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# Challenges in improving the safety of learner motorcyclists

Narelle Haworth and Peter Rowden  
Centre for Accident Research and Road Safety - Queensland (CARRS-Q),  
Queensland University of Technology, Australia

## Abstract

Inexperience has been shown to be a major factor in many motorcycle crashes worldwide. Learner motorcyclists are not protected from the risks of the on-road environment to the same extent as learner car drivers. Whilst the learner stage has consistently been shown to be the safest phase for car drivers and the provisional stage to be the most dangerous, data from several Australian states has shown similar numbers of learner and provisionally licensed motorcyclists in crashes. This paper reports a review of learner rider safety research undertaken to inform potential future improvements to the licensing and training system in Queensland, Australia.

## Résumé

Le manque d'expérience de conduite est un facteur majeur qui contribue aux accidents des motocyclistes dans le monde. Les motocyclistes inexpérimentés ne sont pas aussi bien protégés contre le risque d'accidents routiers dans la même mesure que les conducteurs de voiture. La phase d'apprentissage de conduite est reconnue comme la plus sur tandis que la phase provisoire est la plus dangereuse pour les conducteurs de voitures durant la formation pour la conduite. Les données d'accidentologie Australiennes ont montré une tendance similaire pour les conducteurs moto durant la phase d'apprentissage et provisoire. Cet article présente une revue des recherches sur la sécurité routière des motocyclistes afin d'améliorer la formation et l'octroi du permis de conduire pour motocyclistes dans le Queensland, en Australie.

## INTRODUCTION

There has been a large growth in motorcycling in many developed countries in the last decade. In Australia, the number of motorcycles registered increased by 57.5% from 396,309 in 2004 to 624,090 in 2009 [1], the strongest growth of any vehicle type. In Canada, the number of new motorcycles sold increased from 79,736 in 2004 to 89,390 in 2008 [2]. Motorcycle registrations in the United States increased by 75% from 3,826,373 in 1997 to 6,678,958 in 2006 [3].

The growth in motorcycling has been accompanied by an increase in rider fatalities and injuries. In Canada, the number of motorcyclists killed in road crashes increased from 172 (5.9% of road user fatalities) in 2002 to 218 (7.6% of fatalities) in 2006 [4]. During the same years, in Australia, the number of motorcyclist fatalities were 224 (13.1% of fatalities) and 239 (14.9% of fatalities) respectively [5]. In the US, the number of motorcyclists killed increased by 144% from 2,116 in

1997 to 5,154 in 2007 [3]. The number of motorcyclists killed per 10,000 registered vehicles has fallen in Australia, but has increased in the US [1,3,5].

Inexperience has been shown to be a major factor in motorcycle crashes worldwide. Whilst the learner stage has consistently been shown to be much safer for car drivers than the subsequent provisional stage, the same is not true for motorcyclists. For example, in the State of New South Wales during 2007, learner and provisional motorcycle licence holders were involved in similar proportions of injury crashes (8.8% and 8.0%) [6]. In contrast, learner car drivers were involved in only 1.1% of all car driver injury crashes compared to 18.2% of provisional car licence holders. In the State of Queensland, more than 16% of motorcyclists in fatal crashes in 2006 had held a licence less a year and 6% had held a licence for between 1 and 2 years. Only 2% had held a licence longer than 8 years [7]. However, not all of the newly licensed riders were young: while 39% of first year licensed riders in fatal crashes were aged 17–24, 36% were aged 30–49 (where age and licence history was known).

These data suggest that current restrictions on learner riders are not producing the same safety benefits as restrictions on learner drivers. It is therefore imperative to improve safety for learner riders, including the introduction of measures that can be implemented prior to the issue of a learner permit. This paper reports a review of learner rider safety research undertaken to inform potential future improvements to the licensing and training system in Queensland, Australia. It examines the potential for pre-learner training to improve the safety of learner riders and what such training needs to consider and include. Pre-learner training aims to ensure that the rider obtains a level of basic riding knowledge and skills in a relatively safe environment before obtaining a learner permit and riding on the road. It also affords the potential benefit within the licensing system of providing a base level of knowledge and skills that can be reinforced and built upon during subsequent licensing stages.

