constant during the 1990s. In recent years, the number of pedestrians killed decreased by 22% from 2000 to 2005 while the number of motorcyclists killed increased by 22%. The number of pedal cyclists killed each year is smaller and more variable, with no clear trends discernible.

The recent increases in motorcycle fatalities (and injuries) reflect the increasing popularity of motorcycling. From 2000 to 2004, motorcycles showed the strongest growth of any vehicle type in Australia, the number registered increasing by 14% to 392,648 (Australian Bureau of Statistics, 2005). There have been no large-scale surveys of why new riders take up riding. While there has been speculation that increases in the costs of fuel and parking and increased congestion may make motorcycles a more attractive means for commuting to and from work (Wigan, 2000), recent surveys of older riders (Haworth, Mulvihill, & Symmons, 2002; Haworth & Mulvihill, 2005) indicate that economic considerations and dealing with traffic may not be the primary factors in why motorcyclists ride, as motorcyclists mostly ride for recreation rather than for commuting.

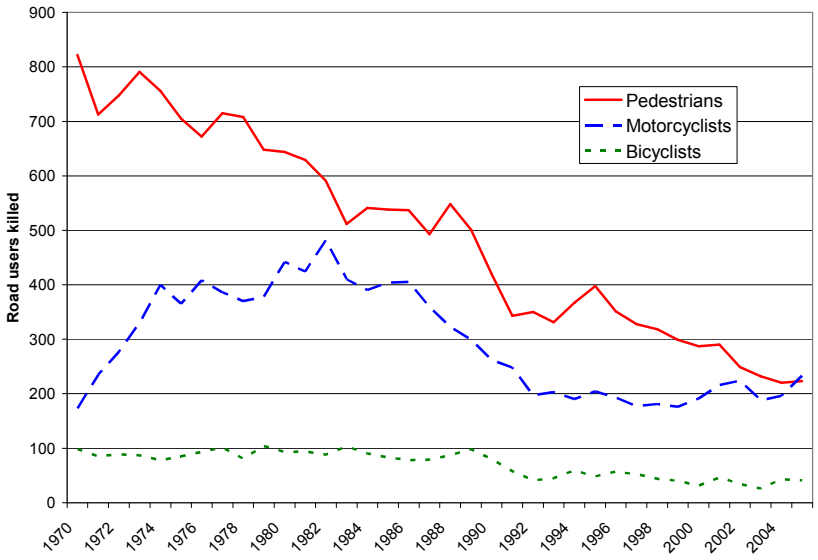

Figure 1 Numbers of pedestrians, motorcyclist and bicyclists killed on Australian roads, 1970 to 2005. (source: Australian Transport Safety Bureau (2006))

The long-term reductions in the numbers of pedestrians killed (and injured) have generally been considered to be a by-product of reductions in the amount of walking, particularly by children. The dramatic reduction in pedestrian fatalities from 501 in 1989 to 231 in 2003 has been attributed to reductions in vehicle speeds resulting from both speed limit reductions (particularly 50 km/h general urban speed limits) and improvements in speed enforcement (Australian Transport Council, 2004).

Road crash fatality data tends to drive road safety policy, but these data may not be representative of the range of severities of outcomes or of the wider range of injuries that may occur. While similar numbers of motorcyclists and pedestrians are killed on Australian roads, with relatively few pedal cyclists, the pattern is different for road users admitted to hospital. In Australia in 2001-02 (the latest period for which data are available), 22% of persons hospitalised as a result of transport-related injuries were motorcyclists, 16% were pedal cyclists and 9% were pedestrians (Berry & Harrison, 2006). More differences are revealed when the transport-related hospitalisations are broken down into traffic- and non-traffic accidents (shown in Table 1). According to the ICD-10-AM classification system, "a traffic accident is any vehicle accident occurring on a public highway. A non-traffic accident is any vehicle accident that occurs entirely in any place other than a public highway" (Berry & Harrison, 2006, p.43). Deaths and injuries from non-traffic accidents are generally not included in road crash statistics.

