



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

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- Focus group participants



Abbreviations and acronyms

AA	Automobile Association
ACC	Accident Compensation Corporation
ANOVA	Analysis of variance
CAS	Crash Analysis System
CBD	Central Business District
EEM	Economic Evaluation Manual
GPS	Global Positioning System
MOG	Minimum Overtaking Gap
MBIE	Ministry of Business, Innovation and Employment
MoT	Ministry of Transportation
NZ	New Zealand
Transport Agency	New Zealand Transport Agency
ONRC	One Network Road Classification System
UK	United Kingdom
US	United States
USA	United States of America



Contents

Executive summary	10
Methods	10
Results	10
What we do know	10
What is still uncertain	11
Recommendations	12
Abstract	15
General introduction	16
1.1 Research objectives	16
1.2 Key project stages	17
1.3 Report structure	18
2 Background	19
2.1 Introduction	19
2.2 Safety as the key barrier to cycling uptake	20
2.3 Motorists are perceived as the greatest source of cycling risk	20
2.4 Minimum overtaking gap law	21
2.5 What is the supporting evidence for MOG laws?	22
2.5.1 Why 3 feet/1 metre?	23
2.5.2 How much space do motorists give cyclists already?	26
2.5.3 Does the law work?	28
2.6 Challenges associated with MOG laws	30
2.6.1 Enforcement	30
2.6.2 Education and awareness	31
2.6.3 Ability to judge lateral distances	37
2.6.4 Overall summary	38
2.7 Knowledge acquisition summary	38
2.7.1 Next stages for further investigation	39
3 Methods	41
3.1 Overview	41
3.2 Crash analysis of space related incidents involving motorists and cyclists	42
3.3 Field data collection	42
3.3.1 The instrumented bicycle unit	43
3.3.2 Selected test areas	44
3.3.3 Participant recruitment	44
3.3.4 Data collection process	46
3.4 Qualitative data collection	51
3.4.1 One-on-one interviews	51
3.4.2 Stakeholder workshops	51
3.4.3 Police focus group	53
3.4.4 Discussion of costs and benefits	54
4 Results	56
4.1 Crash analysis of incidents relating to space using CAS	56
4.2 Field data collection	58



4.2.1	Self-limiting of rides.....	59
4.2.2	Recorded overtaking gaps.....	60
4.2.3	Rider flagged 'uncomfortable' or 'high perceived risk' events.....	62
4.3	Qualitative data collection.....	67
4.3.1	One-on-one interviews.....	67
4.3.2	Stakeholder workshops.....	68
4.4	Police focus group.....	79
4.4.1	How safe is it to cycle on New Zealand roads?.....	79
4.4.2	Motorists' overtaking behaviours.....	80
4.4.3	Discussing the concept of a minimum overtaking gap law.....	81
4.5	A discussion on the costs and benefits of a minimum overtaking gap law.....	83
4.5.1	Costs.....	84
4.5.2	Benefits.....	87
4.5.3	Discussion.....	91
4.5.4	Conclusions.....	92
5	Discussion.....	93
5.1	Current situation: What is a safe distance and how often are cyclists given such a distance in New Zealand?.....	93
5.1.1	What is a safe distance?.....	93
5.1.2	What is the extent of the problem?.....	94
5.2	Future potential: What is the feasibility and practicality of introducing a MOG rule in New Zealand?.....	95
5.2.1	Would a MOG law work?.....	95
5.2.2	Three main challenges associated with MOG law of enforcement, education and practical ability to follow the law.....	95
5.3	Conclusions.....	100
5.3.1	What we do know.....	100
5.3.2	What is still uncertain.....	101
6	Recommendations.....	102
7	References.....	104
8	Appendices.....	110
	Appendix A: International MOG laws.....	110
	Appendix B: Stakeholder discussion prompts.....	112
	Appendix C: Instrumentation Detail.....	115
	Instrumented Bike Development.....	115
	Motorist overtaking distance and speed and vehicle type (LiDAR units).....	115
	Bicycle speed (speedometer).....	115
	Location on the road network (GPS).....	115
	Subjective rider discomfort (push button).....	115
	Qualitative assessment of interactions (video capture).....	116
	Meaningful data representation.....	116
	Data validation.....	116
	Appendix D. Study Area Detail.....	118
	Wellington metropolitan area.....	118
	Wairarapa.....	119
	Appendix E. Study Procedure.....	120



