# EVALUATION OF THE MINIMUM PASSING DISTANCE ROAD RULE TRIAL IN QUEENSLAND, AUSTRALIA

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**ABSTRACT**

Minimum passing distance (MPD), or three-foot, laws have been introduced in several countries to reduce the occurrence and severity of crashes occurring when motorists overtake cyclists. However, research into the effectiveness of these laws is lacking. This study was an evaluation of a 2-year trial of a MPD rule in Queensland, Australia. The evaluation comprised of four components; (i) Police officers ($n$ = 21) were interviewed to evaluate the practicality of implementing the rule; (ii) Motorists ($n$ = 4,332) and cyclists ($n$ = 3,013) were surveyed to assess their awareness, attitudes and self-reported compliance; (iii) passing events ($n$=3,202) were observed at 15 urban, regional, and tourist locations on South East Queensland roads to assess compliance with the rule; (iv) analysis of police crash, injury, and infringement data. Police reported that the rule was difficult to enforce and many motorists surveyed doubted their ability to accurately judge lateral distance. Just over half of the motorists (52.5%) and almost all cyclists (94.7%) agreed with the rule. Most motorists and cyclists surveyed had observed motorists giving cyclists more space when overtaking than 12 months earlier. The observed non-compliance rates were 12.1% at low speed sites (60 km/h or lower speed limits) and 20.9% at high speed sites, suggesting that compliance with the MPD rule was relatively good. It is premature to draw conclusions regarding the road safety benefits of the road rule given the lack of pre-implementation data and detailed crash and injury data. These initial findings, however, suggest that the MPD road rule encourages motorists to provide more space to cyclists and as such, improves cyclist safety.

*Keywords.* bicycle safety; lateral overtaking distance; minimum passing distance; one meter rule; three-foot law

## INTRODUCTION

Cycling is an increasingly popular activity in Australia (*1*) but most cyclists must cycle on the road for at least part of their journey and as a result, they are at risk of a crash with a motorist. Cyclists have a higher risk of serious injury and death compared with motor vehicle occupants e.g., (*2, 3*), and therefore, it is imperative that strategies are implemented to prevent motorist-cyclist collisions and protect these vulnerable road users. Rear-end crashes and sideswipes are two major crash types that result in serious injury or death of cyclists (*4*). In the State of Queensland, Australia, police-reported cyclist crash data reveal that 11% of crashes are due to sideswipes, with a further 5% due to rear-end crashes (*5*).

Minimum passing distance (MPD) laws have been introduced in the U.S. and some European counties (e.g., France, Portugal, and Spain) to reduce crash risk and the severity of crashes between motorists and cyclists. As at December, 2015, 26 U.S. states and the District of Columbia had introduced MPD laws to enhance cyclist safety (*6*). All states except for two and the District of Columbia observe a 3-foot passing law: Pennsylvania enacted a 4-foot passing law and South Dakota enacted a 2-tiered passing law.

The first Australian state to introduce a MPD rule was Queensland, who began a 2-year trial on 7 April, 2014. The purpose of the trial was to clarify any ambiguity about safe passing distances and to encourage motorists to provide a suitable amount of space between cyclists and their vehicle (*7*). The rule requires motorists to maintain a minimum lateral passing distance of 1 meter (3 feet) when overtaking cyclists in a speed zone of 60 km/h (37 mph) or less, and 1.5 meters (5 feet) when the speed limit is greater than 60 km/h (37 mph). To allow for the required passing distance, motorists are allowed to cross broken or unbroken lines, straddle lines, or drive on painted islands if it is safe to do so (*7*). Motorists who breach the law receive a fine of three penalty units (AU$353 in December, 2015) and incur three demerit points. A maximum fine of 40 penalty units (AU$4,712 in December, 2015) can apply if the matter goes to court. Previous research has identified MPD rules as key strategies for improving cyclist safety (*8*).

Evaluations of the MPD laws have only been undertaken in the U.S. A process evaluation across 20 states (*9*) found that there has been minimal enforcement of the law, and when it has been enforced, it has typically been enforced only after a motorist-cyclist collision. The only other evaluation of a MPD law was an evaluation of Maryland's 3-foot passing law, which was introduced in 2010 (*10*). Five cyclists were recruited to record their daily commutes using a video camera attached to their bicycles. Data were collected post-implementation in 2011. Findings revealed that 16% of passes were 3-feet or less. Given that pre- and post-implementation data were not compared, it is difficult to determine the effect of the law. A more comprehensive evaluation is required to evaluate the effectiveness of the MPD law in advancing cyclist safety.

### Research Aim

The aim of the current research was to evaluate the effectiveness of the trial Queensland MPD road rule. A novel methodological framework was developed to evaluate the trial in terms of the rule's (i) practical implementation, (ii) impact on road users' behaviour, knowledge, awareness and perceptions, and (iii) road safety benefits.