Table 1 shows that substantial numbers of pedal cyclists and motorcyclists are admitted to hospital after non-traffic accidents. While only 11.1% of car occupants hospitalised were involved in non-traffic accidents, 19.4% of pedestrians, 53.3% of pedal cyclists and 47.7% of motorcyclists hospitalised were involved in non-traffic accidents. In addition to the 4,260 hospitalisations of pedestrians in 2001-02 resulting from transport-related injuries, another 4,507 hospitalisations occurred as a result of falls on streets and highways (not including falls associated with vehicles) (Berry & Harrison, 2006).

Given that vulnerable road users comprise a significant proportion of road fatalities, traffic- and non-traffic related transportation injuries and falls, this paper discusses the potential for integrating safety policies for vulnerable road users, some of the challenges that might be faced in the process and whether integration should go beyond road safety to encompass environmental and transport policies.

Table 1 Hospital separations resulting from traffic, non-traffic and unspecified transport injuries Australia 2001-02 (source: Berry & Harrison (2006))

	Non-traffic	Traffic	Unspecified	Total
Pedestrian	826	2,995	439	4,260
Pedal cycle	4,059	3,308	242	7,609
Motorcycle	4,898	5,124	242	10,264
Car	2,089	16,339	460	18,888
Other	1,453	1,003	3,616	6,072
Total	13,325	28,769	4,999	47,093

2 Different policy approaches

Government policies from the roads and transport, health, education, tourism, sport, local government and environmental portfolios impact on vulnerable road users. Within transport departments, the policy treatment of vulnerable road users often differs between transport network sections and road safety sections. Transport, health and environmental policies often proclaim their support for increasing walking and cycling while road safety policies attempt to minimise the risks associated with motorcycling (and to a lesser extent walking and cycling).

For example, the Queensland Cycling Strategy states that

> Queensland values cycling for the important contribution it makes to the development of a sustainable and effective transport system. Cycling is not just a transport issue. It has significant benefits for health, the environment and tourism as well as having positive local impacts in connecting communities. The aim of the Queensland Cycle Strategy is to make Queensland a place where cycling is safe and convenient, and where choosing to cycle is respected, supported, and encouraged by all levels of government and the community.
> (http://www.transport.qld.gov.au/qt/LTASinfo.nsf/index/cycling_strategy)

The Strategy is overseen by Queensland Transport's Cycle and Pedestrian Area (CAPA), a part of the transport network section rather than the road safety section. The tone of the discussion in the road safety strategy is somewhat different. Under the heading of "Plan for at-risk road user groups in the development and management of road environments and traffic systems" the Queensland Road Safety Strategy 2004-2011 Safe for Life (p.13) states that

> "We need to continue developing effective solutions to protect at-risk road users without unnecessarily compromising their access to services. For example, the safe passage of pedestrians and bicycles through shared facilities, separation, identification of alternative routes, speed reduction, appropriate enforcement measures or other best-practice initiatives".

2.1 Vulnerable road users in road safety strategies

The emphasis in road safety is often on pedestrians and cyclists as road users at risk, whereas motorcyclists are often seen as risky (rather than at risk). Interestingly, motorcyclists are sometimes not included when the term "vulnerable road users" is used.

State and National road safety strategies have traditionally had a structure similar to a shopping list with a list of problem issues and road user types, among whom are pedestrians, pedal cyclists and motorcyclists. The National Road Safety Strategy and the newly developing strategies in Victoria and Western Australia are focusing less on interventions to change driver behaviour and more on moving towards a safe system. The safe system approach is in essence an Australian adaptation of the European Vision Zero and Sustainable Safety models. The 2005 and 2006 Action Plan for the Australian Road Safety Strategy (ATC, 2004) introduces the Safe System concept as the "overarching framework for road safety intervention". This approach emphasizes the ways in which the safety of roads and roadsides, speeds and vehicles combine to affect total road trauma.