Australia has many similarities to Canada in that driver licensing is a State and Territory, not Federal, responsibility. Each jurisdiction has a graduated licensing system for motorcyclists, with learner, restricted or provisional and full licence stages, but different requirements [8]. Pre-learner programs vary between states in terms of requirements for training, assessment, and the resources available from transport agencies. In Queensland, applicants for a motorcycle learner licence must have held a provisional car licence for at least 12 months. Motorcycle training and assessment can then be voluntarily undertaken via the Q-Ride system. Alternately, after a period of six months, learners can be assessed by a Q-Safe driving examiner without undertaking any training. In contrast, completion of training is *mandatory* to obtain a motorcycle learner permit in New South Wales, South Australia, Tasmania, and the Australian Capital Territory. Structured pre-learner training programs are available and *voluntary* in Victoria and the Northern Territory.

## METHOD

This review of the international literature examined academic journal publications, industry training documentation and government and non government documents relevant to motorcycle licensing and training. Relevant research findings were identified by searching electronic publications databases such as Safety Lit and Science Direct, by checking conference proceedings, and by broad internet searches (e.g. Google, Google Scholar) using the terms: “motorcycle rider training”, “learner motorcyclist”, “novice motorcyclist”, “learner licence”, and

“motorcycle evaluation”. Much pertinent information identified in previous research by the authors was also included.

In this document the term “learner motorcyclist” refers to a rider holding a learner permit, however “novice motorcyclist” is a broader term that may offer more meaning to some of the issues related to crash risk. Whilst official crash statistics may delineate between learner and provisional licensing phases, the road safety literature pertinent to this paper generally refers to inexperienced or novice motorcyclists rather than learner motorcyclists per se.

## **RESULTS**

### **Factors affecting the safety of learner riders**

Safety during the learner period for motorcyclists is influenced by issues common to all riders (e.g. road conditions, conspicuity, other road users); issues specific to licensing requirements for learners (i.e. riding restrictions); as well as issues applicable to novice riders generally, regardless of their licence status (e.g. inexperience). For example, some provisional and open motorcycle licence holders may still be novices if they have done little riding or if the licensing phases are of short duration. Riders in the learner phase, provisional phase or open phase may therefore potentially have equivalent on-road riding experience in some cases. Hence, whilst on-road riding experience (or lack thereof) underpins many of the issues relating to the safety of learner motorcyclists, it is not necessarily exclusive to this group and much of the broader literature may also prove useful.

With this in mind the following factors were reviewed regarding their impact on the safety of learner riders:

- Heterogeneity of the learner rider population;
- Limitations of supervised riding;
- The difference between learner car driving and learner motorcycle riding;
- The temptation to wait out the learner period;
- The conflict between exposure and experience;
- Whether or not training will make riders safer;
- Personality characteristics and riding motives;
- The type of vehicle ridden;
- Vulnerability to injury;
- Rider impairment;
- The lack of willingness to invest in safety;
- A lack of sound evaluations of what initiatives work.

The 12 issues discussed are an amalgam of many issues identified in previous research to affect motorcycle rider safety, particularly those riders with limited experience. The first four are most relevant to learner permit holders; the next three to all novices and the final five are relevant to all riders.

#### **Heterogeneity of the Learner Rider Population**

Motorcyclists wishing to obtain a learner permit differ much more in terms of age, gender and previous experience than learner car drivers. The mean age at learner permit issue for motorcyclists in Queensland is 33 years, with a range from 18 to 75. Only 15% of learner permit

applicants are female. Similar data have been reported for riders in the adjoining State of New South Wales at the end of the learner period [9]. A study by Watson et al [10] found that 67% of motorcycle learner permit applicants had previous riding experience (whether off-road or riding illegally on-road). Additionally, it must also be borne in mind that other factors such as purpose of riding (e.g. recreational vs. commuting) may potentially result in different subgroups of learner riders with different riding habits that may influence their safety.