## METHOD

The methodology for evaluating the MPD rule involves four key tasks: (i) interviews with police officers responsible for enforcement of the law to understand issues related to implementation of the law, (ii) survey of cyclists and motorists to assess their attitudes and perceptions about the law, (iii) observational study of passing events to measure compliance

rates, and (iv) analysis of crash, injury, and infringement data to understand road safety benefits associated with the law. These tasks are described in the following sections.

**Interviews with Police Officers**

Qualitative data were gathered from police officers to assess the practicality of implementing the MPD road rule, addressing aim 1. The Queensland Police Road Safety Strategic Development and Intelligence Unit approached officers who had issued a Traffic Infringement Notice (TIN) for a MPD offence, and Road Policing Unit Officers in Charge to request to invite the officers to participate in an interview or focus group discussions. As a result, 21 officers replied directly to the research team and agreed to participate. Three agreed to be interviewed in person or via telephone, all of whom cycled >150km per week. The remaining 18 police officers participated in two focus groups ($n$ = 9 per group).

The focus group discussions were conducted in South East Queensland (Brisbane and Toowoomba) and facilitated by two members of the research team. Few focus group participants identified themselves as cyclists. The focus groups and interviews were guided by four key questions: (i) Do you think the minimum passing distance road rule is needed? (ii) What is your understanding of the minimum passing distance road rule?, (iii) What enforcement is undertaken?, and (iv) What issues have you had (do you foresee) enforcing/ securing prosecution for a violation? Interviews and focus groups were conducted in the latter part of 2015. The interview and focus groups were recorded. AS reviewed the transcriptions and created initial codes from the data. Themes were identified and refined by reviewing the frequency, elaboration, and extensiveness of the coded data. Multiple authors were involved in this process in order to enhance both the reliability and validity of the data.

**Cyclist and Motorist Survey**

An online survey was developed to assess cyclists' and motorists' awareness of, knowledge and perceptions about, and self-reported compliance with the MPD road rule, addressing aims 1, 2, and 3. New items to assess perceptions about the MPD road rule and road user behaviour were developed for this evaluation. Other items were adapted from surveys used in previous research (*11, 12*).

The first survey item asks, 'Have you ridden a bicycle on the road, in Queensland, in the last 12 months?' Participants who responded 'No', were directed to a motorist version of the survey. Those who responded 'Yes' were directed to a cyclist version of the survey. Survey items were similar across the two versions with only the road user perspective changing for relevant items. For example, motorists were asked, "When you overtake a bicycle rider on a road with a speed limit of 60 km/h or less, how often do you leave less than 1 metre of clearance?" and cyclists were asked, "When you are riding on roads with a speed limit of 60 km/h or less, how often do overtaking motorists leave you less than 1 metre of clearance?".

The survey was advertised in the February/March 2015 print magazine of RACQ and an email was sent to subscribers to their online magazine in July 2015. RACQ is the largest club in Queensland and supports and advocates for the interests of motorists. A link to the survey was also distributed by Queensland's largest bicycle community and advocacy group, Bicycle Queensland, to half of their members in May, 2015. Participants were offered a chance to receive one of five AU$200 gift cards.

**Observational Study of Passing Events**

Observational data were collected to objectively assess road user behaviour, addressing aim 3. Observation sites included higher-speed sites, and sites for which pre-trial data were available. Cameras attached to roadside poles recorded motorists' overtaking behaviour at 15

urban, regional and tourist locations on Queensland roads (see Table 1 for specific locations). Sites included locations in both high and low socio-economic areas. The locations varied in relation to; speed limit, number of lanes, bicycle and motor vehicle volumes, presence or absence of marked bicycle lanes, and weather kerbside parking was present (and occupied). Data were collected on 16-19 April and 7-10 May 2015 (Thursday to Sunday inclusive) except for one location: for Mt Sampson Road the second occasion took place 28-29 May 2015 after a camera was stolen.

**TABLE 1 Data Collection Sites for Observation of Passing Events**

| Road name | Suburb | Region | Speed limit (km/h) |
|---|---|---|---|
| Breakfast Creek Rd | Newstead | Brisbane | 60 |
| Gladstone Rd | Dutton Park | Brisbane | 60 |
| Annerley Rd | Dutton Park | Brisbane | 60 |
| Cordelia St | South Brisbane | Brisbane | 60 |
| Grey St | South Brisbane | Brisbane | 40 |
| Montague Rd | West End | Brisbane | 60 |
| Sandgate Rd | Bracken Ridge | Brisbane | 70 |
| Jacaranda Av | Logan | Brisbane | 60 |
| Hope Island Rd | Hope Island | Gold Coast | 70 |
| The Esplanade | Surfers Paradise | Gold Coast | 40 |
| Pacific Boulevard | Buddina | Sunshine Coast | 50 |
| Cooroy-Noosa Rd | Tewantin | Sunshine Coast | 80 |
| Mt Sampson Rd | Dayboro | Sunshine Coast | 100 |
| Dean St | North Rockhampton | Rockhampton | 60 |
| Bruce Highway | South Rockhampton | Rockhampton | 70 |

### Analysis of Crash, Injury, and Infringement Data

Crash and injury data were examined to assess potential benefits of the MPD road rule in terms of reductions in crashes and injuries, addressing aims 1 and 3. The Queensland Police Service provided preliminary data for crashes that involved cyclists for the period 1 April, 2012 to 31 October, 2015. Finalised data for fatal crashes were provided by Transport and Main Roads (the state road authority) from the Queensland Road Crash Database for April 2012 to July 2015. Infringement data from the Transport Registration and Integrated Licensing System for the same period were examined to provide further information on the practical implementation of the MPD road rule.