Table 2 shows the extent to which the different approaches in the strategy are expected to benefit car occupants, motorcyclists, pedal cyclists and pedestrians. In general, it predicts lower benefits for motorcyclists than car occupants and lower benefits still for pedal cyclists and pedestrians. It is only for the speed initiatives that similar levels of benefits are predicted for all four road user groups.

Table 2 Expected benefits for car occupants, motorcyclists, pedal cyclists and pedestrians from road safety approaches in the National Road Safety Action Plan 2005-2006 (source : ATC (2004))

Approach	Car occupants	Motorcyclists	Pedal cyclists	Pedestrians
Road initiatives				
Targeted road improvements	***	**	*	*
Safe roadside programmes	***	***	-	-
Public education	***	***	-	-
Speed initiatives				
Public education & information	**	**	**	**
Improved enforcement	***	***	***	***
Lower speed limits	***	***	***	***
Vehicle initiatives				
Seat belt warning devices	***	-	-	-
Crashworthiness & compatibility measures	***	*	*	*
In-vehicle technologies	***	**	**	**
Driver impairment				
Alcohol and drug deterrence	***	***	*	*
Alcohol interlock programmes	***	*	*	*
Fatigue countermeasures	**	*	**	**
Driver management				
Licensing improvements	***	**	**	**
Post-licence driver education	***	*	**	**
Deterrence issues	***	***	**	**

2.1.1 Motorcycle safety plans

Motorcycle safety is traditionally part of the overall road safety strategy or plan, rather than a stand-alone document. However, stand-alone motorcycle safety strategies have been developed in Victoria, New South Wales (separately by the RTA and the Motorcycle Council of NSW), Tasmania and South Australia. de Rome (2006) reviews the development of motorcycle safety plans from Europe, Australia and the USA. She notes the differences in the patterns and priorities of countermeasures in the plans developed by rider associations and those developed by road authorities. Plans developed by rider associations tended to focus on motorcycling as a form of transport with safety issues but plans developed by road authorities focused on crash incidence and injury reduction strategies. She argues that the cultural difference between these two views "must be bridged if road safety professionals and the motorcycling community are able to work together effectively" (p.1). From the point of view of this paper, the plans developed by rider associations are more successful in integrating transport, road safety and environmental aspects, despite being restricted to only one group of vulnerable road users.

2.2 Vulnerable road users in transport strategies

Many current transport strategies have as a stated aim to strive for a decrease (or a decrease in the rate of growth) in the use of private cars and an increase in travel by public transport, walking and cycling (Ker, Huband, Veith & Taylor, 2006; Queensland Government,

2006).

Motorcycles are sometimes ignored in transport planning. The recent Queensland Government Transport Green Paper on Smart Travel Choices for South East Queensland presents the transport options as car, walking, cycling and public transport and does not mention travel by motorbike (or motor scooter).

Wigan (2000) claims that "powered two wheelers are currently inadequately integrated into the transport policy process as a whole" and calls for "an integrated Vulnerable Road User Strategy with broader evaluation criteria than solely safety" (p.v).

2.3 Integrated strategies

There are few strategies that seek to coordinate activities for vulnerable road user groups. The Australian National Cycling Strategy 2005-2010 (Austroads, 2005) is an example of a strategy that sets out to provide a framework for activities related to cycling across a broad range of government, community and industry groups. It estimates that all levels of government in Australia currently spend in the order of $100 million per year on cycling infrastructure and facilities, coordination and planning, road safety for cyclists and cycling promotion and education. Yet this strategy does not mention pedestrians or motorcyclists.

The NSW Roads and Traffic Authority has produced a Motorcyclist and Bicyclist Safety Action Plan 2002-2004. Its goal is to "reduce the incidence and severity of road crashes involving motorcyclists and bicyclists". It refers to motorcyclists and bicyclists as vulnerable road users. The percentages in the document are based on fatality data which can be somewhat misleading/unreliable because of small numbers (particularly for bicyclists) and because these trends may not necessarily be found in non-fatal data and, lastly because the numbers are based on Police-reported road crash data which does not reflect the non-traffic component and also will include significant under-reporting where non-fatal outcomes are included.