It is well established that age has a significant effect on crash risk for motorcycle riders. While the majority of serious injury crashes involve mature riders, younger riders have consistently been shown to be more at risk per kilometre travelled [11-12]. A particular concern regarding young novice riders is their propensity for risk taking. That is, while inexperienced riders of all ages are at risk of injury due to a lack of skill and hazard recognition, riders under the age of 25 are more likely to deliberately break the road rules (e.g. speeding) and engage in careless behaviours such as riding too close and drink riding [13].

Crash statistics for the broader motorcycling population in Australia consistently show little crash involvement of female riders compared to male riders [14]. The percentage of injured female riders is far less than the known percentage of female riders within the overall riding population, suggesting that female riders may be safer riders than males, or perhaps they may simply ride less. Watson et al. [10] found that female riders were significantly more likely to undertake training and were more safety conscious than male riders. Haworth and Smith [15] reported that females were more willing to undertake a longer and more comprehensive training course than males. Rowden, Watson, and Haworth [16] found that females were generally less confident during training than males. More research is required regarding the specific gender differences for learner motorcyclists that may impact on their safety and their specific training needs.

Riding experience prior to licensing is also an issue that highlights the heterogeneity of the learner rider population. Previous riding experience is often gained from riding off-road. Blackman, Veitch and Steinhardt [17] compared hospitalised motorcyclists who crashed on-road with riders who crashed off-road (predominantly on public tracks/land). The authors expressed concern that riders that rode primarily off-road in rural settings may be less compliant with road regulations when riding on public roads or lands (e.g. unregistered motorcycle, unlicensed). Harrison and Christie [18] reported that crash rates for younger (licensed) trail bike riders were five times that of all other riders per kilometre travelled. Additionally, many riders with previous experience have ridden during adolescence. Riding during early adolescence [19] or any off-road riding experience prior to licensing [20] has been shown to be associated with increased crash risk. While it is commonly assumed that previous riding experience will enhance the safety of learner riders, the evidence suggests that this is not the case. Learner riders with previous experience (particularly males) may be more able to control a motorcycle, but they may overestimate their own ability to ride within the dynamic on-road traffic environment.

Rowden et al. [16] identified different learning needs during Q-Ride licence training for novice riders with some previous experience as opposed to riders with no previous experience. Riders with previous experience reported roadcraft as the most valuable part of their training for subsequent on-road riding, whilst some novices who had never ridden prior to their training were comparatively overwhelmed with the amount of training information and still felt highly anxious about riding on-road once initially licensed. Additionally, riders with previous experience reported having to unlearn bad habits. Collectively, this information indicates that learner riders should not be viewed as a homogeneous population. Individual characteristics such as age, gender, and previous riding experience are all factors that may influence the safety of learner riders.

### **Limitations of Supervised Riding**

Learner motorcyclists are not protected from the risks of the on-road environment to the same extent as learner car drivers. Not only are they subject to a lack of conspicuity and the obvious vulnerability of an unenclosed vehicle, they are far less likely to receive immediate feedback or instruction from a supervisor in order to avoid risky situations or address technical deficiencies (e.g. braking). When accompanied by a supervising rider on another motorcycle, the learner rider is essentially still solely in control of the vehicle. If accompanied by a pillion supervisor (where legislation allows), the lack of advanced skills required to ride with a pillion may place both the rider and pillion at heightened risk [21]. In either case the ability for the supervisor to intervene to prevent a crash is minimal. Hence, similar to the provisional licensing phase, a learner rider is (generally or effectively) unsupervised. The crash data reflect this, with the crash involvement of learner riders being as high as newly licensed riders, while the crash involvement of learner car drivers is very much lower than for newly licensed drivers [6-7].