In the crash data, a road crash is defined as a crash reported to police, which involved movement of a vehicle and caused injury, death, or property damage. Specifically, the crash had to occur on a public road, and one of the following conditions applied: a person was a fatality or a casualty, the value of damage to property other than to vehicles was $2500, or at least one vehicle was towed away. A fatal crash was recorded when a person died within 30 days after receiving injuries resulting from the crash. When a severely injured person was transported to a hospital, a hospital crash was recorded.

## RESULTS

The results are presented separately for each task of the evaluation framework. Thematic analysis was used to identify codes and themes from the interview data. The road user survey data was analysed descriptively to compare motorists and cyclists on their awareness of, knowledge and perceptions about, and self-reported compliance with the MPD road rule. Similarly, the passing distance data collected from the observation study was analysed descriptively to measure compliance rates with the law. The crash, injury, and infringement data for the pre-MPD introduction data (1 April, 2012 – 31 March, 2014) were compared to post-MPD introduction data (1 April - 31 October, 2015).

## Interviews with Police Officers

The findings are presented below in accordance with the four themes that were identified: (i) purpose of, and need for, the MPD road rule, (ii) knowledge of the MPD road rule, (iii) enforcement of the MPD road rule, and (iv) changes in behaviour.

*Purpose of, and Need for, the MPD Road Rule*

All officers perceived that the primary purpose of the rule was to improve cyclist safety by reinforcing the message, "Share the Road". Some officers felt that the rule was introduced due to pressure from vocal cycling advocacy groups to improve cyclist safety on the roads. The need for the rule depended upon how safe officers perceived cycling in their areas: officers from large metropolitan areas perceived cycling to be more dangerous compared to officers from smaller, regional areas and therefore reported a greater need for the rule. Some officers also noted the need for a clear definition of a safe passing distance because there had not previously been one. However, officers reported that few of the crashes between cyclists and motorists involved overtaking, and therefore, the rule may not have a large impact on crashes involving cyclists.

*Knowledge of the Rule*

Officers expressed concern that some motorists were not aware of the rule and suggested that more public education should have been conducted prior to the introduction of the rule. They suggested that visual representations of appropriate passing distances, from different vehicle perspectives, would have enhanced knowledge of the rule. Some officers also stated that regular reminders of new road rules would enhance knowledge, particularly for individuals who do not cycle or know cyclists.

*Enforcement of the Rule*

Officers stated that enforcement of the rule was difficult and some noted that no active enforcement was occurring in their areas except in response to complaints. They also noted that cycling-related crashes and fatalities took priority over complaints. One officer noted that there was limited awareness of the rule among officers at his station who did not ride a bicycle. Officers also believed that cyclists expected more enforcement of the rule.

Some officers reported that motorists not complying with the rule were more likely to be issued with an Undue Care and Attention TIN than a MPD TIN. However, among officers who had issued a MPD TIN, there was a perception that the greatest obstacle to enforcement of the rule was obtaining sufficient evidence; if evidence was not sufficient, motorists could easily contest the ticket. One senior officer said that he would be satisfied to issue a ticket based on personal observation, but officers of lower ranks indicated that there was some resistance from more senior officers to enforce the rule given the difficulties in prosecuting cases.

Some cyclists who reported an incident to police provided video evidence. Without such evidence, according to most of the officers, a case would not proceed further. However, some officers who had not issued a MPD TIN were concerned with video distortions that could make it difficult to estimate the distance between a bicycle and a motor vehicle.

*Changes in Behaviour*

Most of the officers perceived that motorists were giving cyclists more than 1 meter when overtaking cyclists at 60 km/h because motorists could not accurately determine passing distance. As a result, some motorists engaged in erratic passing manoeuvres. However, officers also believed that some close passing events were the result of deliberate actions by

motorists. They also noted that cyclists may have become less cautious by cycling further away from the left-hand edge of the road after the introduction of the rule and taking other risks on the roads because they felt safer or a greater sense of entitlement.

## Cyclist and Motorist Survey

In total, 10,431 online surveys were completed. Responses were excluded if participants: had ridden a bicycle, but completed the motorist survey ($n$ = 182); had not ridden a bicycle or driven a motor vehicle in the previous 12 months ($n$ = 122); were under 18 years of age ($n$ = 24); did not reside in Queensland ($n$ = 1); or did not report age or gender ($n$ = 2,782). Of the remaining participants, 3,013 were cyclists and 4,332 were motorists. Cyclists were aged 18-85 years (*Mean* = 50.5, *SD* = 11.2), and 80% were male. Motorists were aged 18-94 years (*Mean* = 53.5, *SD* = 14.2), and 61% were male.

