Examining the International Research Evidence in relation to Minimum Passing Distances for Cyclists.

A pre-legislative scrutiny

Road Safety Research and Driver Education

23/02/2018

Údarás Um Shábháilteacht Ar Bhóithre
Road Safety Authority

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1. Introduction

Motor vehicles and bicycles typically travel at different speeds, leading to overtaking manoeuvres when drivers and cyclists meet. These interactions become more dangerous as the distance between a cyclist and motor vehicle decreases, and the risk of a collision becomes higher. One approach to tackling this issue, is the implementation of a Minimum Passing Distance ('MPD') law, wherein motorists are required to leave a specified safe passing distance when overtaking a cyclist, lowering the probability of a collision occurring, and cyclist discomfort (Nehiba, In Press).

The first MPD law was passed in Wisconsin in 1973, and to date, 28 US states have enacted MPD legislation. Several provinces in Canada (e.g. Ontario, Nova Scotia), and European countries including Belgium, France, Spain and Portugal all have mandatory MPDs in place, with a number of Australian states and territories (e.g. Queensland, New South Wales) also recently introducing cyclist passing distance laws (Balanovic et al., 2016; Schramm et al., 2016). The majority of these passing distances are typically stipulated at 1m (or 3 feet) - 1.5m (5 feet), often dependent on the speed limit of the road being travelled (Brown, Farley, Hawkins & Orthmeyer, 2012).

It is currently proposed that legislation mandating a MPD of 1m between cyclists and motorised vehicles on roads with a speed limit of ≤ 50km/h, and a MPD of 1.5m on roads with a speed limit >50km/h, be passed in the Republic of Ireland. In considering this proposal, the Minister for Transport, Tourism and Sport, Shane Ross, tasked the Road Safety Authority of Ireland (RSA) with examining the evidence regarding the efficacy of MPD legislation in other jurisdictions, and how this can be successfully enforced, with a key focus on the findings of an evaluation study of a 2-year MPD trial in Queensland, Australia, published in 2016.

In addressing this request, the RSA adopted a 2-pronged approach. First, a survey on MPD policy was drafted, and administered to the member countries of the International Traffic Safety Data and Analysis (or 'IRTAD') group. Second, a rapid evidence review of the international research literature on MPD was conducted, in order to identify evaluation studies regarding MPD efficacy, and synthesise their findings. The findings of both exercises (i.e. the MPD survey and rapid evidence review) are captured in the current short report.

In addition, the RSA has provided an analysis of cyclist casualty collisions (2011-2016) in Appendix 1. This provides a summary overview of the numbers of cyclists killed and injured over this period, with a particular focus on trends of relevance to the potential introduction of a MPD (e.g. vehicles involved in cyclist collisions, and types of vehicle and cyclist manoeuvres taken). Reference is also made to Central Statistics Office and National Transport Authority data on cyclist numbers in Ireland. This analysis provides additional relevant context to the potential introduction of a MPD.

2. Survey

In order to identify international best practice regarding MPDs for cyclists, a survey on this topic was created by members of the RSA research department for circulation amongst the IRTAD Group. The IRTAD Group are a permanent working group on road safety of the International Transport Forum (ITF), with approximately 70 members and observers from 40 countries. The members of this group comprise road safety experts from national road administrations, road safety research institutes, international organisations, automobile associations, insurance companies, car manufacturers and others.

The survey contained 9 questions in total, designed to elicit information regarding country-specific policy of advisory or mandatory MPDs (see Appendix 2), if applicable. For the purpose of this report, the results of Questions 1-3, 7 (for countries with mandatory MPDs) and 9 (for countries with mandatory MPDs) are considered (see Table 1). No material relevant to the focus of the current report was provided in response to the other questions.

Table 1. *Key survey questions regarding MPDs*

Question	**Response**
1. Does your country recommend a minimum passing distance for cyclists (i.e. non-mandatory)?	Yes/No
2. Does your country have a mandatory minimum passing distance for cyclists?	Yes/No
3. If applicable, what minimum passing distance is a) recommended, or, b) mandatory for cyclists in your country (e.g. 1.5 metre passing distance on roads with a speed limit ≥ 80km/h)?	a: _____ b: _____
7. How is this passing distance enforced in practice in your country?	
9. Have there been any difficulties in proving violation of this passing distance during prosecution? Please give examples.	

The survey was circulated via email to all members of the IRTAD group on the 18th January 2018, with a deadline for receipt of survey responses listed as the 2nd February 2018. Responses were received from 17 countries in total, as listed in Table 2 below.

Table 2. *List of countries who responded to the MPD survey (n = 17)*

Country		
Austria	Greece	Serbia
Belgium	Hungary	Switzerland
Chile	Japan	Turkey
Finland	Lithuania	United Kingdom
France	Netherlands	United States*
Germany	New Zealand	

* *Please note, multiple states across the US have different advisory and mandatory MPDs[1].*

Of the 17 countries who responded to the survey, 4 documented an advisory (i.e. non-mandatory) MPD for cyclists (Austria, Chile, New Zealand and multiple states across the US), the majority of which advise 1.5m of clearance (see Table 3 below). Three of the 17 responding countries confirmed their implementation of a mandatory MPD (Belgium, France and multiple states across the US), ranging from requiring 1 - 1.5m of clearance for cyclists. Of note, the representative from Chile stated that mandatory MPD was currently "waiting for… congress approval", and New Zealand reported that "The Ministry of Transport is currently considering a package of initiatives aimed at improving cycling safety in New Zealand, which may include a minimum overtaking gap".

Table 3. *List of countries by MPD policy type (n = 17)*

Country	MPD Advised	MPD Mandated
Austria	**Yes** - 1.5m	No
Belgium	No	**Yes** - 1m
Chile	**Yes** - 1.5m	No
Finland	No	No
France	No	**Yes** – 1m on roads with ≤50km/h speed limit, and 1.5m on roads with >50km/h speed limit.
Germany	No	No
Greece	No	No
Hungary	No	No
Japan	No	No
Lithuania	No	No
Netherlands	No	No
New Zealand	**Yes** - 1.5m	No

[1] Please see Appendix 3 for a summary of state-specific MPDs in the United States.

Serbia	No	No
Switzerland	No	No
Turkey	No	No
United Kingdom	No	No
United States	**Yes** - varies*	**Yes** - varies*

**Please note, multiple states across the US have different advisory and mandatory MPDs[2].*

Of the 3 countries who confirmed mandatory MPDs for cyclists, relatively little information was reported regarding how this legislation was enforced (i.e. in response to Question 7). The Belgian representative provided the most detailed response, describing that 'If a policeman happens to witness a dangerous situation where a driver passes a cyclist at a short distance, he will write a ticket, but since there is no way to actually measure the passing distance, it has to be clearly closer than 1m'. No examples of cases where it was difficult to prove violation of the MPD during prosecution were provided (i.e. in response to Question 9). Full responses from the 17 countries to Questions 1-3, 7 and 9 are provided in Appendix 3.

It is potentially worth noting that the Netherlands, regarded as a progressive country in terms of policy and infrastructure to promote cyclist safety, does not have an advisory or mandatory MPD. The Netherlands representative provided additional detail when responding to the survey, to clarify that instead of implementing a MPD (which would be impractical in light of their high volume of cyclists) they provide infrastructure that separates cyclists from motorised traffic as much as possible, and have 'cycle-streets' or 'cycle-areas' where cyclists have greater rights than motorised traffic, as enforced by the police.

Overall, relatively few of the countries who responded to the survey either advise (4 out of 17) or mandate (3 out of 17) a MPD for cyclists. Of those who mandate a MPD, the passing distance required varies from 1m – 1.5m. Little detail on how this is enforced, other than by police where witnessed, was provided, and no examples of difficulties in proving violation of a MPD during prosecution were given by respondents. These findings must be considered in light of the relatively low response rate to the survey however (responses were received from 17 out of 40 total member countries - 43%), and cannot be deemed wholly representative of global MPD policy and practice.