Participant recruitment detail.....	120
Handover of the instrumented bicycle.....	120
Post-ride process.....	121
Scheduled maintenance and data download.....	122
Appendix F: GIS survey of cycling routes.....	123
Figure 2.1 Cyclist serious injuries.....	19
Figure 2.2 Cyclist deaths.....	19
Figure 2.3 Mapping of current MOG laws in the USA (sourced from current online legislation).....	21
Figure 2.4 Dates when Australian states passed a 1m ($\leq 60\text{km/h}$) and 1.5m ($> 60\text{km/h}$) MOG law sourced from current online legislation). Yellow sections indicate states that have passed a MOG law.....	22
Figure 2.5 Passing clearance and lateral distance (Llorca et al., 2014).....	24
Figure 2.6 Relationship between lateral distance, speed and perceived safety, where the risk 1 denotes an 'acceptable level of risk' and the (Llorca et al., 2014).....	25
Figure 2.7 Example video capture of a 5-foot pass (Love et al., 2012).....	28
Figure 2.8 Example video capture of a 3-foot pass (Love et al., 2012).....	29
Figure 2.9 BSMART instrumented bike used to enforce rule in Tennessee (Healey, 2015).....	31
Figure 2.10 Temporary 3-foot sign in New Hampshire (received from New Hampshire Correspondent).....	32
Figure 2.11 Example signs relating to the 1m law gap campaign (The Amy Gillett Foundation, 2013).....	32
Figure 2.12. Sign used in study by Kay et al., (2014).....	32
Figure 2.13 Results from the first quarter self-report evaluation of the NZ 'see the person –share the road' campaign.....	35
Figure 3.1 Project milestones overview.....	41
Figure 3.2 Extent to which survey responses matched group allocation criteria.....	46
Figure 3.3 Trial routes ridden across Wellington city (Basemap credit: LINZ Data Service).....	47
Figure 3.4 Trial routes ridden throughout the Hutt Valley (Basemap credit: LINZ Data Service).....	48
Figure 3.5 Trial routes ridden throughout the Wairarapa (Basemap credit: LINZ Data Service).....	48
Figure 3.6 NZTA CAS Vehicle movement coding.....	50
Figure 4.1 Overtaking gap distribution on urban Roads (60km/h and below).....	61
Figure 4.2 Overtaking gap distribution on major arterials and rural roads (60km/h and above).....	61
Figure 4.3 Stakeholder support or opposition towards a potential MOG law before and after the workshop.....	78
Figure 4.4 Transport Agency Rule Change Process (Transport Agency, 2016b).....	84
Figure 4.5 Process overview of the Rule Development and Consultation phase (Transport Agency, 2016b).....	85
Figure 8.1. A detailed illustration of the instrumented bike technology.....	115
Figure 8.2. The Wellington Region (Basemap credit: Land Information New Zealand & Eagle Technology Group Ltd).....	118
Figure 8.3. Wairarapa Region (Basemap credit: Land Information New Zealand & Eagle Technology Group Ltd).....	119
Table 2.1 European countries with MOG laws in place.....	22
Table 2.2 Details of correspondence with international experts.....	23
Table 2.3 Average overtaking distances and percentages of unsafe passes.....	26
Table 2.4 Summary of factors that influence the overtaking distance given by motorists to cyclists.....	27
Table 2.5 Sources by which participants were exposed to MOG advertisement.....	33
Table 2.6 Descriptions and evaluations of three road safety campaign's in Canada (Baglo et al., 2013).....	36
Table 3.1 CAS codes for cyclist-motorist space-related crashes.....	43
Table 3.2 Final sample of participants.....	45
Table 3.3 Criteria for study group allocation.....	46
Table 3.4 Stakeholder workshop procedure.....	52
Table 3.5 Semi-structured narrative approach.....	55
Table 4.1 Space-related crash statistics from the CAS database between 2006 and 2015 for the Wellington Region and New Zealand.....	56



Table 4.2 Severity of space-related crashes in New Zealand (2006-2015)	57
Table 4.3 Correlation between rider experience, age and gender and environmental conditions	59
Table 4.4 Descriptive statistics of overtaking gap for recorded observations	60
Table 4.5 Exposure to overtaking gap - number of vehicles that were recorded overtaking at specified distances	62
Table 4.6 Distribution of vehicle movements with rider flagged interactions compared with the same movement codes for cyclists involved in crashes during the period 2006-2015	63
Table 4.7 Presence of different factors in rider flagged interactions	63
Table 4.8 Oncoming vehicles and overtaking gaps	64
Table 4.9 Road shoulder width and overtaking gaps	64
Table 4.10. Flagged events by rider experience and road network type	65
Table 4.11 Overall rider acceptance of overtaking gap by range	66
Table 4.12 Beginner rider acceptance of overtaking gap by strata	66
Table 4.13 Key themes emerging from one-on-one interviews	67
Table 4.14 Background information of workshop participants	69
Table 4.15 The impact of a MOG law on cyclist safety and comfort - benefits and limitations	70
Table 4.16 Key raised implementation challenges (and potential mitigation options) of a MOG law in New Zealand	72
Table 4.17 Key raised implementation challenges (and potential mitigation options) of a MOG law in New Zealand	73
Table 4.18 SCENARIO 1: A single mandatory overtaking distance vs a graduated (e.g., different distances in different situations) minimum overtaking gap law	74
Table 4.19 SCENARIO 2: A behaviour change campaign with no mandatory requirements (i.e., the law) vs a behaviour change campaign supported by a mandatory requirement	75
Table 4.20 Social cost per crash - 2015 update	87
Table 4.21 Per kilometre benefits of active transport modes	88
Table 4.22 Mode share of time, distance and trip legs	88
Table 4.23 Air pollution cost (year 2000 Euro-cents/vehicle kilometre)	89
Table 4.24 Percentage of road travel in major urban areas	89
Table 4.25 Cost and benefit scenarios related to various levels of increased cycling (\$1000)	90
Table 4.26 The Transport Agency's economic efficiency assessment criteria	91
Table 4.27 Summary table of maximum ongoing yearly expenditures if a MOG law had a benefit cost ratio of 4	92
Table 5.1. Discomfort rates from motorist overtaking events by overall and beginner riders	95
Table 8.1. Incentives offered to each participant	120
Table 8.2. Road width by rural road type for New Zealand and Queensland	123
Table 8.3. Road width by rural road type for New Zealand and Queensland	124



Executive summary

Cyclists¹ are at a disproportionately high level of risk when riding on New Zealand roads, with findings showing that cyclists are 10 times more likely to be involved in a serious or fatal incident per kilometre travelled, as compared to car drivers (New Zealand Cycling Safety Panel, 2014). It has also been noted that the perception that cycling is an unsafe mode of transport is one of the key deterrents to greater cycling uptake, with findings showing that, while only 9% of Wellingtonians currently sometimes cycle to work, an additional 22% would prefer to cycle to work (with similar patterns being observed in Auckland data as well; New Zealand Transport Agency, 2015).