It has been suggested that learner motorcyclists should be required to attain a minimum of 120 hrs supervised riding, comparable to that of learner car drivers in Queensland [22]. The safety benefits of logged hours have not been evaluated for learner riders. The higher crash involvement of learner riders compared to learner car drivers suggests that increasing the amount of riding of such a vulnerable group may not be a useful road safety measure. On the other hand, a requirement for logged hours of learner riding might discourage some potential motorcycle learner permit applicants and this may have some road safety benefits by reducing exposure.

### **The Differences Between Learner Car Driving and Learner Motorcycle Riding**

Learner motorcycle riders share some commonalities with learner car drivers such as needing to learn the complexities of the traffic environment, but the potential consequences of an error for learner riders are much more severe. Motorcycling is a much higher risk activity than driving, because of the more complex skills required for riding compared to driving and the lack of protection afforded by the motorcycle compared to that afforded by a car. Two-wheelers are less stable than four-wheelers. The difficulties in braking effectively to avoid a crash are increased by most motorcycles having separate front and rear braking systems [23].

Additionally, road surface and environmental hazards are a more important issue for riders than for other road users [20]. These are additional factors that learner motorcyclists have to learn to deal with over and above those which learner drivers face. Indeed learning to perceive hazards and predict the movements of other road users also holds greater credence for learner riders than learner car drivers. This is evidenced in the general patterns of motorcycle crashes compared to other road user crash types [24].

Another vehicle-related issue is that of maintenance. A minor technical failure is generally nothing more than an inconvenience for a car driver, but the consequences can be much more serious for a motorcycle rider [25]. The Melbourne Case-Control Study of Motorcycle Crashes [20] found mechanical faults to have contributed to about 12% of crashes. Hence, it is imperative that learner riders are aware of the heightened importance of maintaining their motorcycle and conducting regular vehicle checks compared to owning a car.

### **The Temptation to Wait out the Learner Period**

In many jurisdictions (including the Q-Safe option in Queensland), there is a requirement to hold a learner or restricted licence for a minimum time period. While this is designed to enable

practice and experience to be gained under lower-risk conditions when skills are still developing, there is no strong evidence that the learner period provides low-risk conditions in the way that occurs for supervised learner car drivers. The effects on rider safety of minimum time periods for holding a learner or restricted motorcycle licence have not been examined.

One problem with this approach is that riding a motorcycle is a discretionary activity for many riders. Motorcyclists who ride only for recreation might hardly ride at all during the learner and restricted licence phases (unlike car drivers for whom the car is the main form of transport). One influence on their decision not to ride during these periods may be engine capacity and/or power to weight restrictions. This temptation to simply wait until the minimum time period has passed then apply for a higher class of motorcycle licence (with fewer restrictions) may put novice riders at increased risk.

### **The Conflict Between Exposure and Experience**

There is an unfortunate paradox that exists in relation to learning to ride a motorcycle and the risks that the on-road traffic environment presents. It is important for all road users to gradually gain experience in a range of road environments and conditions so that appropriate driving/riding schemas are developed over time. A lack of experience has been shown to be one of the key issues to impact on novice rider safety [12-13]. However for learner motorcyclists, exposure to the on-road traffic environment is full of risks as discussed earlier. The conundrum therefore exists with the need for riders to develop experience in order to minimise injury, within an environment that contributes to injury. Effectively, the more a person rides, the more they are at risk through exposure; however if they ride too little they are at risk because of a lack of experience. The latter is supported by evidence from Harrison and Christie [18] who found that minimal amounts of kilometres ridden was associated with higher crash rates.