3. Rapid Evidence Review

In order to examine the efficacy of MPD legislation, a rapid evidence review of the published research literature on MPDs was conducted. This approach encompasses a more structured search and quality assessment of research evidence than a traditional literature review. In the context of completing the current short report, this primarily involved iterative, targeted searching of the ScienceDirect and Transport Research International Documentation ('TRID') databases, and Google Scholar, with a list of strategic keywords informed by the research literature identified at various stages of the search process. This also involved analysis of

[2] Please see Appendix 4 for a summary of state-specific MPDs in the United States.

correspondence and literature generously provided by Phil Skelton ('Stayin' Alive at 1.5' campaign), which is incorporated in the synthesised points made in Sections 4-6 of this report.

Six key studies (three reports, and three academic research papers) were identified from this search process. Detailed summaries of all of these are provided below. A synthesis of the study findings, discussed in light of the survey results, is provided in 'Section 4. General Discussion' of this report.

Study 1. 'Evaluation of the Queensland minimum passing distance road rule'

Rationale

In response to recommendations made by the Transport, Housing and Local Government Committee's *Inquiry into Cycling Issues,* the Queensland Minister for Transport and Main Roads (TMR) announced a 2-year trial of a MPD law, commencing in April 2014. This required motorists to maintain a minimum distance of 1m (3 ft) when overtaking cyclists in areas with speed limits of ≤60km/h, and 1.5m (5 ft) when the speed limit is ≥60km/h. Penalties for motorists breaching these MPDs included a fine of three penalty units (AU $353 in December 2015) and three demerit points, with a maximum fine of 40 penalty units (AU $4,712 in December 2015) potentially applying if the matter was brought to court. The Centre for Accident Research and Road Safety - Queensland (CARRS-Q) were commissioned to develop the evaluation framework for the trial, and later undertook the evaluation, including completing a detailed report.

Method

Evaluating the effectiveness of the 2-year Queensland trial involved the completion of five key tasks:

Task 1. Correspondence

A review of MPD correspondence from the general public to TMR up until October 2015 was conducted, to examine public opinion, attitudes and perceptions in relation to the implementation of the MPD law. In total, this included 145 communications, from 135 individuals (the majority were motor vehicle drivers).

Task 2. Qualitative Analyses

Interviews and focus groups with members of the Queensland Police Service were undertaken, in order to gain a detailed understanding of the practicality of enforcing the MPD law. 21 police officers participated, with 3 officers who had issued a Traffic Infringement Notice (TIN) for a MPD infringement being interviewed (from Brisbane, Ipswich and Longreach), and 18 police officers taking part in one of two focus groups in late 2015 (n = 9 for each, in Brisbane and Toowoomba).

Task 3. Survey

An online survey (cyclist and motorist versions) was conducted to collect process, impact, and outcome measures following commencement of the MPD trial. The motorist survey (from which

drivers who also reported cycling were excluded) was launched in April 2015. The cyclist survey was launched in May 2015, with both surveys being closed in July of that year. A number of items included in the surveys were designed to match those measured in previous studies from before the MPD trial, for comparison where possible. A total of 7,345 participants were included in final analyses (motorist n = 4,332, cyclist n = 3,013).

Task 4. Observational Study

An observational study of interactions between cyclists and vehicles was completed, using videoed traffic count footage captured by Data Audit Systems (a specialised traffic counting company) to assess the impact of the MPD law. Due to changes in site characteristics, and camera locations pre- and post- MPD implementation however, these data could not be compared. Post-implementation data were collected at 15 observation sites (including urban, suburban, regional and tourist locations) during April (16th-19th) and May (7th-10th, 28th-29th) 2015. Passing events were manually identified and coded. Passing distances were computed using a custom Python script based on the pixel-scale of the image, and a reference distance (typically the width of the lane), once the operator had selected the position of the passing motor vehicle and cyclist in the image.

Task 5. Collision Data

Collision and injury data from before and after the introduction of the MPD law were compared, to identify any safety benefits from its implementation. TMR provided fatal collision data (April 2012-March 2014, and April 2014-July 2015) from the Queensland Road Crash Database, and preliminary data for all collision types (April 2012-March, 2014, April 2014-October 2015) were provided by the Queensland Police Service. Infringement data (April 2014-June 2015) were accessed from the Transport Registration and Integrated Licensing System, to examine the extent of practical implementation of the law.

Results

Task 1. Correspondence

The majority of the correspondence came from motor vehicle drivers unhappy with the MPD law (e.g. complaints that the law was unfair, or that drivers having to cross central lines more could result in additional head-on collisions with other vehicles). Communications also typically came from cyclists (a smaller amount), who were supportive of the law, but expressed dissatisfaction with the magnitude of the penalty, or extent of enforcement. Most correspondence was received in the first year of the trial, suggesting that attitudes towards the rule stabilised over time.

Task 2. Qualitative Analyses

Analysis of the qualitative interviews and focus groups with police officers identified a number of key themes. First, officers' beliefs that a MPD law was necessary typically depended on how safe they perceived cycling to be in their area, with many reporting that relatively few cyclist-motorist collisions have involved overtaking, and that MPD was unlikely to have much of an impact. Enforcement was acknowledged as being particularly difficult, with some noting that no active enforcement was occurring in their areas (except in response to complaints), and that motorists not complying with the law were more likely to be issued with Undue Care and Attention TINs. The greatest obstacle to enforcing MPD was voiced as obtaining sufficient

evidence, with officers concerned about video quality and distortions rendering even video footage as insufficient for prosecution.

In terms of behaviour change, officers perceived that cyclist safety had been improved by the MPD law, and that motorists were giving cyclists greater distance than required when passing (particularly at 60km/h). Some felt that this was potentially due, at least in part, to motorists' inability to determine passing distance accurately however, with officers noting the need for further public education regarding MPDs. As a result, some officers were concerned about motorists engaging in erratic passing manoeuvres. Certain officers also reported their observations that cyclists had become less cautious since the implementation of the law (e.g. cycling further away from the left-hand side of the road).

Task 3. Survey

The majority (95%) of cyclists agreed or strongly agreed with the MPD law, as compared to half (52.5%) of drivers. 23.5% of cyclists and 36% of drivers reported that drivers were failing to comply with the MPD law on roads with a speed limit of ≤60km/h 'most of the time' or 'almost always'. This changed to 25% (reported by cyclists) and 32% (reported by drivers) for >60km/h speed limit roads. 73% of cyclists and 60% of drivers agreed or strongly agreed that they have observed motorists giving cyclists more room when overtaking. Of note, most cyclists (79%) reported that they were certain or very certain that they could accurately judge 1m when being passed. Only 60% of motorists reported that they were certain or very certain at accurately judging 1m when passing a cyclist however. Similar findings were reported for the distance of 1.5m.

56% of cyclists and 43% of drivers agreed or strongly agreed that they were more aware of cyclists when driving 'than 12 months ago', and one third of drivers and two thirds of cyclists reported that MPD law had made the roads safer for cyclists. 49% of cyclists and 26% of motorists agreed or strongly agreed that their empathy for cyclists had increased in the past year however, and no changes in levels of harassment experienced by cyclists were identified when compared to survey data collected in 2009. Cyclists (79%) were more likely than motorists (50%) to report that the law was being enforced 'not at all' or 'not much'.

47% of cyclists indicated they had been in at least one collision causing them injury in the last 12 months. 6% of these were with a vehicle that was overtaking them, with a further 5.5% being due to a 'fall after swerving to avoid a vehicle that was overtaking you'. In terms of near-misses, the most common event reported by cyclists in the last 12 months was a 'near-miss with a vehicle that was overtaking you' (59%). 15% of drivers reporting near misses reported that this occurred with a vehicle travelling in the opposite direction when overtaking a bicycle, and 9% with a vehicle travelling in the same direction when overtaking a bicycle.