As a step towards enhancing the actual and perceived safety of cycling on New Zealand roads, the New Zealand Transport Agency (hereon in referred to as the Transport Agency) is considering the recommendation of the New Zealand Cycling Safety Panel to trial a Minimum Overtaking Gap (MOG) law in New Zealand (i.e., a law that would mandate that motorists provide cyclists with a specific minimum lateral distance when overtaking them on the road). While the first law of this kind was passed in Wisconsin in 1972, the recent proliferation of such rules across the US, Australia and Europe has prompted New Zealand road safety authorities to conduct more in-depth investigations. Thus, to make an informed decision, the Transport Agency and Opus Research conducted an investigation into the feasibility and practicality of introducing such a law, as well as the effectiveness of complementary/alternative education campaigns.

Methods

This investigation was conducted in six key phases including an inception phase, a knowledge acquisition phase (literature review and correspondence with international experts), a crash analysis, quantitative on-road field data collection (assessing the relationship between discomfort and overtaking distance), qualitative stakeholder and interview data collection, and a discussion on costs and benefits, followed by the completion of the final report to the Transport Agency.

Results

Drawing across all components of this investigation, it can be said that improving cycling safety by changing motorist overtaking behaviours is a worthy cause that warrants the attention and effort of roading authorities as well as the New Zealand public. As a potential avenue in achieving such a goal, the findings suggest that the introduction of a MOG law is a complex solution that holds both promise and uncertainty regarding its effectiveness in improving overtaking behaviours (and cycling safety more broadly).

What we do know

Through a variety of approaches and methods, the current investigation has substantially enhanced our understanding of the feasibility of introducing a MOG law in the New Zealand context. Firstly, results from field trials revealed that, if a MOG law were to be introduced, there is now empirical evidence to support a speed graduated law. More specifically, results show that a 1.0m distance should be suitable for roads with speeds of 60km/h or less (i.e., urban roads) and a 1.5m distance should be suitable for roads with speeds over 60km/h (i.e., major arterials and rural roads). As these were the threshold distances where most riders were comfortable (including novice riders), the relative improvement in comfort beyond these distances was minor. These distances intuitively align with existing motorist behaviour, will focus improvement on the higher risk behaviour, and have been applied in overseas standards. It is important to note,

¹ In this document, we use the term 'cyclists' to refer to all people who use bicycles. This is to be differentiated from other interpretations of the word which refer to those who 'identify' as being cyclists.



however, that such a law should be sensitive to the fact that different riders feel comfortable at different distances and in different situations, and so, while the minimum is required, motorists should be encouraged (perhaps via means of an education campaign) to provide more space where possible. Complementing the field-data, discussions from the stakeholder interviews revealed that a graduated MOG law would be more suitable as it would be sensitive to the differential needs of cyclists at different speeds, particularly for less confident riders.

Secondly, the field results have given us a much clearer understanding of the extent of the problem in New Zealand. Findings show that, on the one hand, a relatively small proportion of passes were perceived as unsafe, giving credence to the perception that it is a minority of interactions that should be targeted for behaviour change (whether that be by MOG with education campaign or with education campaign alone). On the other hand, however, though low in frequency, the few passes that were perceived as unsafe were substantially distressing, and thus, could be deterring people from cycling on New Zealand roads (particularly new cyclists and tourists who are unaccustomed to close passes). This is a noteworthy finding given that the discussion on the costs and benefits showed that the benefits of introducing a MOG law would very likely out-weigh the costs if the law resulted in a 0.5% increase in cycling mode share. Put simply, the fact that these findings focus on 'perceived' safety does not detract from their importance as it is the perceived lack of safety that acts as a considerable deterrent from greater cycling uptake.

Table 1 below outlines the discomfort rates from motorists overtaking cyclists (for overall riders and for a sub-sample of beginners), showing that about 1 in every 40 overtaking interactions were perceived as uncomfortable, and this was higher for beginner riders. It also indicates different exposure to overtaking interactions by beginners, such that their ride time per discomfort event was longer (perhaps suggesting behavioural adaption by newer riders choosing to avoid high traffic situations).

Table 1. Discomfort rates from motorist overtaking events by overall and beginner riders

Rider type	Discomfort rate from motorist overtaking interactions	Cyclist ride time (per Discomfort event)
Overall riders	1 in 40	22 mins
Beginner riders	1 in 37	31 mins

Finally, the gathered information regarding the effectiveness of a potential MOG law revealed that, if it is introduced with special consideration around its enforcement, education and practicality, it has the potential to improve the overtaking behaviours of motorists, and thereby greatly enhance the safety of cyclists on the road by legitimising cyclists as road users as well as bringing cycling safety discussions into the public discourse. What is more, the law could be used as an educational tool to give immediate information to motorists exhibiting close passing gaps by police officers, while also giving authorities an additional piece of legislative evidence to support any crashes that may occur between a cyclist and a motorist. Well-executed, a MOG law has the potential to help shift the current culture of road use and could bring substantial health, social and economic gains to New Zealand through an increase in cycling mode share.