3 Similarities and differences

There many similarities among the three groups of vulnerable road users as well as real differences. All three serve as both recreation and transport, have poor data and similar contributing factors to injury. Certainly pedal cycling and motorcycling are passions for many of their proponents. In addition, most adult pedestrians, pedal cyclists and motorcyclists are also car drivers. Walking, cycling and motorcycling are discretionary activities.

3.1 Recreation as well as transport

Walking, cycling and motorcycle riding are recreational activities as well as modes of transport. The multiple purposes of these activities plus the variety in the types of infrastructure that suit these purposes has a number of consequences.

Firstly, treatment of the needs of vulnerable road users becomes fragmented among different agencies with responsibility for sports and recreation, for transport, for environmental issues etc. As shown earlier in this paper, this can lead to conflicting goals and approaches.

Secondly, particular activities may "fall between the cracks" of institutional responsibilities. For example, because of a perception that motorcycles are for transport, it is often perceived that all of the issues related to motorcycling will be handled by transport agencies. Thus, no

agency will take leadership for the safety of off-road motorcycling (which Table 1 shows results in almost as many hospitalisations as on-road motorcycling). Road safety agencies will state that they are not responsible for safety beyond the public road network, Police and local councils and parks authorities may try to prevent illegal riding, and environmental agencies will respond to public concerns about noise pollution from off-road riding but any safety programs or initiatives will be largely left to rider groups themselves.

The phenomenon of activities falling between the cracks also affects the collection of data. Agencies are only likely to collect data that relates to their areas of responsibility.

3.2 Poor availability and selective use of data

Good policy requires good data for development and evaluation of programs. Unfortunately the safety data for vulnerable road users is patchy, particularly for off-road use or for comparing the relative safety of different groups. Measures of the raw numbers of persons killed and injured are not adequate to compare the safety of the three groups or to assess whether this has changed over time. While rates are commonly used, in the area of vulnerable road users, there are substantial problems with rates both in terms of numerators and denominators. The issues related to the scope of data to be included in the numerator have been discussed above. The denominators used in road safety (which may not be adequate here) often relate to per head of population, per licence or per registration or per distance travelled. Rates per head of population can be easily calculated but is not very meaningful since not all members of the population ride a pedal cycle or a motorcycle. Licensing and registration data are relevant for only one group (and then only for on-road riding). Distance travelled appears to be conceptually a better denominator, but the availability of this data is patchy at best. A number of studies from around the world have shown that on the basis of deaths per kilometres travelled, the risk of fatal injury from a motorcycle crash is about thirty times greater than that of other vehicles (Haworth & Mulvihill, 2005). There are disputes about the reliability of estimates of distances travelled by motorcycles (see Haworth, 2003), but data regarding the distances travelled by pedal cyclists and pedestrians are very sparse. The most recent rates that I have seen comparing the three groups were based on survey data collected in 1985-86.

3.3 Similar factors contributing to injury

While the factors contributing to injury for the three groups of vulnerable road users are not identical, there are significant overlaps.

The factors that have been identified as contributing to the over-representation of motorcycles in serious road crashes include (Haworth & Mulvihill, 2005):

1. Vulnerability to injury
2. Inexperience or lack of recent experience
3. Driver failures to see motorcycles
4. Instability and braking difficulties
5. Road surface and environmental hazards
6. Risk taking

Of these factors, numbers 1, 3, 4 and 5 (and arguably 2 and 6) are also relevant to cycling. Numbers 1 and 3 are also relevant to pedestrians. Issues related to protective clothing (which address the first factor) are thus relevant to both motorcyclists and pedal cyclists.

While vulnerability to injury is the defining characteristic of vulnerable road users, it receives relatively little emphasis in countermeasure development. Human biomechanical tolerance

to impact is a popular concept in road safety at the moment, but most often it is applied to setting appropriate speed limits in environments where cars can be involved in particular types of crashes (e.g. head-on, side impact). It has been used to assess suitable speed limits for areas where there are large numbers of pedestrians (e.g. Haworth & Tingvall, 1999) but has had little application to pedal cyclist and motorcyclist safety, at least in Australia.