Task 4. Observational Study

More than 10% of bicycles observed at the sites (n = 15) were overtaken by motor vehicles (although there was variability in passing events across sites). The degree of non-compliance for those passes varied considerably, from 0 to approximately 50% of passes at certain sites. Across 7 low-speed sites (i.e. speed limits ≤60km/h), for example, the average non-compliance was 12%. For 5 high speed sites (i.e. speed limits > 60km/h), the non-compliance rate was 21%. Passing manoeuvres for cyclists riding two abreast were documented at four sites, where

the percentage non-compliance when overtaking the two cyclists (based on distance to the outside cyclist) was much higher than for a cyclist riding single file (23% versus 15.5%).

Task 5. Collision Data

Road traffic collisions resulted in 23 cyclist fatalities during the 2 years prior to the introduction of the MPD law and 10 cyclist fatalities during the 16 months following its introduction, although this 35% reduction in the fatality rate for cyclists was not statistically significant. There was a significant decrease in collisions requiring medical treatment (i.e. where the injured party did not need to be admitted to hospital, 487 versus 264), and across all injury collisions (1,372 versus 950) however. Importantly, due to the use of preliminary data, and the absence of cycling participation data (i.e. to identify whether there was variation in the number of cyclists on the roads after implementation of the MPD law, influencing collision related data), the authors concluded that the "extent to which the reduction in serious bicycle crashes can be attributed to the introduction of the MPD road rule is unclear" (p. 69). During the 16 months following the introduction of the law, 60 MPD infringements were issued, accounting for 0.7% of all bicycle related infringements during that time period.

Discussion

The MPD law has been difficult for police in Queensland to enforce, and the findings of the survey and broader research literature (e.g. Baumberger, Fluckiger, Paquette, Bergeron & Delorme, 2005) suggest that drivers and cyclists may have difficulty estimating the minimum distance during passing manoeuvres. Police officers have indicated that this may result in drivers leaving large distances when overtaking, leading to conflicts with other vehicles. None of the drivers surveyed reported such collisions in the previous year, but did report near-misses, implying this should be monitored over time.

Despite enforcement issues, police officers, cyclists and drivers have reported motorists giving adequate clearance to cyclists. Motorists and cyclists have also reported greater awareness of cyclists, and that the law has made the roads safer for cyclists. Half of drivers reported an increase in empathy for cyclists in the past year, however no substantial changes in the levels of harassment experienced by cyclists in Queensland from 2009 to 2015 were reported. This suggests that while motorists are more aware of cyclists and the MPD law, their attitudes towards cyclists may not have changed.

While the fatality and injury reductions documented in this evaluation are in line with the views of the police officers interviewed, and cyclists and drivers surveyed (i.e. that MPD has made the road safer for cyclists), the authors of this report stated that "it is premature to draw conclusions regarding the road safety benefits of the road rule at this stage" (p. 71). Definitive collision and injury data were not available for use in this study, and in the absence of cycling participation data before, during and after the trial period, changes in collision and injury-related data cannot be attributed to MPD alone, and may reflect variation in the number of cyclists/distance travelled by cyclists on Queensland roads.

Overall, the lack of comprehensive data available from before the trial commenced, across all evaluation components, is a substantial limitation of this report. Particularly, in the absence of observational data pre-April 2014 for comparison with 2015 cyclist passing manoeuvres, it is not clear if the levels of MPD non-compliance observed across the 15 sites mark an actual

improvement in motorist behaviour. Including a larger sample of police officers in the qualitative component of the evaluation, assessing objective measures of driver and cyclist abilities to estimate passing distance, and collecting cycling participation data would also have improved the quality of the evaluation overall. Similarly, incorporating measures of passing speed (i.e. to see if drivers were passing cyclists more slowly, and thus, safely) and other variables known to influence passing distances (e.g. use of cycle lanes, cyclist distance from the curb), could further enhance understanding of the impact of MPD law in Queensland, Australia.

Study 2. 'Cyclists' perceptions of motorist harassment pre- to post- trial of the minimum passing distance road rule amendment in Queensland, Australia'

Rationale

Cyclists in Australia, the US and the UK, have reported that they regularly experience hostility from other road users, particularly motorists, which can constrain their cycling. This study sought to extend a component of the evaluation of Queensland's MPD trial (Study 1 of this report; Schramm et al. 2016), by statistically analysing whether there were differences in cyclists' reporting of harassment between 2009 and 2015 in Queensland, Australia, following the implementation of the MPD trial in April, 2014.

Method

Data were collected via two cross-sectional, online surveys in 2009 (a 'Cycling in Queensland' survey, conducted prior to MPD) and in 2015 (post MPD implementation, as part of the Queensland MPD trial evaluation). Identical questions were used in both surveys, and both surveys recruited participants from adult (i.e. ≥18 years) members of Bicycle Queensland (a cycling advocacy group). Responses from 1,758 cyclists in 2009, and 1,997 cyclists from 2015 were included in final analyses. All participants were Queensland residents, and reported cycling at least monthly in the previous year.

In addition to providing demographic and cycling experience information, cyclists were asked to categorise any perceived intentional harassment they had received from motorists (or their passengers) in the past 12 months (if applicable) as either: driving too close (causing fear/anxiety); tailgating; throwing objects; deliberately blocking your path; shouting abuse; making obscene gestures, and/or; sexual harassment.

Multivariate logistic regression modelling was used to assess whether time of survey completion (i.e. pre- or post- MPD legislation) was associated with reporting of each type of harassment.

Results

The most reported types of harassment in 2009 and 2015 were 'deliberately driving too close (causing fear/anxiety)' (68% of cyclists reporting harassment in 2009, 66% of cyclists reporting harassment in 2015) and 'shouting abuse' (66% of cyclists reporting harassment in 2009, 68% of cyclists reporting harassment in 2015) at the cyclist sample. The percentage of respondents who reported 'tailgating' increased significantly between 2009 and 2015 (from 15% to 19.5% of

cyclists reporting harassment). No significant change was reported between 2009 and 2015 across the other types of harassment.

Discussion

This study demonstrated that the proportion of cyclists perceiving harassment from motorists (and/or their passengers) remained high, even after the implementation of MPD in Queensland. Of note, there was no significant reduction in perceived harassment due to motorists 'driving too close (causing fear/anxiety)', and 'tailgating' was found to increase significantly. The authors concluded that these extended analysis findings were in line with the larger MPD trial evaluation (Study 1 of this report; Schramm et al. 2016), in that both cyclists and motorists participating in the MPD evaluation in 2015 perceived that not all motorists complied with MPD, and some continued to drive too close when overtaking cyclists. Similarly, the increase in tailgating reported in the current study could reflect the actions of motorists waiting behind cyclists until the MPD could be achieved when overtaking. Overall, the authors suggested that further interventions to MPD legislation are needed to improve cyclists' perceptions of safety, and motorist behaviour in relation to this.

These findings must be considered in light of the limitations of this research study however. In particular, the participants recruited in both 2009 and 2015 were from a non-representative sample (i.e. they were all members of a cycling advocacy group), and as such, these findings may not be generalisable to the experiences of the broader community of cyclists in Queensland. This study also focused on 'perceptions' of harassment from the cyclists' perspectives, rather than objective measures of these behaviours, and could be biased. Last, it is worth noting that additional external variables, such as changes in infrastructure, or the number of cyclists/motorists travelling on Queensland roads, may have influenced results between 2009 and 2015.

Study 3. 'Investigating the feasibility of trialling a minimum overtaking gap law for motorists overtaking cyclists in New Zealand'

Rationale

In light of the publication of statistics demonstrating that cyclists in New Zealand are at disproportionate risk when cycling (e.g. they are 10 times more likely to be involved in a serious or fatal RTC per km travelled than car drivers; New Zealand Cycling Safety Panel, 2014), and the recent proliferation of MPD legislation across the US, Australia and Europe, the New Zealand Transport Agency commissioned a research study in 2016 on the feasibility and practicality of introducing a MPD law, to inform decision-making about whether a minimum overtaking gap (i.e. MPD) law be should trialled on New Zealand roads as a safety initiative.

Method

This investigation featured 6 distinct stages including:

Stage 1. Collision Data

Examination of collision data from the New Zealand Transport Agency's Crash Analysis System (for 2006-2015), to examine the frequency and type of motorist-cyclist collisions relating to overtaking and other space-related collisions.