What is still uncertain

There are still considerable gaps in our knowledge regarding the extent of a MOG law's effectiveness and wider impacts, requiring further investigation. Firstly, a lack of behavioural baseline measures overseas means that, at present, there are scant evaluations of MOG laws effectiveness in improving overtaking behaviours. Although perceptual changes were observed in an evaluation of the recently passed MOG law in Queensland, Australia (Schramm, Haworthm, Heesch, Watson & Debnath, 2016), it is unknown whether such perceived changes would be matched with observable behavioural improvements, or any overall crash reduction. Lastly, similar uncertainties remain around the effectiveness



of education campaigns (as standalone or complementary to law initiatives) due to the lack of evaluations, and as such, they too warrant additional research and consideration.

With respect to the 'feasibility' of a MOG law, there are numerous variables that would determine its effectiveness, including its enforceability, its practicality (in terms how easy it is to follow), levels of compliance and the response of the public to these factors, as well as the law itself. While informed estimates can be made, it is still relatively uncertain how such factors would manifest in the New Zealand context without additional information. Consequently, it is difficult to produce accurate estimates of the costs that would be involved in the introduction of such a law (and accompanying education programme). Moreover, due to the uncertainty of its effect on cycling mode share (i.e., we do not know whether it would in fact lead to a 0.5% increase), it is also unknown whether such costs would be out-weighed by the benefits (both social and economic).

Finally, the research is still scarce regarding the ability of motorists and cyclists to judge lateral distances while operating their respective vehicles. Research of this kind could be of substantial value, as it could have significant ramifications for the expected behaviour changes (of cyclists and motorists). A situation could transpire where motorists overcompensate due to uncertainty around the passing distance, resulting in unnecessary delays or movements into oncoming traffic. Conversely, over-reporting of close passing manoeuvres may occur on behalf of cyclists due to an inaccuracy in lateral distance judgements. Further investigations could help better anticipate such situations and could be incorporated into education campaigns and enforcement methods to help educate the public and authorities of the realistic abilities of road users in this respect.

Recommendations

Based on the findings and insights of this investigation, we propose the following for consideration:

- 1 **Graduated MOG law.** If a MOG law is to be introduced, it is recommended that consideration be given to the two distances based on road hierarchy and speed zone (namely, 1.0m at 60km/h or less and 1.5m at over 60km/h) – an option that has been under consideration by the Cycle Safety Panel (New Zealand Cycling Safety Panel, 2014). However, drivers should be encouraged to give this as a minimum, as there is some variation regarding levels of perceived comfort given specific MOGs.
- 2 **Comprehensive education campaign.** Regardless of the introduction of an MOG law, it is recommended that, building on existing share the road cycle campaigns, an additional education campaign be taken to address the needs of cyclists with particular emphasis on space given when being overtaken by motorists. Such a campaign should have clear objectives and measurable success indicators, should target specific audiences in appropriate ways, use all channels of messaging, address difficulties in current mobility culture while also building on its strengths. If such a campaign were to be accompanied by a MOG law, the campaign should include comparative methods to illustrate how such a law would function in different contexts/situations. This could include how it might function within the context of other laws (such as the ability for slow passes on yellow no passing lines or painted medians), as these situations are not well communicated or understood. For monitoring and improvement purposes, it is also recommended that before-and after evaluations of the campaign be conducted, noting any behavioural or perceptible changes.
- 3 **Wider mobility culture.** Irrespective of the introduction of a MOG law, it is recommended that the broader mobility culture be given careful consideration and potential investigation (by means of attitudinal surveys). Developing a clear understanding of the current mobility culture in New Zealand will enable for a) before and after evaluations of perceptions and social norms, b) more informed education campaigns that will increase the likelihood of more consistent, longer term results, c) application to a wider range of issues and potentialities, giving relevant authorities a high-level view of not only behavioural but perceptual patterns of mobility in New Zealand (identifying areas that overlap, and ways of optimizing initiatives and resources).



- 4 **Wider legal context.** If a MOG law is to be introduced, it is recommended that an assessment be made of how it would fit within the wider set of laws relating to cyclists (including shared paths/pedestrians). More specifically, if wider culture surveys were to go ahead, it is recommended that questions be included regarding other cycling related laws in an effort to create an integrated approach (a method vital for successful behaviour change and optimising cost-effectivity). This should also take into account stricter enforcement of cycling related laws (e.g., running red lights), which could help to create an overall culture change and build on New Zealand's existing cultural values of fairness and equality.
- 5 **A trial period.** It is recommended that either a MOG law (with education) or the aforementioned comprehensive education campaign alone be trialled (similar to how a MOG law was introduced in Queensland, Australia). This would enable for before and after assessments of behaviour change, user comfort and comparison of injury and crash statistics over time. Moreover, this would give authorities an opportunity to trial enforcement and communication approaches, identify strengths and improve on weaknesses. The advantage of this approach is that it would provide the evidence base to either permanently introduce the law or to discount it. To increase the likelihood of the trials success, as well as to acquire the needed evidence, the following steps should be considered:
 - a **Evaluating success.** It is recommended that real-time measures of road user discomfort be used to inform and monitor future enforcement or education interventions in conjunction with any behaviour change monitoring, with the main goal of reducing the small number of overtaking interactions that are perceived as being considerably distressing. Perceived risk is a key barrier to greater cycling uptake, which is the main benefit of any action around overtaking behaviour (MOG law or otherwise).
 - b **Integrated MOG implementation approach.** It is recommended that if a specific MOG is made mandatory, that special consideration be put into the practicalities of enforcement and the ability of motorists to comply with the law (and how this will be communicated to the public in such a way to give them realistic/positive expectations while also avoiding potential public backlash). To achieve this, all the factors presented in this report regarding enforcement, education and followability should be presented to relevant transport authorities (e.g., road design and maintenance, police) and detailed approaches be composed regarding enforcement and compliance of the law. This should be an integrated initiative to ensure that a consistent approach be conducted and consistent messaging be delivered to the wider public.
 - c **Understandings and perceptions of MOG law.** It is recommended that a MOG perception study be conducted in advance of any MOG law (if introduced), to mitigate uncertainties around the public understanding and response to a MOG law (in regards to attitudes, expectations and behaviours). This will greatly inform the decision-making process, enabling anticipation and mitigation of negative public responses, and provide a benchmark to monitor the success around education. It would also improve the process around education, especially for targeted groups who may hold specific views, and testing how to communicate around problem space locations (like narrow rural roads).
 - d **Lateral distance judgement.** It is recommended that, in light of the knowledge-gap regarding motorists' and cyclists' abilities to judge lateral distances (particularly when in motion), investigations be conducted to assess levels of accuracy as well as ways of improving judgements. Such information could greatly inform education campaigns (knowing how to illustrate to people what a specific distance looks like and how to achieve it). It would also enable police authorities to anticipate the potential behaviours of road users (and perhaps times/situations/areas where judgements are likely to be less accurate).
- 6 **Signage.** Signage could be used to encourage cyclist groups to ride in single file at difficult (e.g. narrow) locations. Irrespective of the introduction of a MOG law, it is recommended that specific 'share-the-road' signage be more consistently distributed across New Zealand. Given the passing of a MOG law, this would raise awareness of its introduction while also acting as legitimisation tool. Without a law, such signage would represent cyclists as legitimate road users who warrant care and attention.