### *Perceptions of Compliance*

Twenty-five percent of cyclists reported that motorists leave less than the required 1-meter (3 feet) clearance "Most of the time" or "Almost always" on roads with a speed limit ≤60 km/h (37 mph ) and <1.5 meters (5 feet) on roads with a speed limit >60 km/h (37 mph). In contrast, 36.0% of motorists reported that they leave cyclists <1 meter (3 feet) of clearance in ≤60 km/h (37 mph) speed zones and <1.5 m (5 feet) of clearance in >60 km/h (37 mph) speed zones "Most of the time" or "Almost always". Motorists were more likely than cyclists to report that motorists comply with the 1-meter (3 feet) road rule (38.0% of motorists vs. 3.0% of cyclists) and with the 1.5-meter (5 feet) rule (37% of motorists vs. 4.4% of cyclists).

A quarter of cyclists and motorists reported that since the introduction of the MPD, they had noticed motorists leaving significantly more space between cyclists and their own vehicles when overtaking. Further, more cyclists (73.2%) and motorists (59.5%) agreed that they have observed motorists giving cyclists more space when overtaking, compared to 12 months earlier.

### *Awareness and Level of Acceptance of the MPD Rule*

Only 1.5% of cyclists and 5.2% of motorists were unaware that the MPD road rule had been introduced in Queensland. In terms of acceptance, more cyclists (94.7%) than motorists (52.5%) agreed with the rule being implemented.

### *Motorist Ability to Comply with the Law*

Most cyclists (78.7%) reported that they were certain that they could accurately judge 1 meter (3 feet) when being passed. However, only 59.6% of motorists reported that they were certain at accurately judging 1 meter when passing cyclists. When asked if other drivers could accurately judge 1 meter (3 feet) when passing cyclists, only 36.5% of cyclists and 19.0% of drivers reported that they were 'very certain' or 'certain' of this.

Similar findings were reported for the distance of 1.5 meters (5 feet), with 67.9% of cyclists and 52.3% of drivers reporting that they were very certain or certain at accurately judging 1.5 meter (5 feet )when being passed (cyclist respondents) or passing (driver respondents). However, 34.1% of cyclists and 16.6% of drivers reported that they were 'very certain' or 'certain' that other drivers would be capable of this.

Participants were asked to read 14 scenarios (see Table 2) and were asked, "how easy do you think it is for drivers to comply with the minimum passing distance rule in the following situations". Scenario 5 was perceived to be the most difficult, followed by scenario 11, scenario 3, scenario 13, and scenario 14. Figure 1 presents the means and 95% confidence intervals of participant ratings of difficulty overtaking a bicycle when driving.

311

312 **TABLE 2 Description of the 14 Scenarios Included in the Road User Survey**

| Scenario | Description |
|---|---|
| 1 | You are riding along a multi-lane road with a 60 km/h speed limit. The road has a broken centre line and broken lane lines. There is no bicycle lane. You are driving in the left hand lane and approaching a bicycle rider who is also travelling in the left hand lane. There is no traffic in the right hand lane. |
| 2 | You are diving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has a broken centre line. There is no bicycle rider travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 3 | You are driving on a multi-lane road with a 60 km/h speed limit. The road has a broken centre line and broken lane markings. There is no bicycle lane. You are driving in the left hand lane and you approach a bicycle rider travelling in the left hand lane. There are multiple vehicles already travelling in the right hand lane. |
| 4 | You are driving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has an unbroken centre line. There is no bicycle lane. You approach a bicycle rider travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 5 | You are driving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has an unbroken centre line. There is no bicycle lane. You approach a bicycle rider travelling in the same direction as you in the traffic lane. There are multiple vehicles driving towards you in the oncoming traffic lanes. |
| 6 | You are driving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has an unbroken centre line. There is a marked bicycle lane. You approach a bicycle rider travelling in the same direction as you in the bicycle lane. There is no oncoming traffic. |
| 7 | You are driving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has a broken centre line. There is no bicycle lane. You approach a group of 10 bicycle riders riding 2 abreast travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 8 | You are driving on a road with a single traffic lane in each direction and a 60 km/h speed limit. The road has a broken centre line. There is no bicycle lane. You approach 2 bicycle riders riding 2 abreast travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 9 | You are driving on a multi-lane road with a speed limit of 80 km/h. The road has a broken centre line and broken lane markings. There is no bicycle lane. You are driving in the left hand lane and approaching a bicycle rider who is also travelling in the left hand lane. There is no traffic in the right hand lane. |
| 10 | You are driving on a road with a single traffic lane in each direction and a speed limit of 80 km/h. The road has a broken centre line. There is no bicycle lane, but there is a wide road shoulder. You approach a bicycle rider travelling in the same direction as you cycling on the wide shoulder. There is no oncoming traffic. |
| 11 | You are driving on a multi-lane road with a speed limit of 80 km/h. The road has a broken centre line and broken lane markings. There is no bicycle lane. You are driving in the left hand lane and you approach a bicycle rider travelling in the left hand lane. There are multiple vehicles already travelling in the adjacent traffic lane. |
| 12 | You are driving on a road with a single traffic lane in each direction and a speed limit of 80 km/h. The road has a broken centre line. There is no bicycle lane. You approach a bicycle rider travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 13 | You are driving on a road with a single traffic lane in each direction with a speed limit of 80 km/h. The road has unbroken double white centre lines. There is no bicycle lane. You approach a bicycle rider travelling in the same direction as you in the traffic lane. There is no oncoming traffic. |
| 14 | You are driving on a road with a single traffic lane in each direction and a speed limit of 80 km/h. The road has an unbroken centre line. There is a bicycle lane. You approach a bicycle rider travelling in the same direction as you who is riding in the marked bicycle lane. There are multiple vehicles driving towards you in the oncoming traffic lane. |