Stage 2. Literature Review and Correspondence

An international and national literature review of MPD-related research, including correspondence with international experts in cycling safety (n = 12) to establish current knowledge in relation to MPD.

Stage 3. Field Study

Collection of objective field data on rural and urban roads in the greater Wellington and Wairarapa regions, using instrumented bicycle technology to capture the passing distances and speeds of motorists overtaking cyclists, including cyclists' perceived safety (or 'comfort') in those scenarios. Comfort/discomfort was captured through the length of time a participant pressed an 'event button' on the bicycle (e.g. a short button press denoted some discomfort, and a long button press denoted an extremely uncomfortable experience with an overtaking motor vehicle). 48 cyclists took part over 8 weeks, to capture 1,429 rural and 4,319 urban motorist-cyclist interactions, over a total of 68 hours of cycling time.

Stage 4. Qualitative Analyses

Collection of qualitative data from one-on-one interviews (cyclist n = 2, police officer n = 1, road transport expert n = 1), a stakeholder workshop, and police officer focus group to identify perspectives on the potential benefits and challenges associated with implementation of MPD.

Stage 5. Costs and Benefits Consideration

Consideration by the authors of the costs and benefits of MPD implementation, based on the amassed information, enabling them to objectively calculate the viability of a MPD law.

Stage 6. Technical report

Production of a technical report, synthesising all components of the evaluation, to produce a set of informed conclusions and recommendations for the Transport Agency.

Results

Stages 1 and 3

Examination of a subset of cyclist collisions (space-related, motorist-cyclist collisions; n = 1,940) indicated that 29% involved a collision potentially linked with MPDs. More specifically, 15% involved a motorist cutting in on a cyclist while changing lane to the left, and 14% involved a motorist hitting a cyclist while pulling out or changing lanes to the left (i.e. 29% in total). Following analysis of the field data collected, it was established that a MPD of 1m should be suitable to protect, and be comfortable for, cyclists in urban speed zones (≤60km/h), with a minimum distance of 1.5m for major arterial and rural roads (>60km/h). It was noted that drivers could be encouraged to leave as much space as possible when passing however, given not all cyclists reported 'comfort' at these levels. Relatively low incidence of unsafe overtaking interactions were documented in the field study (2% of passes on roads with a speed limit ≤ 60km/h were < 1m, and 7% of passes on roads with a speed limit >60km/h were <1.5m), with

approximately 1 in 40 passes deemed 'uncomfortable' events by cyclists (or one pass per 22 minutes of cycling). These events were deemed as distressing for cyclists however, and could be improved with the implementation of an MPD law.

Stages 2 and 4

Key themes emerged from the literature review, expert correspondence and qualitative research with stakeholders regarding MPD enforcement, education, and the practicalities of potential implementation. Specifically, acquiring sufficient evidence to prove violation of a MPD was identified as the main challenge to enforcing MPD legislation in New Zealand, although the potential for technology (e.g. the BSMART device[3]) to assist in this regard was noted.

In line with this, the educational benefits of implementing a MPD law, through generating public awareness of the importance of MPDs and the vulnerabilities of cyclists (even if enforcement proves challenging) were acknowledged. Incorporating an effective education/awareness campaign was identified as a key factor to successful MPD legislation. It was noted that the campaigns used in jurisdictions with MPD in place (e.g. in numerous states in the US, France, Belgium, and Australia etc.) have used varying approaches to this (e.g. from social media videos, to billboards, to road signage etc.).

Practical concerns, such as whether drivers can estimate passing distances in real-time (i.e. whether they can detect when they are 1m, or 1.5m away from a cyclist when passing) were also noted. Research suggesting that drivers have difficulty judging lateral distances (e.g. Baumberger et al., 2005) was identified, and concerns that implementation of a MPD law could lead to drivers reducing the amount of space they currently give, or overcompensating and leaving too much space when overtaking when it is unsafe to do so (e.g. with oncoming traffic) were voiced.

Stage 5

An analysis of the potential costs (e.g. costs of developing and rolling out an education campaign, road policing, congestion costs etc.) and potential benefits (e.g. fewer cyclist collisions, injuries and fatalities, reduced emissions if more people switch to cycling etc.) of the implementation of a MPD law, broadly suggested that the overall benefits of introducing a MPD law would outweigh costs if it resulted in a 0.5% increase in cycling modal share in New Zealand. Importantly however, the authors cautioned that the figures used to estimate this calculation were contingent on a number of assumptions for which there is very limited evidence (e.g. it is unclear how MPD will influence cycling rates in New Zealand).

Discussion

The findings of this report led the authors to conclude that 'the introduction of a MPD law is a complex solution that holds both promise and uncertainty regarding its feasibility for improving overtaking behaviours (and cycling safety more broadly)' (p. 100). More specifically, key recommendations from this report included that, should a MPD law in New Zealand be passed, a graduated MPD law (i.e. 1m passing distance for ≤60km/h speed limit roads, and 1.5m passing distance for roads >60km/h) was acknowledged as optimal. So too was the

[3] Further information on the device can be found here: http://codaxus.com/c3ft/c3ft-v3/

implementation of an accompanying comprehensive, evidence-based education campaign emphasising the need, and how, to safely share the road, ideally in conjunction with signage promoting MPD. Consideration of how a MPD could fit with existing legislation in relation to cyclists was also recommended, to ensure an integrated approach to enforcement, and cyclist and vulnerable road user safety.

One of the core recommendations emerging from the findings of this study however, was that a New Zealand MPD trial, (or, at a minimum, an evaluation of a comprehensive MPD education campaign), should be conducted. The potential benefits of enforcing a MPD in light of the study findings were acknowledged, including: the potential to improve the overtaking behaviours of motorists, legitimise and protect the rights of cyclists as road users, bring cyclist safety to the fore of public discourse, and enhance cycling modal share. Despite the findings of this body of work however, considerable gaps in knowledge regarding MPD law efficacy were still noted. Although improvements in perceptions of cyclist safety following MPD implementation have been reported (Schramm et al., 2016), for example, it was still unclear whether such perceived changes align with observable behavioural improvements, or reductions in collision and fatality/injury rates. A robust trial/evaluation study, wherein pre- and post- behavioural and attitudinal measures are captured and analysed for cyclists and motorists, and the law's feasibility assessed (including how it can actually be enforced in New Zealand, levels of compliance, drivers' ability to estimate lateral distances; response of the public to the measure, etc.), was identified as a key means of addressing these gaps. The findings of such a study should provide an evidence base to justify mandating MPD legislation, identify means of improving this for optimal outcomes, or discount it.

Study 4. 'Is the three-foot bicycle passing law working in Baltimore, Maryland?'

Rationale

On October 1st, 2010, a three-foot law ('3FL') took effect in Maryland (United States), to protect cyclists travelling on roadways. Similar to other 3FLs enacted throughout the US, this MPD legislation requires motorists to pass cyclists with a distance of 'not less than three feet'[4]. Given the absence of empirical research evaluating the impact of MPD legislation on road user behaviour, Love et al. (2012) conducted a research study in Baltimore, Maryland in 2011 to assess 3FL compliance, measures of MPD and identify risk factors associated with close vehicle passes.

Method

Five cyclists (4 male, 1 female) on personal bicycles fitted with video recording equipment logged a total of 10.8 hours of video footage, featuring 586 vehicle passes, during 34 bicycle commuting trips, across September and October 2011 in Baltimore. A convenience sampling approach was used, where each cyclist videotaped his/her route from home to work and back,

[4] Please note, there are some listed exceptions to the 3FL within the Maryland legislation, such as when 'the highway on which the vehicle is being driven is not wide enough to lawfully pass the bicycle, electric personal assistive mobility device, or motor scooter at a distance of at least 3 feet' (to read the full Maryland MPD legislation, please see Brown et al., 2012; p. 49-50).

with routes beginning and ending in Baltimore neighbourhoods (e.g. Hampden, Charles Village). Bicycle routes traversed 37 streets, and 101 cross streets, with some degree of overlap (i.e. 4 of the cyclists worked in John Hopkins Medical Campus, and one worked in John Hopkins Homewood Campus). The average cycling trip lasted 19.5 ± 4.9 minutes and cyclists were passed on average 17.2 ± 11.8 times per trip. Passing distances were recorded as either ≤3 feet, 4, 5, 6, 7, 8, 9, or ≥10 feet.