- 7 **Targeted infrastructure improvements.** It is recommended that consideration be given towards opportunities for targeted infrastructure improvements that would allow a MOG law (or behaviour change more generally) to function effectively. The data collected in this investigation (and/or its methodology) could be used to identify pinch-points or areas where problematic passing behaviours occur at greater frequencies, and use this information to help inform any infrastructure upgrades or changes.



Abstract

This investigation aimed to assist the Transport Agency in evaluating the feasibility and practicality of introducing a minimum overtaking gap (MOG) law in New Zealand while also assessing the effectiveness of any complementary/alternative education campaigns. To this end, a multi-pronged investigation was conducted, beginning with a comprehensive review of existing research and knowledge which then informed the subsequent quantitative and qualitative data collection phases. Firstly, results from a crash analysis and on-road field observations using instrumented bicycles (N = 6268) revealed that a 1.0m distance would be suitable for urban speeds of 60km/h and below, and a 1.5m distance would be suitable for major arterials and rural roads with speed zones over 60km/h, as these were the threshold distances where most riders were comfortable (including novice riders). Secondly, a relatively small proportion of passes (about 3%) were perceived as unsafe, though the rate of these events was still meaningful (occurring once every 22 minutes of riding). Following this, qualitative findings from a stakeholder workshop, four one-on-one interviews and a police focus group identified that enforcement, education and ability to follow a MOG law are key challenges and potential avenues for enhancing cycling safety in New Zealand. Specifically, it was highlighted that acquiring sufficient evidence is the main practical challenge regarding enforcement (though it could be used as a warning-system to educate motorists). Additionally, education was considered a vital component that should not only bring awareness of a MOG law but also discuss wider safety needs and implications of sharing the road (with an emphasis on cyclist needs). Finally, a MOG law should be practical to follow. While there was no evidence that New Zealand's road topography or dimensions were any more problematic than other countries that have implemented a MOG law, such a law would work more smoothly if consideration was given to improved infrastructure at high conflict locations, a better understanding and use of complementary laws, and improved rider and driver expectations and attitudes under narrow road conditions.



1 General introduction

As vulnerable road users, cyclists face a greater safety risk than other road users, with higher rates of fatalities and serious injuries (NZ Transport Agency, 2015). According to the Transport Agency (2015), cyclists comprise ~3% of on-road deaths (despite the fact that cycling makes up only 1.6% of the total time travelled). Because cyclists tend to cover less distance in a given time than motorists, they are at approximately 10 times the risk per kilometre as compared to other road users (NZ Transport Agency, 2015). Reasons for the disproportionate risk include; a network that is primarily designed for motor vehicles, the speed of vehicles, cyclist vulnerability due to decreased stability and lower level of protection than cars, the traffic volumes of vehicles, the low number of cyclists, and motorist and cyclist behaviours. The consequences of cycling risk comes at a great social and economic cost to New Zealand, with the Accident Compensation Corporation (ACC) data revealing 23,729 new cycling related claims in 2014 – coming to a total cost of \$31,155,000 (Accident Compensation Corporation, 2014)².

Alongside the objective risks involved with cycling on New Zealand roads, findings also show that the perception that cycling is an unsafe mode of transport is one of the key deterrents from greater cycling uptake. Indeed, evidence suggests that there is 'untapped potential' in the cycling space. A Wellington City Council survey found that, while only 9% of Wellingtonians currently cycle sometimes to work, an additional 22% would prefer to cycle to work (with similar patterns being observed in Auckland data as well; New Zealand Transport Agency, 2015)³. It is therefore the case that addressing cycling safety is not only important for protecting existing users, but also has the potential to unlock a substantial latent demand for bicycle riding in New Zealand.

In response to such findings, the New Zealand Government has put several initiatives in place to enhance the actual and perceived safety of cycling in New Zealand, including the allocation of \$100 million in extra funding in 2014 to further develop urban cycleways. Following on from this effort, the Transport Agency has made it one of their key strategies to take measures to make urban cycling a safer and more attractive transport choice (Transport Agency, 2014).