313 *Note*. Question, "How easy do you think it is for drivers to comply with the minimum passing distance rule in
314 the following situations? Fourteen situations are presented. Please read the descriptions carefully as there are
315 slight variations between the scenarios. For all situations, please imagine you are travelling on a straight, flat
316 road with good sight distance"

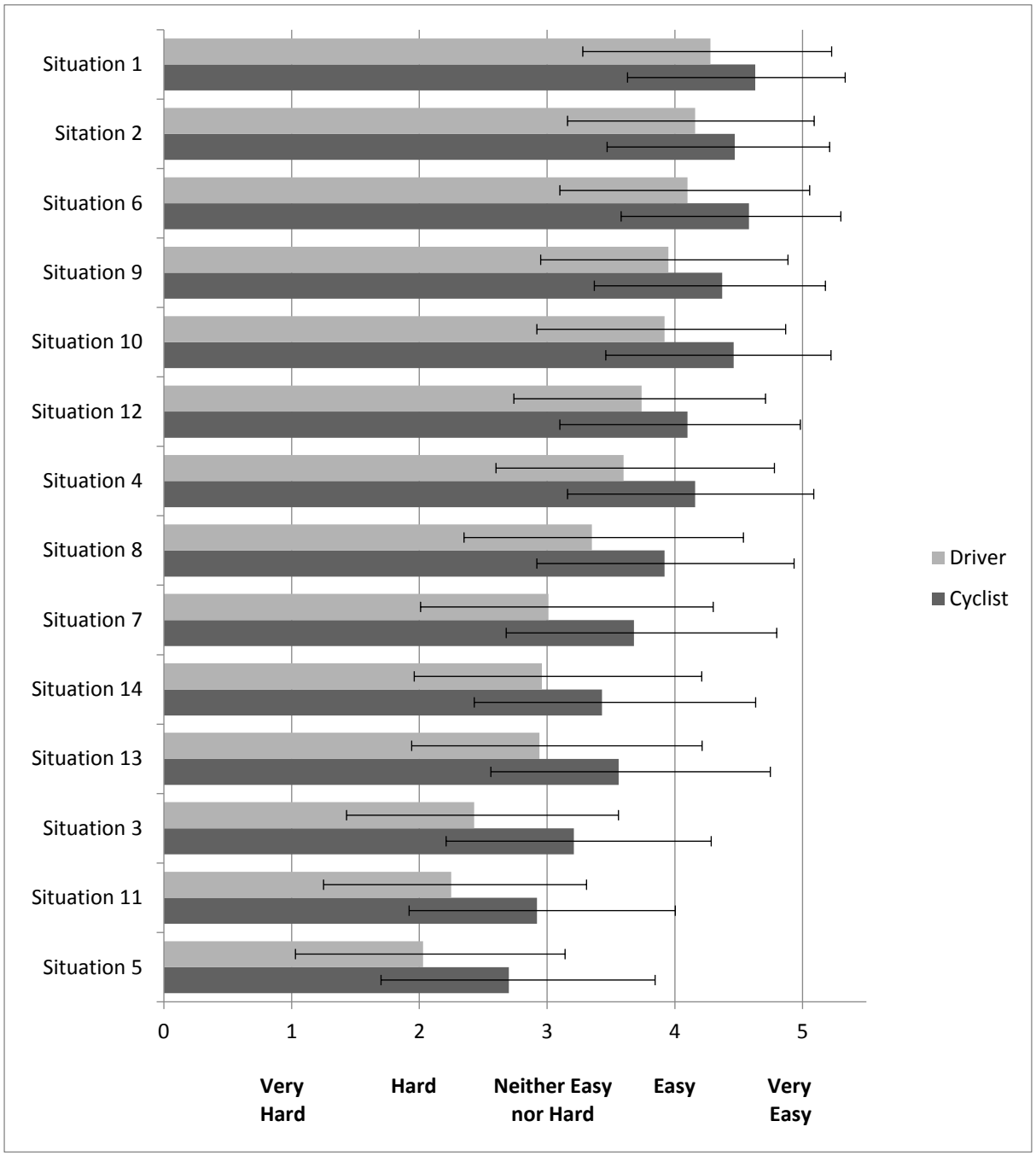


**FIGURE 1 Mean Ratings of Difficulty in Overtaking a Bicycle When Driving**

*Enforcement*

Cyclists (79.3%) were more likely than motorists (50.4%) to report that the rule was being enforced 'not at all' or 'not much'. Compared to other road rules, however, both cyclists and motorists perceived that there was 'a fair bit' or 'a lot' of enforcement for motor vehicle occupants not wearing seatbelts (58.2% cyclists; 62.8% motorists), driving through red lights (63.8% cyclists; 65.1% motorists), and driving a vehicle while under the influence of alcohol (85.8% cyclists; 85.4% motorists).

*Motorist awareness of cyclists*

Over half of cyclists (56.3%) but under half of motorists (43.1%) agreed that, compared to 12 months earlier, they were more aware of cyclists on the road (11.9% of cyclists and 23.8% of motorists disagreed with this statement). Additionally, compared to 12 months ago, 57.4% of cyclists and 44.8% of motorists agreed that they had reported observing more bicycle riders on the roads (8.8% of cyclists and 18.0% of motorists disagreed that they had reported observing more bicycle riders on the roads); 30.2% of cyclists and 14.4% of motorists agreed that they had observed fewer incidents of road rage between motorists and cyclists (21.6% of cyclists and 28.0% of motorists disagreed that they had observed fewer incidents of road rage); and 48.8% of cyclists and 26.2% of motorists agreed that their empathy for cyclists had increased (9.9% of cyclists and 47.4% of motorists disagreed with this statement)[1].

*Involvement in Overtaking Crashes and Near-Misses*

Few cyclists (6%) reported being involved in a collision with an overtaking vehicle (5.8%) in the previous year. However, 59.0% of cyclists reported a near-miss with an overtaking vehicle, with 15.7% reporting a near-miss when swerving to avoid an overtaking vehicle. Few motorists (2.9%) reported a collision that involved a cyclist over the previous 12 months but 15.1% motorists reported a near-miss with a motor vehicle travelling in the opposite direction when they were overtaking a cyclist. Nine percent of motorists reported a near-miss with a motor vehicle that was travelling in the same direction when they were overtaking a cyclist.