Results

Passing distances of ≤3 feet were reported as common when cycling in standard lanes (17%, 78 out of 451 passes), or lanes with a shared road marking (i.e. 'sharrows'; 23%, 11 out of 47 passes). No passes of ≤3 feet occurred when the cyclist was travelling in a bicycle lane (0 out of 88 passes).

The authors also conducted a modelling analysis (linear regression) which identified that larger passing distance was predicted by larger lane width, better bicycle infrastructure (e.g. presence of cycle lanes), cyclist identity (i.e. passes differed for each of the cyclists) and street identity (i.e. passes differed for specific streets).

Discussion

These findings led the authors to conclude that cyclists in Baltimore, Maryland are routinely passed by motorists at a distance ≤3 feet during morning and evening commutes, that the 3FL is not being followed by motorists, and cyclist safety is still compromised. Risk factors for dangerously close passes were identified as cycling on narrower roads, and roads without cycling lanes.

These results must be considered in light of substantial limitations however. In particular, the MPD legislation in Maryland requires that drivers pass cyclists at a distance 'not less than three feet' (i.e. they must pass cyclists at a distance of 3 feet, or more). However, the current study categorised their results in terms of passes ***≤3 feet***, which is inconsistent with the legislation (a pass of 3 feet is within the law, and should be considered safe). Thus, it is likely that fewer passes were actually in violation of the 3FL, and the modelling results may no longer be valid. Similarly, cyclist lane position (or distance-to-curb) was not recorded or controlled for throughout, and may have constrained the passing distances available, in addition to other factors known to influence this (e.g. traffic volume, passing speed etc.).

In addition, given that no pre-implementation measures of passing distances were taken, it is not clear if the passes documented actually represent a significant improvement on motorist behaviour before the implementation of the 3FL. Last, results from a small sample of cyclists, travelling on specific, overlapping routes, cannot be considered as representative of the experiences of the broader cycling population in Baltimore.

Study 5. 'The 3 ft. Law: Lessons Learned from a National Analysis of State Policies and Expert Interviews'

Rationale

Following recognition that New Jersey cyclists were overrepresented in RTC fatalities as compared to the national average (2.2% of RTC fatalities in New Jersey were cyclists, as compared to 1.9% nationally; National Highway Traffic Administration, 2009), cyclists and other stakeholders in the state called for the adoption of a 3 Foot Law (3FL), requiring that motorists approaching a cyclist in the same direction provide a MPD of 3 lateral feet (1m) between the vehicle and cyclist when overtaking them. In order to inform decision-making regarding the potential implementation of a 3FL in New Jersey, the New Jersey Department of Transportation and Federal High Administration commissioned an in-depth study in order to document the present state of knowledge regarding 3FLs in the US.

Method

A review of relevant national literature (i.e. within the US), and a series of structured interviews with cyclist advocates (n = 20) and experts (n = 3) from the 20 states that had passed MPD legislation at the time of data collection were conducted, with the main aims of identifying best practice, any challenges associated with implementing MPD laws, and the overall effectiveness of MPDs. The 20 states covered by the report are listed in Table 4 below.

Table 4. *List of states incorporated in the report by Brown et al., 2012*

State			
Arizona	Arkansas	Colorado	Connecticut
Delaware	Florida	Georgia	Illinois
Kansas	Louisiana	Maine	Maryland
Minnesota	Mississippi	Nevada	New Hampshire
Oklahoma	Tennessee	Utah	Wisconsin

Results and Discussion[5]

In terms of best practice, the majority of the 20 states have a 3FL in place, with civil penalties (typically a monetary fine) for drivers who violate this. In multiple states, supportive legislation to MPD law has also been passed, including: measures to restrict dooring (i.e. where a motorist can be penalised for opening a car door into the oncoming path of a cyclist), cyclist anti-harassment laws, and vulnerable road user laws, for example. Training on MPD enforcement (e.g. training manuals or handouts) is typically developed/provided by cyclist advocates, and distributed to police departments.

In terms of efficacy, the vast majority of interviewees believed that safer interactions between cyclists and motorists are now occurring throughout their various states as a result of MPD

[5] As the results for this study were provided on an individual basis, for all 20 states included, a synthesised 'Results and Discussion' sub-section is provided here.

legislation, typically providing anecdotal evidence that motorists are leaving more space when overtaking cyclists. The majority of states have reported little to no enforcement of MPDs however (e.g. Florida advocates estimate that about 300 citations have been issued since 2006, while Minnesota estimates that an average of 3 citations are issued per year), with citations often being given only after a collision with a cyclist had occurred.

The main challenges to MPD legislation, and efficacy of that legislation if/when passed, included the difficulty of enforcement, lack of education and public awareness of the law, and concerns regarding the need for wider roads (instead of promoting shared road spaces) for MPDs to be feasible. Some states have also included caveats and technicalities within their legislation (e.g. amongst other caveats, Maryland legislation states that a motorist will not be found in violation of the law if the bicycle fails to maintain a steady course), which render it virtually ineffective. Cycling advocates critical of 3FLs also claim a MPD of 3 feet may not be sufficient for safety, particularly on higher speed roads.

Interestingly, MPD laws are currently viewed by those interviewed as a successful means of increasing cyclist safety by providing motorists with a definitive, unambiguous distance they are required to observe when passing cyclists, but also seen as a measure with little hope of effective enforcement. Advocates claim that a lack of enforcement and formal success measures shouldn't be taken as an indication of 3FL ineffectiveness however. Rather, the success of the law is that it provides an educational opportunity, particularly for motorists willing to safely pass cyclists, but who are unaware of best practice in doing so. Providing cyclists with legal protection also legitimises their place on the road, and may serve to enhance perceptions of safety when cycling, leading to increases in cyclist numbers. Objective measures to ensure that MPD legislation is, at a minimum, not having a negative impact on cyclist outcomes (e.g. encouraging greater numbers of the public to cycle, without changing driver behaviour could result in increased collisions) are of key importance however.

Study 6. 'Give me 3': Do minimum distance passing laws reduce bicycle fatalities?[7]

Rationale

In light of the lack of definitive evidence in the US regarding MPD legislation effectiveness, and voiced concerns regarding, for example, the potential to enforce such laws adequately, Nehiba (In Press) undertook a modelling study to examine the impact of passing MPD law on cyclist fatalities in the US.

Method

Detailed data regarding 18,534 cyclist fatalities, occurring in the US between 1990-2014, from the Fatality Analysis Report System of the National Highway Traffic Safety Administration (NHTSA) were utilised. Twenty-three states and the District of Columbia were identified as having enacted MPD legislation during this timeframe, and control states (i.e. states which had not enacted MPD legislation during that time period) were assigned for each of these. These data were examined in relation to cyclist fatalities in a negative binomial model, while controlling for a series of potentially confounding variables (e.g. weather conditions).

Results

This analysis failed to identify a significant impact of enacting MPD legislation on the number of cyclist fatalities in the US from 1990-2014, even after controlling for differences in weather, demographics, cycling commuter rates, state level traffic and time variation. Based on these findings, it was calculated that a state mandating a MPD may save, at best, 1 cyclist's life every 20.4 months, compared to a state without this in place. At worst, however, MPD legislation could result in an increase of 2.67 cyclist fatalities during the same timeframe.

Discussion

The findings of this study were interpreted to suggest that MPD laws are ineffective in preventing cyclist fatalities, and that complimentary, or alternative, interventions are necessary to significantly improve outcomes for cyclists in the US. This could involve increasing the MPD specified, for example, providing greater training/education for police officers enforcing the MPD law, or focusing on improving cyclist infrastructure, such as cycle lanes. Given the relatively low costs of implementing this kind of legislation, it was acknowledged that many policy makers may still roll-out mandatory MPD.