Drawing from the recommendations of the New Zealand Cycling Safety panel, the Transport Agency is currently considering trialling a Minimum Overtaking Gap (MOG) rule in New Zealand (i.e., a law that would mandate that motorists provide cyclists with a specific lateral distance when overtaking them on the road). The rationale behind such a rule is that it *"helps to inform discussion on appropriate driving behaviours, such as motorists waiting behind cyclists if necessary, passing at a safer slower speed, or clearly using the opposing traffic lane to overtake rather than trying to squeeze' past the same lane"* (New Zealand Cycling Safety Panel, 2014).

To make an informed decision regarding the trialling of a MOG law, the Transport Agency required an investigation into the feasibility and practicality of introducing a MOG law in the New Zealand context as well as the effectiveness of complementary/alternative education campaigns that would accompany such a trial. This investigation would allow for the development of recommendations into whether a MOG law is the next best step towards improving actual and perceived cycling safety for New Zealanders.

1.1 Research objectives

The aims of this investigation were to examine the relationship between motorist overtaking cyclists passing distances and rider safety; the feasibility of implementing a law that would mandate a specific distance be given by motorists to cyclists during overtaking manoeuvres; and the practical implications (including enforcement and education) that would be associated with the introduction of such a law. To achieve this goal, the researchers had the following research objectives:

² This includes on-road and off-road cycling claims.

³ It is worth noting however that cycling is more common in these urban areas than more suburban and regional areas.

- 1 Review the existing international and New Zealand literature regarding motorists overtaking behaviours as well as assess current practice examples of the MOG law used in overseas jurisdictions.
- 2 Identify the extent to which motorists overtaking cyclists (and similar space-related motorist-cyclist interactions) is a cause of cyclist related crashes in New Zealand.
- 3 Determine a) the amount of space currently being given to cyclists by motorists on New Zealand roads and b) the relationship between the distances given to cyclists and their level of perceived safety.
- 4 Capture the feasibility and practicality of a potential MOG law from a range of perspectives as well as capture views on any complementary/alternative education campaigns relating to motorists overtaking cyclists.
- 5 Produce well-informed recommendations by weighing up the costs and benefits of each respective option (i.e., the introduction of a law with an education campaign vs the introduction of a law without an education campaign vs no law with an education campaign vs none of the above).

1.2 Key project stages

The goal of this investigation was to examine the relationship between motorists overtaking cyclists passing distances and rider safety; and the practical implications (including legislation, enforcement and education) of introducing such a rule. To this end, a six-pronged methodology was employed that included:

- 1 **Stage 1:** Crash Analysis System (CAS) data was examined to understand the frequency and type of cyclist-motorist crashes related to motorist overtaking gap and other space-related crashes. The analysis examined New Zealand data as well as the Greater Wellington Region data (where the field data was being collected), to identify the extent that a law might mitigate crashes.
- 2 **Stage 2:** A stocktake was conducted of existing knowledge on the implementation and effectiveness of MOG laws/rules as well as overtaking behaviours of motorists to cyclists more broadly. This involved a comprehensive international and local literature review as well as correspondence with international experts involved in cycling safety and road sharing in their respective areas. The findings from this stage provided a clear research platform and informed all subsequent stages to ensure that they were relevant and up-to-date.
- 3 **Stage 3** Objective field data was collected using instrumented bicycle technology that captured the passing distances and speeds of motorists overtaking cyclists, as well as cyclists' perceived safety, on both urban and rural roads in the Wellington and Wairarapa regions of New Zealand. This gave researchers a baseline of passing distances given by motorists to cyclists and the ability to assess the relationship between specific distances and perceived safety of the riders. Both of these measurements were necessary for understanding a) the specific distance riders need to feel safe, and b) the current level of risk reflected by the proportion of 'unsafe' passes.
- 4 **Stage 4:** Qualitative data was collected using a variety of methods (i.e., one-on-one interviews, a stakeholder workshop and police officer focus group) to capture perspectives on the potential benefits and challenges (and solutions to said challenges) associated with the implementation of a MOG law in New Zealand. In conjunction with a review of the literature, these sessions were also used to produce ideas for potential education and awareness programmes that could complement the introduction of such a law.
- 5 **Stage 5:** This stage resulted in a discussion of the costs and benefits which would be associated with a rule change under a range of scenarios, enabling researchers to methodically determine the viability of the MOG law, informing the formulation of final recommendations.
- 6 **Stage 6:** A final technical report was produced that included all findings (including both the quantitative and qualitative components) integrated into a well-informed set of conclusions and recommendations. Special emphasis



was placed on providing recommendations to the Transport Agency on the feasibility and practicality of implementing a MOG law in the New Zealand context as well as providing guidance around the type and scope for complementary/alternative education and awareness raising campaigns.

1.3 Report structure

Section 1 of this report introduces the project and the research objectives.

Section 2 describes the knowledge acquisition, including literature findings.

Section 3 describes the complete methodology, including the CAS analysis, on-road field trials, qualitative data collection and a discussion of the costs and benefits that would be associated with a rule change under a range of scenarios.

Section 4 describes the results from all data collection and analysis phases.

Sections 5 integrates and discusses the findings from sections 2 to 4 for assessing the feasibility of implementing a MOG law in New Zealand.

Section 6 produces a series of recommendations to the Transport Agency.

Section 7 gives a list of references used in this report.

Section 8 provides appendices that give further details on more detailed methodology and relevant findings (including legislative information, tool and equipment use and statistical analyses conducted).