## Observational Study of Passing Events

More than 10% of bicycles observed at the sites were being overtaken by motor vehicles. However, there was a large variability in the number of bicycles and passing events among sites. The highest number of passing events occurred at The Esplanade (1,114) and the lowest number of passing events occurred on the Bruce Highway (26).

The degree of non-compliance with the MPD road rule was measured by the percentage of passing distances that were <1 meter (3 feet) or greater in ≤60 km/h (37 mph) speed zones or <1.5 meters (5 feet) in >60 km/h (37 mph) speed zones. The degree of non-compliance varied considerably across the observational sites, from 0 to more than 50%. Across the seven low-speed sites, the average non-compliance rate was 12.1%. More specifically, the non-compliance rate was 13.74% for 40 km/h (25 mph) sites and 8.8% for 60 km/h (37 mph) sites. For the five high speed sites (>60 km/h), the non-compliance rate was 20.9%. There were no other clear trends in passing distance as a function of speed limit or number of lanes.

Compliance when cyclists were riding single-file versus 2-abreast was evaluated at two low speed and two high speed sites where sufficient data was available. Combining data across these sites, the non-compliance rate tended to be lower for single file (15.5% ± 1.0%) than 2-abreast riding (22.8% ± 3.7%), $Z = 1.92$, $p = .055$.

## Analysis of Crash, Injury, and Infringement Data

Road crashes resulted in 23 cyclist fatalities during the 2 years prior to the introduction of the MPD rule and 10 cyclist fatalities during the 16 months following its introduction. This 35% reduction in the fatality rate for cyclists did not reach statistical significance. There were also no significant reductions in the total number of hospitalisations (650 before vs. 474 after, Rate ratio = 0.92, 95% CI 0.82-1.04), serious injuries including fatal and hospitalisations

[1] The remaining number of respondents reported that they neither agreed nor disagree with each statement.

(674 before vs. 485 after, Rate ratio = 0.91, 95% CI 0.81-1.02), and minor injuries (211 before vs. 201 after, Rate ratio = 1.20, 95% CI 0.99-1.46). There was, however, a significant reduction in medical treatments (487 before vs. 264 after, Rate ratio = 0.68, 95% CI 0.58-0.79) and all injury crashes (1,372 before vs. 950 after, Rate ratio = 0.87, 95% CI 0.81-0.95).