Of note, the potential for MPD law to improve cyclist outcomes in relation to reductions in serious and/or minor injuries was not assessed in the current study, and all cyclist fatalities (not just fatalities caused by overtaking motorists) were examined. Where possible, modelling cyclist injuries, or more specific fatality, outcomes could further enhance understanding of the impact of MPD legislation, and provide a more accurate picture of how cyclist safety is influenced by this.

4. General Discussion

It is currently proposed that legislation mandating a MPD of 1m between cyclists and motorised vehicles on roads with a speed limit of ≤ 50km/h, and a MPD of 1.5m between pedal cyclists and motorised vehicles on roads with a speed limit >50km/h, be passed in the Republic of Ireland. In considering this proposed legislation, and the findings of this report (in relation to the MPD survey of the IRTAD members, and rapid evidence review), the following observations can be made:

1. In completing the current report, it became clear that there are inherent challenges with conducting robust pre- and post- evaluations of MPD laws, and in particular, measuring passing distances during field research. Similarly, difficulties in measuring and proving violations of MPD by police officers have been acknowledged internationally.

2. Introducing MPD legislation will impact upon a sub-set of motorist-cyclist collisions relating to overtaking (e.g. please see Appendix 1), and other interventions must be considered in order to address the issue of cyclist safety holistically. The Netherlands, for example, have focused on developing cycling infrastructure to separate cyclists from motorised traffic where possible.

3. The findings of the MPD survey administered to the IRTAD group suggest that a minority of countries responding to the survey have adopted MPD legislation. Of those countries who have adopted MPD law, the distances specified are similar to those specified in the proposed legislation for the Republic of Ireland.

4. Of the countries who responded to the survey, and reported having adopted a MPD law, little detail as to how this was enforced was provided. The findings of this survey must be considered in light of the low response rate to the survey however (responses received from 17 out of the 40 total member countries - 43%), and cannot be deemed wholly representative of global MPD policy and practice.

5. In completing the rapid evidence review, a total of 6 MPD-related research studies were identified for inclusion and consideration in this report. Key findings from each of the 6 studies are presented below:

    a) An evaluation of a 2-year MPD trial in Queensland, Australia provided evidence of self-report improvements in motorist passing practices (Schramm et al., 2016). Reports that enforcement of the rule was challenging were also provided. While fatality and injury reductions were noted during the course of the trial, the authors stated that it was “premature to draw conclusions regarding the road safety benefits of the road rule at this stage” (p. 71), as the “extent to which the reduction in serious bicycle crashes can be attributed to the introduction of the MPD road rule is unclear” (p. 69).

    b) An extension of the 2-year Queensland MPD trial study identified that the amount of ‘driving too close (causing fear/anxiety)’ reported by cyclists had not decreased significantly post MPD implementation (i.e. 2009 versus 2015), while

the amount of motorist tailgating had increased significantly (Heesch et al., 2017).

c) A study designed to inform decision-making regarding the feasibility and practicality of a MPD trial in New Zealand recommended that a trial of MPD legislation be implemented, to provide more definitive data regarding MPD efficacy (Balanovic et al., 2016). 29% of a sub-set of motorist-cyclist collisions involved a manoeuvre potentially linked to MPDs. Challenges of enforcing MPD legislation and the importance of evidence-based, education and awareness campaigns on MPDs were also acknowledged.

d) A study designed to evaluate the implementation of a MPD law in Baltimore, Maryland provided limited evidence of routine motorist non-compliance through an instrumented bicycle field study (Love et al., 2012). Larger lane widths and better cycling infrastructure (e.g. cycle lanes) were found to predict larger passing distances for cyclists.

e) A study designed to inform decision-making in New Jersey regarding the potential implementation of a MPD law confirmed that this presents a potential means of improving cyclist outcomes, particularly if sufficiently publicised, designed and enforced in line with vulnerable road user law(s) (Brown et al., 2012).

f) A modelling study examining cyclist fatalities in the US from 1990-2014 did not report significant differences in cyclist deaths due to implementation of MPD legislation during that time period (Nehiba, In Press).

This next segment outlines some of the key arguments put forward in favour of, and some of the key barriers to, MPD legislation, as identified across the literature consulted for the purpose of completing the current report.

Arguments put forward in favour of MPD legislation can include:

a) The potential for improvement in the overtaking behaviours of motorists (through MPD education and/or enforcement), which could decrease the number of motorist-cyclist collisions and near-misses. This could subsequently decrease the number of cyclist fatalities and injuries, and cyclist discomfort and fear when cycling.

b) Reinforcing and legally protecting the rights of cyclists as road users. MPD legislation could serve to further underpin the rights of cyclists as vulnerable road users on Irish roads, and facilitate penalising motorists engaging in dangerous driving around cyclists.

c) Bringing cyclist safety to the fore of public discourse and awareness, in light of increasing numbers of cyclists on Irish roads. In order to implement MPD legislation, a widespread MPD education and awareness campaign would be required, providing a platform to discuss cyclist safety issues in Ireland, particularly in the Irish media.

d) By improving perceptions of safety when cycling, modal share could be increased, resulting in health benefits (from cycling itself, and reduced emissions if new cyclists were previously driving). Increasing the volume of cyclists on the roads is also regarded as having general benefits for cyclist safety (e.g. Fyhri, Sondfor, Bjornskau & Laureshyn, 2017), in that drivers are more aware of and expect cyclists on the roads when travelling, for example.

e) In Ireland at present, there is a particular problem with high levels of congestion in urban centres. By increasing cycling modal share, this could reduce the number of motor vehicles on city roads, and congestion rates into the future.

f) By enhancing cycling infrastructure (e.g. cycle lanes) and lane widths on roads, greater motorist compliance with MPD legislation could be generated (as per Love et al., 2012).

Potential barriers to the implementation of MPD law can include:

a) At present, there is a lack of objective research evidence that MPD legislation improves outcomes for cyclists. Given that motorist-focused research has traditionally dominated the national and international literature however, and that there were numerous limitations with the studies reviewed as part of the current report, further investigations of the potential of MPD law to impact on cyclist outcomes could be beneficial.

b) There is widespread acknowledgement from international stakeholders pre- and/or post-implementation of MPD legislation that it is challenging to enforce effectively.

c) There is a lack of objective research evidence that drivers can accurately judge lateral distances from their vehicle to cyclists. This could lead to under- or over- compensation when overtaking cyclists under MPD law.

d) If MPD legislation is not effective (e.g. if driver behaviour does not change due to a perception that the MPD law will not be enforced), but enhances perceptions of cyclist safety so as to increase cycling numbers, this could increase the likelihood for motorist-cyclist collisions and near-misses due to dangerous overtaking.

e) It is unclear how MPD law will impact on driver behaviour, traffic flow and congestion in urban areas, where it may not be possible for motorists to overtake cyclists with 1m clearance due to constant oncoming traffic. Furthermore, narrow rural roads in Ireland may present a particular challenge in this regard.

5. Key Considerations and Conclusions

In looking at the body of research evidence reviewed in completing the current report, a common theme regarding the impetus for MPD legislation being passed in various jurisdictions emerged and is noted here. As described in detail by Brown et al. (2012) and Balanovic et al. (2016), MPD legislation is typically enacted in response to a high profile cyclist death or personally experienced injury or near-miss by a cycling advocate, with the aim that "something be done to address cyclists safety" (Balanovic et al., p. 22). Unfortunately, little empirical evidence is available to date to support the claim that a MPD law is an appropriate response to this issue, or that it can produce the desired effects. It should be noted however, that this body of research is in its relative infancy, and additional, better quality studies in this area may be needed to establish the objective safety impact of MPD legislation.