### **Whether or not Training Will Make Learner Riders Safer**

Whilst rider training is often perceived by the public and promoted as an effective crash countermeasure [26], past evaluations have generally not found any reduction in crashes for formally trained riders compared to those who have *not* undertaken a formal training course (for reviews see [8,27]). Indeed some studies have found higher crash rates for trained riders [28]. While some of these discrepancies may reflect differences in evaluation methodologies [10,27] or differences between programs, a key issue for novice rider training is that training may be undertaken with the motive of purely passing a test or meeting licence competencies. The implication of this approach is that whilst a student may do enough to pass the licence test or competency assessment, they may have never fully understood how basic concepts in training relate to their safety and the possible consequences of their behaviour. The prime distinction may therefore be between riding *performance* (skills and abilities taught in training) and actual riding *behaviour*. Hence, though the basic vehicle-handling skills and knowledge that is taught in most licence training programs can be seen as an *essential* condition of safe practice, it is not necessarily *sufficient* in terms of crash reduction for learner riders.

Rowden et al. [16] found that novice riders often required some riding experience before personal meaning could be obtained from training information. That is, whilst basic riding skills may be obtained from training, safety concepts may not be readily embraced or internalised until the rider has been exposed to certain situations on-road. This lends support for the notions of spaced learning and over-learning via a second “dose” of training. Further support for second phase training for motorcyclists has been found in Austria [29-30]. Overall, training has the potential to improve safety for learner riders, however this relies on valid content, delivery protocols, sufficient duration, and the timing of such programs within the licensing system.

## **Personality Characteristics and Riding Motives**

People are attracted to motorcycling for a variety of reasons including image, the thrill of riding, the feeling of freedom, and to impress others [10] as well as the practical motives for riding such as convenience and economy. It has been posited that people with an increased propensity for risk taking may be attracted to motorcycling [31-32]. Broughton and Stradling [33] found that risk taking is an inherent part of enjoyment during riding for some participants (accordingly labelled 'risk seekers' and 'risk acceptors') whilst for others (labelled 'risk averse') the enjoyment of riding came from a sense of freedom rather than risk. Importantly, this highlights the importance of considering fundamental rider motives when attempting to change their behaviour and the understated role of emotions in riding in terms of hedonic motives. These riding motives and motorcyclists' subjective views of risk often do not readily reconcile with expert perceptions of risk [34]. The implications of the above findings for learner motorcyclists is that while some will plan to ride responsibly, others are attracted to riding for all the wrong reasons from a road safety point of view.

## **The Type of Vehicle Ridden**

Safety for learner riders may arguably vary as a function of the type of powered-two-wheeler (PTW) chosen. Crash rates have been shown to vary as a function of type of PTW, with higher fatality rates for supersport than cruiser/standard motorcycles [35] and higher involvement in crashes overall for riders of dual purpose motorcycles [18]. Crash rates for scooters and mopeds remain less clear because of difficulties in identifying (non-moped) scooters in crash reporting systems and lack of appropriate distance travelled data [36]. Riders commonly identify with a particular style of motorcycle which to a large degree reflects their riding motives and their subsequent patterns of riding as discussed earlier. Importantly, the interaction between the type of motorcycle and the potential for risk taking may impact on learner rider safety. Learner Approved Motorcycle Schemes (LAMS) have been introduced in some Australian jurisdictions to provide access to a range of motorcycles that excludes high power-to-weight models that may be attractive to risk-takers, but the effects of these schemes have not been evaluated.

Overall the performance and handling of various types of PTWs vary greatly. This has particular implications for the training of learner riders. Some learner riders are attracted to scooters or mopeds to serve their transportation needs and these riders may have specific training needs due to the handling capabilities of the machine compared to other PTWs and the type of transmission involved, as many scooters have automatic transmissions.