From the point of view of human biomechanical tolerance, pedal cyclists and motorcyclists are unlikely to be substantially different. One can speculate that a motorcyclist is similar to a pedestrian with huge kinetic energy. The difference when it comes to the level of energy that has to be dissipated in a crash is where it comes from. For pedestrians, it is not their kinetic energy but the kinetic energy of what hits them. With pedal and motorcyclists, we assume that their own kinetic energy becomes important, particularly in single vehicle crashes, because that determines the amount of energy to be absorbed by the human body when it impacts with the road or a fixed object.

Numerous studies of crash injuries to pedestrians have demonstrated that the risk of serious injury or death is relatively low when the speed of an impacting vehicle is below 30 km/h but that death is likely for speeds above 50 km/h (McLean et al, 1994). It would be interesting to assess whether the curve showing the probability of fatality or serious injury would be similar for pedal cyclists and motorcyclists.

4 How much integration is possible?

Given the similarities and differences between pedestrians, pedal cyclists and motorcyclists, how much integration is possible?

4.1 Allocation of space

Allocation of road space has been the area where the challenges of integration of the three vulnerable road user groups have been most keenly felt. Motorcyclist groups sometimes express the view that the bicycling lobby is too strong and that allocation of road space to bicycle lanes endangers motorcyclists by forcing them to ride closer to cars and trucks. Worse still, pedal cyclists do not pay licence, registration nor insurance costs. Wigan (2000) comments that “the wide variety of both powered and unpowered vehicles raises fresh questions about the best way to manage road and lane space on the pavement and off it, including the mixed use of transit, high occupancy vehicle (HOV) and bus lanes. A systematic policy or policies for managing road space would appear to be both timely and necessary, and in the interest of all road users” (Wigan, 2000, p.3).

How compatible are the three modes in terms of safety and therefore how much integration of allocation of space is possible? In general, motorcycles are faster (and heavier) than bicycles are faster than pedestrians – thus their kinetic energy follows the same pattern and it is thought that the group with the lower level of kinetic energy in the crash will be more severely injured. While this seems reasonable, I do not recall seeing any specific data analyses that demonstrate the point for these groups.

The Australian jurisdictions differ in their practices in terms of footpath cycling (Ker et al., 2006). Some jurisdictions appear to keep more closely to the Australian Road Rules approach that children and adults accompanying children may ride on the footpath, but other pedal cyclists should ride on the road. Queensland appears to permit footpath cycling unless there is a sign prohibiting this practice. The jurisdictions also appear to differ in the extent to which they use shared paths which are footpaths (as an alternative to on-road bicycle lanes). Western Australia appears to do this much more than Victoria, for example.

In Queensland at least, both motorcycles and bicycles are allowed to use transit lanes on some major roads.

The extent to which space is allocated to particular groups can increase or reduce their risk of injury but it can also (and is often used to) affect the popularity of that activity (not always a mode of transport). Thus, allowing motorcyclists in high occupancy lanes will encourage commuting by motorcycle at the same time as potentially improving rider safety.

4.2 Health and environmental differences between vulnerable road user groups

While motorcycling is similar to walking and cycling in having lower environmental effects than driving, it does not share the health benefits of walking and cycling. In addition, some of the measures that have been taken or proposed to reduce car dependence in many parts of the world actually encourage motorcycling (e.g. parking policies, tolling systems where cars are tolled but not motorbikes). The policy challenge is whether to clamp down on motorcycling to prevent increases in road trauma or whether to try to address some of the safety issues associated with increases in motorcycling by infrastructure provision (e.g. providing dedicated road space, ensuring that signal detector loops function adequately).