Potential concerns have been noted across the research literature that a MPD law could increase cyclist risk exposure, result in motorist under- or over- compensation when overtaking cyclists due to difficulties judging lateral distances, and increased congestion. It is also important to acknowledge that collisions resulting from motorist overtaking manoeuvres represent a sub-set of motorist-cycling collisions both internationally and in the Republic of Ireland. Interventions targeting other aspects of cyclist safety (e.g. providing cycling infrastructure to separate cyclists from motorised traffic, as adopted in the Netherlands) are needed to improve cyclist safety on Irish roads.

6. Recommendations

At present, there is limited empirical evidence currently available to support the implementation of MPD legislation. The potential safety benefits and arguments put forward in support of motorists observing safe passing distances for cyclists in Ireland must be acknowledged, however. As such, in light of the findings of the current report, the following recommendations are made:

a) An education and awareness campaign recommending an advisory MPD of 1m on roads with a ≤50km/h speed limit, and 1.5m on roads with a >50 km/h speed limit, be implemented in the Republic of Ireland.

b) An evaluation of the effectiveness of this education and awareness campaign be conducted.

c) Inclusion of recommended MPDs (i.e. 1m on roads with a ≤50km/h speed limit, and 1.5m on roads with a >50 km/h speed limit) in the official Driver Theory Test material and test questions, and in the Rules of the Road publication, to educate young and novice drivers as to the importance of safe passing distances for cyclists.

d) The RSA complete an in-depth analysis on the factors contributing to fatal cyclist collisions in the Republic of Ireland (2008 - 2015), and share these findings to inform targeted interventions for cyclist safety on Irish roads.

e) In light of increasing numbers of cyclists on Irish roads, and increasing numbers of casualties since 2012, it is recommended that An Garda Síochána place a greater emphasis on enforcing unsafe motorist-cyclist interactions, including potentially enforcing an advisory MPD, or prioritising the enforcement of the existing legislation on unsafe overtaking.

f) In order to ensure the broader protection of cyclists on Irish roads, there must be continued focus on reducing vehicle speed in urban, cyclist-rich areas. In addition, as per international best practice recommendations (e.g. the European Transport Safety Council), infrastructural solutions should be implemented to segregate cyclist and motorised traffic, particularly in higher speed, congested locations.

g) There is scope for further research on the topic of MPDs. In particular, the RSA could consider looking at the approach adopted by New Zealand (Balanovic et al., 2016), and potentially replicate certain aspects of their investigation in an Irish context, to further inform decision-making regarding MPD law.

References

Balanovic, J., Davison, A., Thomas, J., Bowie, C., Frith, B., Lusby, M., Kean, R., Schmitt, L., Beetham, J., Robertson, C., Trotter, M., Kortegast, P., & Burton, J. (2016). *Investigating the feasibility of trialling a Minimum Overtaking Gap for motorists overtaking cyclists in New Zealand.* Wellington: New Zealand Transport Agency.

Baumberger, B., Fluckiger, M., Paquette, M., Bergeron, J., & Delorme, A. (2005). Perception of relative distance in a driving simulator. *Japanese Psychological Research, 47*(3), p. 230 – 237.

Brown, C., Farley, P., Hawkins, J., & Orthmeyer, C. (2012). *The 3 ft. Law: Lessons learned from a national analysis of state policies and expert interviews.* New Jersey: New Jersey Bicycle and Pedestrian Resource Centre for New Jersey Department of Transportation.

Heesch, K. C., Schramm, A., Debnath, A. K., & Haworth, N. (2017). Cyclists' perceptions of motorist harassment pre- to post-trial of the minimum passing distance road rule amendment in Queensland, Australia. *Health Promotion Journal of Australia, 28*, p. 247 – 250.

Fyhri,A., Sundfor, H. B., Bjornskau, T., & Laureshyn, A. (2017). Safety in numbers for cyclists – conclusions from a multidisciplinary study of seasonal change in interplay and conflicts. *Accident Analysis & Prevention, 105,* p. 124 – 133.

Love, D. C., Breaud, A., Burns, S., Margulies, J., Romano, M., & Lawrence, R. (2012). Is the three-foot passing law working in Baltimore, Maryland? *Accident Analysis & Prevention, 48*, p. 451 – 456.

Nehiba, C. (In Press). Give me 3': Do minimum distance passing laws reduce bicyclist fatalities? *Economics of Transportation.*

Schramm, A. J., Haworth, N., Heesch, K., Watson, A., & Kumar, A. (2016). *Evaluation of the Queensland Minimum Passing Distance Road Rule.* Brisbane: Centre for Accident Research & Road Safety – Queensland.

Appendix 1. Collisions and injuries involving pedal cyclists

Over the period 2011 – 2016 there were 4,404 cyclist casualties in 4,381 collisions recorded. From 2011 to 2017, there were 69 cyclists killed. The 2014 and 2015 figures are not directly comparable to the number prior to 2014 due to the system change described[6]. This does constitute a trend break across this time period.

Table 1. Number of casualty collisions[7] and cyclists killed and injured 2011 - 2017

	2011	2012	2013	2014*	2015	2016^	2017^	Total
Cyclist casualty collisions	400	629	637	867	913	935	n/a	4,381
Number killed	9	8	5	13	9	10	15	69
Number injured	395	630	638	864	911	966	n/a	4,404

*break in the series, ^provisional and subject to change

The percentage share of pedal cyclist injuries compared to injuries sustained by other road users (excluding fatalities) increased from 5% to 9% between 2011 and 2013. The 2014 and 2015 figures are not directly comparable to the number prior to 2014 due to the system change[1] but on average represented 11% of all injuries reported.

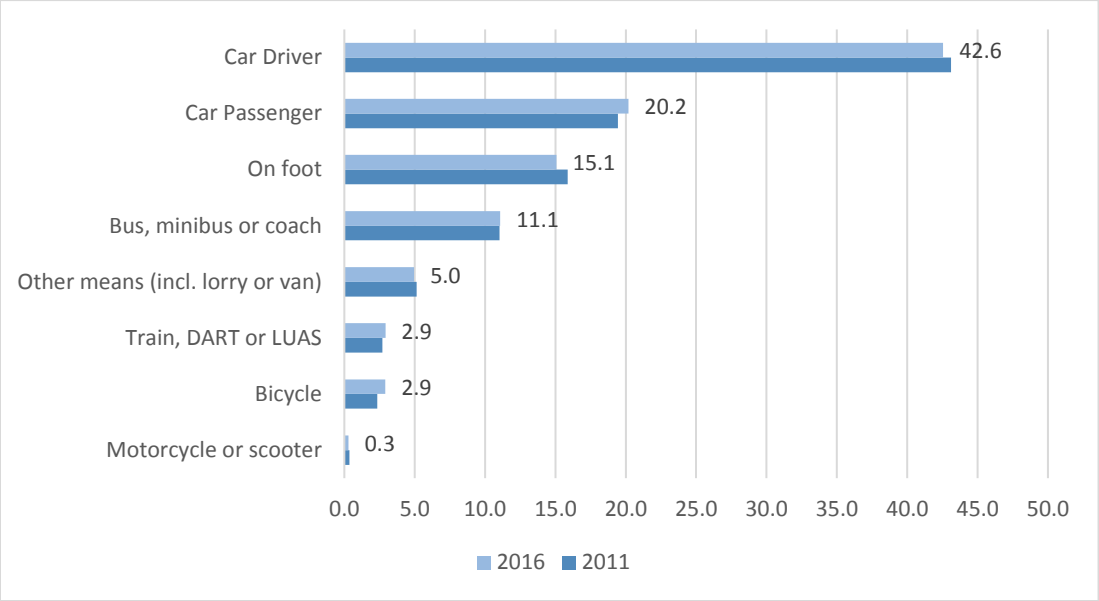
Growing popularity of cycling

The census includes a section on commuting to work, college or school. Comparing results from the 2011 census and 2016 census shows an overall increase of 34% in commuting to work, college or school by cyclists. The increase in cycling to work seen was 43%. Figure 1 provides the percentages by mode for 2011 and 2016. Increases have been seen across car passengers, train, dart or LUAS and cycling. Cycling as a regular mode of commuting increased from 2.3% in 2011 to 2.9% in 2016.