There was an average of 28 serious, non-fatal bicycle-related crashes per month in the 2 years preceding the MPD introduction, with no significant month-to-month changes in the number of serious bicycle-related crashes, $p = .949$. However, post-MPD introduction, there was a significant decreasing trend in the number of serious bicycle-related crashes, $p = .001$.

During the 16 months following the introduction of the rule, 60 MPD infringements were issued, accounting for 0.7% of all bicycle-related infringements. The total number of bicycle-related infringements per month remained consistent pre- to post-MPD introduction (568 before vs. 549 after). There was a significant reduction of bicycle helmet infringements pre- to post- (472.8 to 396.3 per month) and an increase in the rate of other bicycle infringements pre- to post-MPD introduction.

## DISCUSSION

This study is one of the first to evaluate the effectiveness of a MPD road rule. In this study, the Queensland MPD road rule trial was evaluated in terms of (i) practical implication, (ii) impact on road users' attitudes and perceptions, and (iii) road safety benefits.

### Practical Implementation of the MPD Rule

Information about the practical implementation of the rule was gathered from the interviews with QPS officers, the road user survey, and the analysis of infringement data.

#### *Practicality of Enforcement*

There were only 60 MPD infringements issued from the commencement of the road rule until 30 June, 2015. The comments of QPS officers interviewed suggest that the low number of infringement notices issued stemmed from practical difficulties in enforcing the road rule. The challenges of measuring passing distances from video recordings were mentioned by QPS officers and were also evident in the observational study undertaken as part of this evaluation, where about one-third of the passing events identified could not be measured because of obscuration by vehicles or glare or the distance being too great. The potential for development and use of improved technology for both enforcement and research in this area should be investigated.

Despite the reported enforcement difficulties, officers generally considered that the introduction of the road rule had led to improvements in cyclist safety. The survey data suggests that motorists may be overestimating the ability of police to enforce the rule and the extent of enforcement of the rule, leading to a degree of deterrence that is greater than expected from the small number of infringements issued.

The results of the current study are similar to those of the process evaluation of minimum passing laws in 20 U.S. states (*9*). In that study, the stance of state and local police departments towards the law was found to vary between locations, with police departments opposed to its introduction because officers considered the law to be unenforceable and a burden to implement. In general, there was little enforcement of the minimum passing law, with very few infringements issued (and little accurate data on numbers of citations issued).

#### *Practicality in Particular Road Environments*

When survey participants were asked to rate how easy it was for the motorist to comply with the rule in 14 scenarios, the absence of bike lanes and the presence of oncoming traffic (for single lane roads) or traffic in adjacent lanes (for multi-lane roads) influenced the ratings

more strongly than whether cyclists were riding single file or two-abreast. These findings highlight the role that the road environment may have on motorists' compliance with the MPD road rule.

*Ability to Estimate Passing Distance*

Motorists' ability to comply with the MPD rule may depend on their ability to estimate what is "at least one meter (3 feet)". There is evidence in the research literature that motorists may have difficulty in doing so accurately. Motorists are likely to experience difficulty in judging lateral distances because the body of their vehicle can partially occlude lateral vision when they are approaching an object on the kerbside (*13*). In a psychophysical experiment, even without obstruction, viewers were likely to overestimate perpendicular distances (both absolutely and relative to distances parallel to the line of sight) (*14*).

In the current study, only about half of the motorists surveyed were 'certain' or 'very certain' that they could judge if they had left at least one meter (3 feet) (or 1.5 meters (5 feet) in a higher speed zone) when overtaking a bicycle and they were less certain that other motorists could judge correctly. In the interviews, QPS officers stated that some motorists appear to be leaving very large distances when overtaking bicycles and that this may be a problem for oncoming vehicles. While there was no crash data available to assess the extent of this potential problem, it is worthwhile to note that none of the more than 4,000 motorists surveyed had been involved in a crash of this kind in the previous year. Although 15.1% reported a near-miss with an oncoming vehicle while they were overtaking a bicycle and 9.0% reported near-misses with other vehicles travelling in the same direction.

**Impact on Road Users' Attitudes and Perceptions**

Despite the concern expressed by some police that motorists may have forgotten about the rule, only 1.5% of cyclists and 5.2% of motorists surveyed said they did not know that the MPD road rule had been introduced. Comparisons between the current survey data and the Queensland's Department of Transport and Main Roads Road Safety Perceptions and Attitudes Tracking (RSPAT) 2014 survey, which was undertaken prior to the introduction of the MPD rule, suggest that fewer drivers are now unaware of the existence if this road rule. These findings suggest that awareness has increased since the introduction of the rule.