## **Vulnerability to Injury**

One of the major contributors to rider injury is their relative lack of protection against impacts with other vehicles, the ground and roadside objects [20,37]. For this reason, rider injuries are often more severe than those of other road users [38]. Novice riders have a heightened potential for incorrect responding to hazardous situations due to their inexperience [39]. If avoidance manoeuvres such as countersteering and emergency braking have not been perfected there is a greater chance of the rider crashing when a hazardous situation is encountered. Hence, learner riders are potentially more vulnerable due to a lack of skill compared to experienced riders.

The lack of conspicuity, design of roadside barriers, and the use of protective clothing and helmets are all additional safety issues related to the vulnerability of motorcyclists [20,23,45]. These are known issues that impact on the safety of *all* riders irrespective of licence status,

however potentially some of these impact more on learner riders due to a lack of knowledge of such issues and a relative lack of skill to avoid hazards.

### **Impairment**

As balance and concentration are extremely important for motorcyclists, the effects of any form of impairment at any licensing stage may have tragic consequences. Alcohol and drugs have been found to be a contributing factor in 21% of all fatal motorcycle crashes in Australia during 1999-2003 and an alarming 46% of single-vehicle fatal motorcycle crashes [11]. The MAIDS [40] study found that the risk of being involved in a crash whilst under the influence of alcohol was 2.7 times greater than whilst sober. For car drivers, evidence shows that the driving skills of novices are more severely impaired at low levels of alcohol than those of their more experienced counterparts [41-42]. For learner motorcyclists it can be reasoned that this effect would prove even more dangerous.

Riding whilst under the influence of drugs is another concern for learner riders given that Drummer et al. [43] reported that 22% of all motorcycle fatalities in Australia for the period 1990 to 1999 tested positive for cannabis. This was nearly twice the proportion of car drivers testing positive for cannabis in fatal crashes.

The effect of fatigue on learner rider safety remains largely unstudied. Haworth and Rowden [44] found that issues contributing to fatigue-related crashes for novice drivers (e.g. night time driving and erratic lifestyle) may not necessarily apply to novice motorcyclists to the same degree as patterns of riding (e.g. time of day) and average age are quite different between the two populations. Nonetheless, the authors identified a range of fatigue-related issues that are unique to motorcycling that should be incorporated in training programs for learner riders.

### **The Lack of Willingness to Invest in Safety**

There are measures that learner riders can take to potentially limit their injury but a lack of willingness to invest in safety in the form of the vehicle features such as ABS [45], quality protective clothing [46], and rider training may compromise the safety of some learner riders. With economic factors impacting on choice of travel mode, some people choose powered two wheelers (motorcycles, scooters, or mopeds) because their initial outlay and running costs can be (or are perceived to be) considerably less than for a car. For example, a rider who purchases a second-hand motorcycle or a new moped for \$2000 may perceive a further cost of \$1500 for protective clothing and/or \$500 for training as defeating the purpose of obtaining an inexpensive vehicle in the first place.

The cost of obtaining a motorcycle licence in some jurisdictions can also play a part in contributing to the overall number of motorcycle crashes. That is, a licensing system that dictates considerable financial investment to obtain a motorcycle licence (e.g. Germany) may dissuade those who are not prepared to invest in their own safety.

### **Lack of Sound Evaluations of What Safety Initiatives Work**

Historically, motorcycle safety initiatives have received little or no evaluation and it has often been assumed that initiatives that work for car drivers will benefit motorcyclists as well. Evaluations of motorcycle restrictions related to vehicle performance (engine capacity, engine power, power-to-weight ratio) and rider training have shown mixed results. Evidence exists regarding the effect of some restrictions when applied to novice car drivers (e.g. lower BAC limits, time of day restrictions) however there have been few evaluations of the effectiveness of particular restrictions placed on novice motorcyclists.

## **Summary**

All of the issues identified in this section require consideration when formulating policy. For example, the heterogeneity of the learner rider population dictates that safety must often be considered at the lowest denominator (i.e. to protect those most at risk). These 12 issues conceptually reframe the findings of prior research in order to guide future discussions regarding rider training and licensing beyond mere skill development or assessment. Implementation of measures to mitigate the effect of such issues must be considered in the context of an overarching system. This system may aim to directly address the aforementioned issues of risk or mitigate these effects by exposure control. The following sections of this paper describe current approaches to pre-learner training and prescribe a model for best practice.