2 Background

2.1 Introduction

Following the lead of established cycling countries such as the Netherlands, Germany and Denmark (Pucher & Buehler, 2008), transport authorities across the world are currently paying particular attention to the role that cycling (i.e., bicycle riding) plays in their mobility networks (Dekoster & Schollaert, 2003; Legislatures, 2014; New Zealand Cycling Safety Panel, 2014; UK Department of Transportation, 2010; US Department of Transportation, 2010). This surge in interest is partly due to the widely acknowledged personal and collective benefits of cycling including: improved individual health (de Hartog, Boogaard, Nijland, & Hoek, 2010; Rojas-Rueda, de Nazelle, Tainio, & Nieuwenhuijsen, 2011; Wagner et al., 2001); a reduction in personal costs as well as societal costs that result from fewer health issues and milder roading effects of non-motorised traffic (Davis, 2010; Gotschi, 2011; Kahlmeier et al., 2014; Lindsay, Macmillan, & Woodward, 2011); lower carbon emissions (Grabow et al., 2012; Woodcock et al., 2009); and even social equity improvements as a wider demographic of individuals become more mobile (Australian Department of Planning Transport and Infrastructure., 2012; Garrard, Crawford, & Hakman, 2006; New Zealand Ministry of Transport, 2008). It is in reflection of such advantages that many see cycling as a viable solution that can help address the ever-present mobility, health (and associated economic) issues facing the world today.

Unfortunately, the potential benefits of cycling go largely unrealised in many developed nations (such as the UK, the USA, NZ and Australia), which still have a predominately motorised mode share and relatively low cycling participation (Koorey, 2014; McKenzie, 2014; Ministry of Transport, 2014a; UK Department for Transport, 2014). What is more, despite the low number of cyclists in such nations, these riders are still at a substantially greater risk of being seriously injured or killed on roads (as compared to other road users), with New Zealand statistics showing an increase in cycling related risk over the past two decades (see Figure 2.1 and Figure 2.2; NZ Cycling Safety Panel, 2014).

This seemingly paradoxical pattern of low exposure and high risk has been termed as the 'safety in numbers effect' where countries with a greater cycling mode share have substantially lower cycling risk (both due to the culture of cycling as well as the investment in their safety (Jacobsen, 2003; New Zealand Cycling Safety Panel, 2014; Wei & Lovegrove, 2013). However, this effect is not just related to cyclist numbers, and thus increasing cycling while improving the cycling environment is the best approach to realise safety benefits (Cycling Embassy of Great Britain, 2011; Peck, 2012; Transport for London, 2010; Wegman, Zhang, & Dijkstra, 2012). In light of such findings, there are incentives for relevant authorities and transport leaders to consider ways to improve cycling infrastructure both in order to increase cycle safety and also increase the health

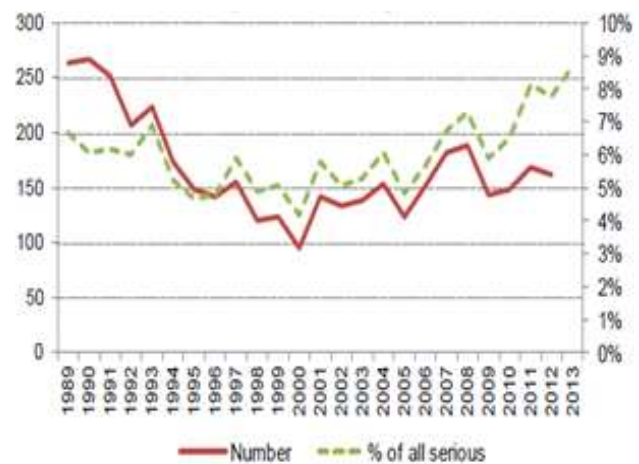


Figure 2.1 Cyclist serious injuries

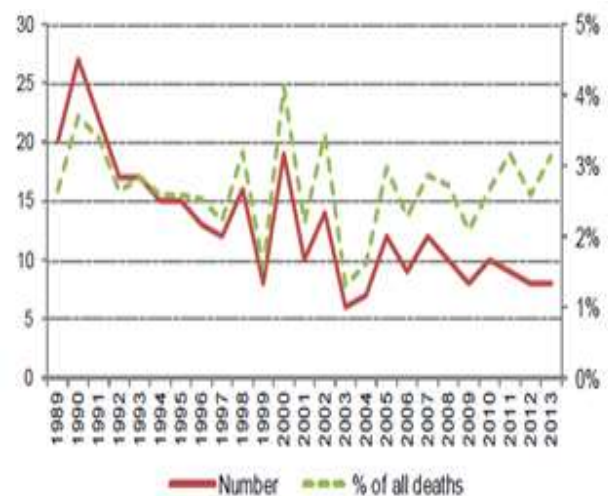


Figure 2.2 Cyclist deaths



benefits to the nation of a greater number of people cycling under safer conditions.

2.2 Safety as the key barrier to cycling uptake

Though the past decade has seen some efforts to encourage active modes of transport such as walking and cycling, and some increases have been noted in cycle commuting, other statistics show a gradual decrease in cycling participation in other areas such as younger cohorts and for transport purposes over the last two decades (Etemad, Costello, & Wilson, 2016; Koorey & Wong Wai, 2013; Ministry of Transport, 2014a; New Zealand Ministry of Transport, 2009; Tin Tin, Woodward, Thornley, & Ameratunga, 2009). There are many reasons as to why cycling in New Zealand isn't as popular as it could be, such as its perceived high level of effort, initial cost and 'outgroup' image (Smith, Wilson, & Armstrong, 2011; Wooliscroft & Ganglmair-Wooliscroft, 2014); however, the research in this area has clearly demonstrated that the most influential barrier to greater uptake is the perceived risk of being hit by a motor vehicle while cycling (Gribble & Douglas, 2014; Smith et al., 2011), particularly for new riders, children, women and the elderly (Chaurand & Delhomme, 2013; Etemad et al., 2016; Heesch, Sahlqvist, & Garrard, 2012; Pucher & Buehler, 2008). Thus, it is likely the case that a lack of actual and perceived safety may be acting as a key inhibitor of a potentially substantial cycling demand.