More than a quarter of motorists surveyed said that the MPD rule had made them more aware of cyclists and more than 40% of motorists "agreed" or "strongly agreed" that they were more aware of bicycle riders when driving on the road than 12 months previously. This finding is similar to data collected by (*11*) as part of the Amy Gillett Foundation (AGF) 'Stay Wider of the Rider' campaign survey, with 22% of respondents reporting that they had noticed a lot more change in space that drivers were providing to cyclists when overtaking since the introduction of the MPD rule. Despite this finding, almost half of the motorists disagreed that their empathy for bicycle riders has increased in the previous 12 months. In addition, almost 30% of motorists disagreed that they had observed fewer incidents of road rage between motorists and bicyclists compared to the 12 months prior. Thus, it appears that motorists have become more aware of cyclists, but have not necessarily improved in their attitudes towards them.

Previous research has reported that behaviour change may lead to attitude change ((*15*); see also (*16*)), although others have argued that attitude change may lead to behaviour change (*17*). For example, and in the context of drink driving behaviour, drink driving legislation, enforcement, and public education campaigns were introduced in Australia when drink driving was perceived to be a socially acceptable behaviour by a large proportion of individuals. Cognitive dissonance (i.e., the state of discomfort that is experienced when there is not consensus between an individual's attitudes and behaviour (*15*)) may play a role in

changing attitudes (i.e., favourable to unfavourable attitudes towards drink driving) (*16*). As such, it could be speculated that legislation, enforcement, and public education campaigns may force drivers to comply with the MPD road rule and in turn, led drivers to change their attitudes to resolve this cognitive dissonance. However, for attitude change to occur in the context of MPD, improvements in enforcement strategies are required.

**Road safety benefits**

The road safety benefits were assessed in terms of bicycle crash trends, observed passing distances, and self-reported compliance with the MPD road rule.

*Bicycle Crash Trends*

The extent to which the reduction in serious bicycle crashes can be attributed to the introduction of the MPD road rule is unclear. Preliminary police data did, however, report an estimated 48.5 fewer bicycle crashes post-commencement of the MPD road rule. While this reduction is consistent with the views expressed by many of the police interviewed and the cyclists and motorists surveyed that the introduction of the MPD road rule has made it safer for cyclists, it is acknowledged that further research is required to examine the implications of this road rule on bicycle crashes.

*Passing Distances*

The actual distances left between cyclists and passing vehicles were estimated from video recordings at 15 sites. The findings revealed that after the MPD road rule was introduced, the degree of non-compliance varied markedly across the sites, from zero to more than 50%. While the passing distances at the high-speed sites were generally greater than those at the low-speed sites, they still resulted in lower levels of compliance at the high-speed sites. This contrasts with the survey results which showed no differences in self-reported compliance levels or the perceived ease of compliance between lower and higher speed locations. The difficulty experienced by motorists in judging passing distances may have contributed to this discrepancy between the patterns in the observed and reported passing distances.

**Limitations**

The current study was one of the first studies to comprehensively evaluate the effectiveness of the MPD rule. However, despite this strength, there are several limitations that also need to be noted. First, the unexpected announcement of the rule meant that there was a lack of comprehensive data from before the commencement of this road rule. In relation to assessing the practical implementation of the MPD road rule, there was a relatively small number of QPS officers in the interviews and focus groups. However, given the high degree of concordance among the responses, similar results are likely to have been obtained if the sample were larger. Further, no objective data were collected on how well motorists and cyclists could judge lateral passing distances. Given that discrepancies may exist between actual and self-reported distance (e.g. (*14*)) future research is required to include objective measures to examine judgement of lateral passing distances.

In relation to measuring the impact on road users' attitudes and perceptions there was no evidence collected on whether the introduction of the MPD road rule encouraged people to take up riding because it now seems safer to them. In terms of measuring the road safety benefits of the MPD road rule, the crash data analyses did not control for any potential changes over time in the amount of cycling because it was difficult to find cycling participation data that is relevant state-wide and covers the period of interest. Similarly, the impact of changes to other cycling rules on cycling participation and rider behaviour was not able to be assessed in the crash data analyses. Further, there were no measures of passing

speed in the observational data or in the survey. If the introduction of the MPD road rule led to motorists passing cyclists more slowly, then this would be expected to have road safety benefits in addition to any benefits related to greater passing distances.

## CONCLUSIONS

The MPD road rule was introduced to increase cyclist safety. The research reported herein suggests that the introduction of the MPD has increased motorists' awareness of bicycles. However, it was also found that there were no reported changes in empathy, suggesting that motorists' attitudes towards cyclists have not necessarily changed. Non-compliance was more prevalent in high-speed environments compared to lower-speed environments (20.9% and 12.1% respectively). Additionally, the research highlighted the challenges associated with enforcement of the MPD road rule and motorists' concern about the ease of compliance where there is adjacent or oncoming traffic. Despite these concerns, it was reported that the introduction of the road rule had led to improvements in cyclist safety and as such, this rule may be effective in enhancing bicycle safety. It is premature to draw conclusions regarding the road safety benefits of the road rule at this stage given the lack of pre-implementation data and detailed crash and injury data that are required to draw such conclusions. However, the initial data reported here suggests that MPD rules have changed driver behaviours and improved cyclist safety.

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