[6] Significant changes were made in 2014 to the mechanism by which collision data is transferred by AGS to the RSA including the addition of new variables, changes to existing variables and introduction of a two-way validation process.

[7] Casualty collisions include fatal, serious and minor injury collisions

Figure 1. Percentage share of commuting by mode, 2011 and 2016



In addition, the National Travel Survey 2016 has shown a rise in the number of journeys taken by pedal cycle when compared to 2013 (1.3% of all journeys) and 2014 (1.6%; 2016 - 1.7%). As well as an increase in percentage share of journeys, the average distances travelled by cyclists increased by 14% and the length of journey time increased by 18% between 2013 and 2016. Although care should be taken when interpreting small numbers (as is the case with the NTA survey), this result coupled with the increase in commuting cyclists found in the census, does point to a strong growth in cycling over this time period.

Summary profile of pedal cyclists' collisions and injuries 2011 to 2015

- Of all vehicles involved in casualty collisions with cyclists between 2011 and 2015, the majority (77%) were classed as private cars[8], a further 6.2% were taxis. Overall, 11% were classed as goods vehicles (both light and heavy), the largest proportion of which were classed as vans (8.3% of all vehicles involved).
- Using data from 2014 and 2015 only, the vehicle manoeuvre most often performed by the motorised vehicle in the collision is classed as driving forward (41%). This is followed by turning right (17%) and turning left (13%). Attempting to overtake accounts for 2.1% of the vehicle manoeuvres recorded for the other vehicle.
- Again using data from 2014 and 2015 only, the vehicle manoeuvre most often performed by the pedal cyclist is classed as driving forward (86%). The next most common manoeuvre is turning right (4.5%).
- Of the 3,446 cyclist collisions recorded between 2011 and 2015, 1,669 (48.4%) were recorded as having occurred at or near a junction. Of these, 51% happened at a T-junction, a further 23% happened at a cross roads and 20% at a roundabout.
- Of all casualty collisions recorded between 2011 and 2015, approximately 85% were recorded as having happened in an urban area compared to 15% in rural areas. An urban area is defined as one with a posted speed limit of 60km/h or less. A rural area is defined as one where the posted speed limit is 80km/h or greater.
- Looking at cyclist injuries by month between 2011 and 2015, from December to March the percentage of all cyclist injuries seen each month ranges from 6.8% (March) to 5.2% (February), and are lower than months from April to November which range from 8.3% (April) to 11% (July and September).
- Cyclist injuries by day of week, indicate lower numbers over the weekend (10.8% of all injuries on Sunday, 9.5% on Saturday) compared to the weekdays which range from 14.4% (Monday) to 17% (Tuesday and Wednesday).

[8] This class will also include MPVs, SUVs and jeeps.

Appendix 2. Survey of IRTAD members regarding minimum passing distance for cyclists

Dear IRTAD colleagues,

The Road Safety Authority (RSA) of Ireland is currently considering the introduction of legislation for a **mandatory** minimum passing distance for cyclists on all Irish roads. Specifically, this legislation would require that motorists in Ireland give cyclists 1 metre clearance on roads with a speed limit ≤ 60km/h, and 1.5 metres clearance on roads with a speed limit ≥ 80km/h.

In order to ensure we are informed by international best practice on this topic, we would greatly appreciate your responses to the following questions:

1) Does your country **recommend** a minimum passing distance for cyclists (i.e. non-mandatory)?

   Yes/No

2) Does your country have a **mandatory** minimum passing distance for cyclists?

   Yes/No

3) If applicable, what minimum passing distance is a) recommended, or, b) mandatory for cyclists in your country (e.g. 1.5 metre passing distance on roads with a speed limit ≥ 80km/h)?

9) _____

10) _____

4) Has your country ever implemented a public awareness campaign to promote a minimum passing distance (either mandatory or non-mandatory)?

   Yes/No

   If yes, can you provide any links to the promotional material (print/poster/TV/etc)?

5) Has your country ever evaluated the impact of introducing a minimum passing distance for cyclists?

   Yes/No

6) If your country has evaluated the impact of introducing a minimum passing distance for cyclists, can you please provide us with information on the evaluation, namely the approach to this and the results?

   If a minimum passing distance is <u>mandatory</u> in your country, please answer the following questions:

7) How is this passing distance enforced in practice in your country?
8) Can you provide information about, or a link to, the legislation in place to underpin this mandatory passing distance?
9) Have there been any difficulties in proving violation of this passing distance during prosecution? Please give examples.

Responses to these questions would be greatly appreciated, **including any links to any relevant information your country may have on this topic,** and can be sent to: akervick@rsa.ie by **Friday 2nd February, 2018.**

Appendix 3. Answers to key survey questions regarding MPDs

Country	Q1 + 3a: MPD advised?	Q2 + 3b: MPD mandated?	Q7 If mandated, how is this enforced?	Q9 If mandated, any difficulties in proving this?
Austria	Yes - 1.5m	No	NA	NA
Belgium	No	Yes - 1m	Not really. If a policemen happens to witness a dangerous situation where a driver passes a cyclist at a short distance, he will write a ticket, but since there is no way to actually measure the passing distance, it has to be clearly closer than 1 m.	Yes. Couldn't find any cases though.
Chile	Yes - 1.5m	No	NA	NA
Finland	No	No	NA	NA
France	No	Yes - 1.5m for roads >50km/h speed limit	The non-compliance of these passing distances is considered as dangerous overtakings. This is a minor road safety offence of the fourth class (fixed fine of 135 Euros, reduced fine of 90 Euros, and 3 points off the driving licence).	None known.
Germany	No	No	NA	NA
Greece	No	No	NA	NA
Hungary	No	No	NA	NA
Japan	No	No	NA	NA
Lithuania	No	No	NA	NA
Netherlands	No	No	NA	NA
New Zealand	Yes - 1.5m	No	NA	NA
Serbia	No	No	NA	NA
Switzerland	No	No	NA	NA
Turkey	No	No	NA	NA
United Kingdom	No	No	NA	NA
United States*	The US does not have an advised MPD, but certain states do.	The US does not have a mandatory MPD, but certain states do.	No response provided.	No response provided.

**Please note, multiple states across the US have different advisory and mandatory MPDs, and enforcement approaches.*

Appendix 4. Extracted summary of state-specific MPDs in the United States

'In 1973, Wisconsin became the first state to enact such a law; several more states have since enacted such measures. As of January 2018, 27 states - Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Kansas, Louisiana, Maine, Maryland, Minnesota, Mississippi, Nebraska, Nevada, New Hampshire, Ohio, Oklahoma, Tennessee, Virginia, Utah, West Virginia, Wisconsin and Wyoming - and the District of Columbia have enacted 3-feet passing laws. North Carolina has a 2 feet passing requirement for motorists, and also allows passing in a no-pass zone if a motorist leaves 4 feet clearance. Two states have laws that go beyond a 3-feet passing law. Pennsylvania has a 4-feet passing law. South Dakota enacted a two-tiered passing law in 2015; with a three foot passing requirement on roads with posted speeds of thirty-five miles per hour or less and a minimum of six feet separation for roads with speed limits greater than thirty five miles per hour. In 9 other states there are general laws that provide that motorists must pass at a "safe distance." These laws typically state that vehicles must pass bicyclists at a safe distance and speed; Montana's law, for example, requires a motorist to "overtake and pass a person riding a bicycle only when the operator of the motor vehicle can do so safely without endangering the person riding the bicycle' (National Conference of State Legislatures, 2018).

This passage was accessed from: http://www.ncsl.org/research/transportation/safely-passing-bicyclists.aspx on the 14/02/2018.

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Údarás Um Shábháilteacht Ar Bhóithre
Road Safety Authority

Páirc Ghnó Ghleann na Muaidhe, Cnoc an tSabhaircín, Bóthar Bhaile Átha Cliath, Béal an Átha, Co. Mhaigh Eo
Moy Valley Business Park, Primrose Hill, Dublin Road, Ballina, Co. Mayo
locall: 1890 50 60 80 fax: (096) 25 252 email: info@rsa.ie website: www.rsa.ie