## **Current approaches to pre-learner training**

In most Australian jurisdictions, the motorcycle licensing system is similar to that for car drivers, with similar stages (learner, provisional and full licence) and similar minimum ages and duration for these stages. The restrictions associated with these stages include those shared by car drivers (e.g. zero BAC and speed limit restrictions) but include additional restrictions such as engine capacity or power-to-weight restrictions and restrictions on carrying pillion passengers. Training has high rates of uptake in licensing systems where it is compulsory (e.g. NSW) or where it is perceived to facilitate passing the practical assessment or test needed to gain a learner permit (e.g. Victoria).

Beyond skills training, some jurisdictions (e.g. Norway) mandate completion of broad road safety education programs prior to the issue of a learner permit for motorcyclists. These programs afford potential riders a preview of the risks associated with the road environment. Combined with computer-based resources, such measures have potential to improve rider safety if motorcycle specific risks are incorporated.

## **Best practice model for pre-learner training**

This section discusses how best practice can be identified, previous attempts to identify best practice and the findings of this review.

### **Conceptual issues in identifying best practice**

The first issue in identifying best practice is that of clearly identifying the desired aim. Different aims may result in different programs being identified as best practice. Often the aim of a program is not well-defined or stakeholders do not agree or the program has multiple aims, which may be at least partly conflicting. For example, if the desired aim of having a pre-learner motorcycle program is to improve the skills of as many learner riders as possible, then this may result in a different type of pre-learner program being identified as best practice than if the desired aim is to minimise the crash involvement of learner riders.

A related and fundamental difficulty in identifying best practice in pre-learner motorcycle programs is the lack of rigorous evaluations of the extent to which the programs achieve their stated aims (or of the outcomes in general). The lack of scientific evidence from training evaluations makes it difficult to identify best practice in terms of frequency and duration of training, learning aids, training venues and assessment techniques. This weakens the ability to

identify best practice programs from an evidence-based approach to one in which best practice is measured in terms of the extent to which the program includes components which have been elsewhere or in theory shown to be beneficial (e.g. programs which embody the underlying concept of graduated licensing that experience should be gained in low-risk situations before graduating to higher-risk situations). This is a drawback in many areas of motorcycle safety, not just in pre-learner programs.

The interactive nature of the components of the training/licensing/testing system is important to consider. This interaction means that best practice in pre-learner programs may need to be considered in the light of other components of the system, or that best practice may require changes elsewhere in the system. For example, it may be that changes to licensing requirements to make involvement in a pre-learner program compulsory would be required for a program to have sufficient reach to be considered best practice.

Finally, a pre-learner motorcycle program that is identified as best practice in an international review may not be considered possible to be implemented in another jurisdiction because it requires changes to the training/licensing/testing system that are not politically or socially acceptable, or the cost to the state or the applicant is not considered acceptable.

### **Existing models of best practice**

Two US models of best practice in motorcycle training and licensing [47-48] have included a learner permit as the first stage of a graduated motorcycle licensing system, but neither proposed that pre-learner training be mandated. Haworth and Mulvihill [8] proposed a best practice model of motorcycle rider training, licensing and testing within the Australian context. In terms of learner riders, the best practice model proposes:

- A higher minimum age for motorcycle learner permit (and provisional licence) than for car
- Zero BAC
- Restrictions on carrying pillion
- Power-to-weight restrictions
- Minimum and maximum durations for the learner permit to be held
- Display of L plates
- Following supervisor
- Speed limit restrictions
- Compulsory training to obtain L and P
- Increased roadcraft training to obtain L and P
- Off-road testing to obtain L

Research suggests that it probably requires about four days of training to take a completely novice rider to a stage at which they could be considered adequately safe to be allowed to ride unsupervised on the road [15]. However, there is little real or perceived demand for such a comprehensive (and necessarily expensive) course in the Australian context. For this reason the balance between learner rider safety and riders' lack of willingness to invest in safety requires consideration in a voluntary system. Whilst a four day course can include coaching the rider from basic to more advanced skills, pre-learner programs in most jurisdictions focus on basic vehicle control and manoeuvring, with more advanced skills taught during subsequent training to obtain a provisional licence.