4.3 Are health promotion and injury prevention incompatible?

Will increasing walking and cycling increase the numbers of persons killed and injured? Shephard (2003) discusses the issue of whether the injury consequences of exercise are sufficient to counter the health and economic arguments. He queries the interpretation of many surveys of exercise-related injury, and argues that there should be an emphasis on taking appropriate preventive actions such as safer infrastructure for walking and cycling, mandatory use of protective gear and the refinement and enforcement of rules of play for some sports.

Jacobsen (2003) found that the likelihood that a given person walking or bicycling will be struck by a motorist varies inversely with the amount of walking or bicycling. His analyses of multiple independent data sets found that the total number of pedestrians or bicyclists struck by motorists varies with the 0.4 power of the amount of walking or bicycling (respectively). Thus a 50% increase in walking or bicycling would lead to a 32% increase in the number of walkers and bicyclists injured, equivalent to a 34% reduction in individual risk. Jacobsen maintains that the changes in time series data occurred too rapidly to be explainable by changes in roadway design or traffic laws, and that behavioural changes were more likely to underpin the observed improvements in the safety of walking and bicycling with increased exposure. He doubts whether greater walking or bicycling would lead to better compliance with traffic laws by pedestrians and bicyclists and concludes that the likely mechanism is changes in motorist behaviour in response to the presence of larger numbers of pedestrians and bicyclists.

4.4 Sharing treatments

Safety treatments that work for more than one group of vulnerable road user are likely to have greater benefits and thus higher benefit:cost ratios.

Do motorcycle blackspot treatments also benefit cyclists? Would expect this for intersection-based treatments but other run-off-road treatments are likely to be applied on routes that are popular with motorcyclists because of their hilly and windy nature and which are less attractive to cyclists (other than the most dedicated).

There is also potential to share the research effort on issues of common interest such as conspicuity and road surface treatments. Driver failure to see vulnerable road users contributes to a very large proportion of multi-vehicle pedal cycle and motorcycle crashes. The similarity of the circumstances of these crashes – often intersections with drivers facing Give Way or Stop signs – suggests that aggregation of data from the two modes could help in identifying problem locations or in monitoring the effectiveness of treatments.

5 Issues for the future

It is always dangerous to attempt to predict future issues, but certain trends are likely to continue into the near future at least.

The ageing of the population will mean more older people walking, crossing roads and falling. Given the greater frailty of older people, we may need to reassess the extent to which shared allocation of space should continue. The ageing of the population will also mean an increase in a new group of vulnerable road users – those using power-assisted wheelchairs and scooters.

It is likely that the distinctions between the three groups may become increasingly blurred. While there have been traditionally few true mopeds (pedal plus motor cycles), new devices such as power-assisted bicycles and Segways are blurring the distinction between pedal and motorcycles with consequent issues regarding where they should be able to be ridden, their registration and licensing systems etc (Rose & Cock, 2003). Wigan also makes the point that the range of performance varies markedly among and between the groups.

"The range of powered two wheelers is very large, and the spectrum now extends beyond the light mopeds of the 1970/80s to powered foot propelled skateboards and scooters, through electrically assisted bicycles to mopeds, light scooters and onward to larger motorcycles of differing degrees of specialisation. Similarly bicycles and bicycle users have become more specialised, ranging from sedate occasional riders to specially dressed riders of advanced technology machines, and to electric and internal combustion-engined power-assisted bicycles" (Wigan, 2000, p.3).

6 Conclusions

Vulnerable road users comprise a significant proportion of road fatalities, traffic- and non-traffic related transportation injuries and falls. Yet policy approaches are fragmented and can have conflicting goals. This is despite many similarities between the three groups. The opportunity exists for much more coordinated effort among the three groups and working together on common issues such as conspicuity and road surface treatments. There is certainly a need to improve data sources to identify current and emerging issues and to monitor the effects of new programs.

Walking and cycling have the potential to contribute to improved health outcomes that can offset injuries, unlike motorcycling where the potential benefits are more to the environment and traffic flow. Recent research shows that an increase in walking and cycling may not necessarily lead to an increase in injuries to those involved. The numbers of vulnerable road users are likely to increase in the future because of more older people and increases in the range and numbers of powered two-wheelers.

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