As the components of the licensing system are interactive, best practice for pre-learner programs needs to be discussed in the context of not only the pre-learner and learner phases but also with consideration of how requirements for the provisional stage will be structured.

In terms of best practice in training:

- Compulsory training appears better than voluntary training. This may be due to reductions in exposure rather than risk reduction. Compulsory training may act to deter would be riders from applying for a licence (because of the effort involved in completing the training), thereby discouraging riding and, hence, exposure to risk;
- There is no real evidence of particular programs or components leading to reductions in crash risk;
- An increased emphasis on roadcraft (without reducing the time spent on vehicle control skills) appears to be necessary at both the learner and provisional levels;
- Longer or more costly compulsory programs might deter would-be riders from applying for a licence (because of the effort involved in completing the training), thereby discouraging riding and hence, exposure to risk. However, concerns regarding social equity may dictate a balance between safety and cost in pragmatic terms;
- Hazard perception training holds promise for the future. Horswill and McKenna [49] found that hazard perception training for car drivers reduced their risk-taking propensity. Given that motorcyclists have been found to engage more often in risky behaviours [50], it might be expected that the potential benefits of a hazard perception training program designed specifically for motorcyclists would be even more critical for this group.

Off-road training is considered necessary at the pre-learner stage to allow the most basic vehicle control and road system knowledge to be acquired under the safest conditions. Whilst limited information regarding specific pre-learner course content was freely available for review, it appears that basic riding skills such as changing gears, cornering, and braking would be a minimal requirement in addition to issues such as how to use mirrors, indicators, and maintain tyre pressure. As risk taking has been shown to be an issue for novice riders (particularly young males with some previous riding experience) some coverage of attitudinal and motivational issues is also warranted in the pre-learner stage with continued reinforcement of such issues during provisional licence training. Whilst assessment of rider attitude within the licensing context may not be possible due to the likelihood of “faking”, facilitated discussion of risk taking and appropriate management strategies may instil a sense of appropriate behaviour in riders from the outset.

Past experience suggests that a rider handbook can provide guidance by describing vehicle control and roadcraft issues and techniques, suggesting exercises, and emphasising the importance of protective gear and maintenance. DVDs and other online products can help extend training beyond the training venue.

Further to the content issues discussed above, reviews have demonstrated that individual motorcycle trainers vary in their teaching skills and in the way that they deliver the same curriculum [19]. This suggests a need for quality assurance either by training organisation or the regulator (or both). There is insufficient evidence to assess whether *specific* training qualifications are helpful.

## CONCLUSIONS

Safety during the learner period for motorcyclists is influenced by issues common to all riders (e.g. road conditions, conspicuity, other road users); issues specific to licensing requirements for learners (e.g. where restrictions are used to mitigate); as well as issues applicable to novice riders generally (regardless of their licence status and age). There is a lack of robust evaluations of measures to improve the safety of learner riders to underpin recommendations for change. Pre-learner programs are part of a broader licensing system where restrictions, education, and assessment are central to rider safety at all phases. Approaches to pre-learner programs are founded within a graduated licensing system with the aim to reduce crash risk for motorcyclists, however the secondary benefit of reduced exposure may be more powerful. However, programs to address learner rider safety not only have potential to protect riders through the learner phase, but also provide them with appropriate skills and behaviour management strategies for their entire riding career.

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