Acknowledging this, the New Zealand Cycling Safety Panel (as commissioned by the Transport Agency) 'Safer Journeys for people who cycle' 2014 report recognised that safety initiatives are needed that both provide for, and encourage, cycling in New Zealand. This report employed a holistic 'safe systems' approach where it was recognised that, while specific actions are required (such as providing more cycling infrastructure and reducing driving speed), a 'cultural shift' towards greater acceptance for cycling is also needed – meaning that, not only do existing objective cycling risks need to be addressed, but cycling also needs to be perceived as a safe, appealing and legitimate mode of transport.

2.3 Motorists are perceived as the greatest source of cycling risk

It is well-known among experts that the perceived risk or 'fear' of cycling is most frequently associated with shared traffic situations (where motorists and cyclists interact; Bauman et al., 2008; Chataway, Kaplan, Nielsen, & Prato, 2014; Chaurand & Delhomme, 2013; Fishman, Washington, & Haworth, 2012; Fraser & Lock, 2011; Haworth, Schramm, & Schramm, 2014; Hunt & Abraham, 2007; Nikitas, Michalakopoulos, & Wallgren, 2014). Even though most cycling-related crashes occur without the involvement of another vehicle (Ministry of Transport, 2015b), statistics show crashes involving cyclists and motorists are the most likely to result in cyclist fatalities (Australian Transport Safety Bureau, 2006; Brearton et al., 2003; Camp, Ranjbar, Uittenbogaard, Rosen, & Buijssen, 2014; Koorey, 2014; Muller et al., 2013; The Amy Gillett Foundation, 2013; Wood, 1999), which may be partly why other motorists are often perceived by cyclists as being the greatest source of threat on their safety. The extent of this perception is well illustrated by Heesch, Sahlqvist, and Garrard (2011) who found that, in a sample of 1830 Australian survey respondents, being 'passed too closely' and 'being passed too quickly' by motorists was not only seen as a source of risk but was actually perceived as the most common form of cyclist harassment (implicating an intentional disregard and disrespect of cyclist safety by motorists).

Aldred and Crosweiler (2015) examined non-injury cycling incidents in the United Kingdom (including annoying events, near misses, "very scary" events, and deliberate aggression) using online diaries which recorded 1532 diary days and 3994 recorded incidents. Incidents were found to occur more often on short trips with slower rider speeds, and factors commonly related to scary incidents included large vehicles and close passes. About three in every five near misses (59%) were related to cyclist-motorist interactions. They also translated these events into rates to give an indication of how often these types of events occurred, and found that for regular riders "very scary" events happen on a weekly basis, and deliberate aggression was experienced monthly. Due to the widespread nature of such events the authors speculate on the impact this has on cycling uptake.

These anticipated risks associated with shared traffic riding not only suppress potential demand for cycling (perceived safety), but can also have objective consequences for the safety of the rider (actual safety), with studies showing that when a cyclist feels threatened, they may engage in 'defensive' behaviours such as swerving, speed changes or greater wheel angle variations, which are notably destabilising for the cyclist (Chuang, Hsu, Lai, Doong, & Jeng, 2013). In fact, a study by Eilert-Petersson and Schelp (1997) found that some cyclists even end up falling in their attempt to avoid a collision. Therefore, alongside the objective safety risks of cycling, the presented studies reveal that addressing the perceived safety of cycling is equally important when aiming to create safe-cycling networks.

2.4 Minimum overtaking gap law

In line with the perceived risks of shared traffic riding, it is unsurprising that surveys examining how to improve cycling safety and encourage greater uptake often find that most respondents (novices and professionals alike) express a desire for more and improved cycling facilities (such as cycle paths and lanes) – a pattern found in New Zealand (Kingham, Koorey, & Taylor, 2011; Tin Tin et al., 2010) as well as internationally (Elliot Fishman, Washington, & Haworth, 2012; Forsyth & Krizek, 2010; Fraser & Lock, 2011; Heesch et al., 2012). The reason for such a preference is due to the greater separation between cyclists and motorists. While ideal on busier roads, constructing cycling infrastructure (particularly in New Zealand) is a difficult and costly task that is often not a practical option for existing transport networks. As such, alternative and complementary options are required that can help address some of the safety issues in a more cost-effective and practical manner.

One popular method for addressing cyclists' concerns of their interaction with motorists is through the introduction of a MOG law which mandates that motorists provide cyclists with a specified lateral distance (most often 3 feet or 1 metre) during overtaking manoeuvres. Figure 2.3, Figure 2.4 and Table 2.1 European countries with MOG laws in place Table 2.1 summarise which states or jurisdictions currently have such a law in place in the USA, Australia and Europe (see Appendix A for more information regarding when the legislation was passed in each location and any other details or provisions related to the rule). Though the first law of this kind was passed in Wisconsin in 1972, there has been a recent proliferation of such rules across the US, Australia and Europe, which has consequently attracted the attention of New Zealand road safety authorities.

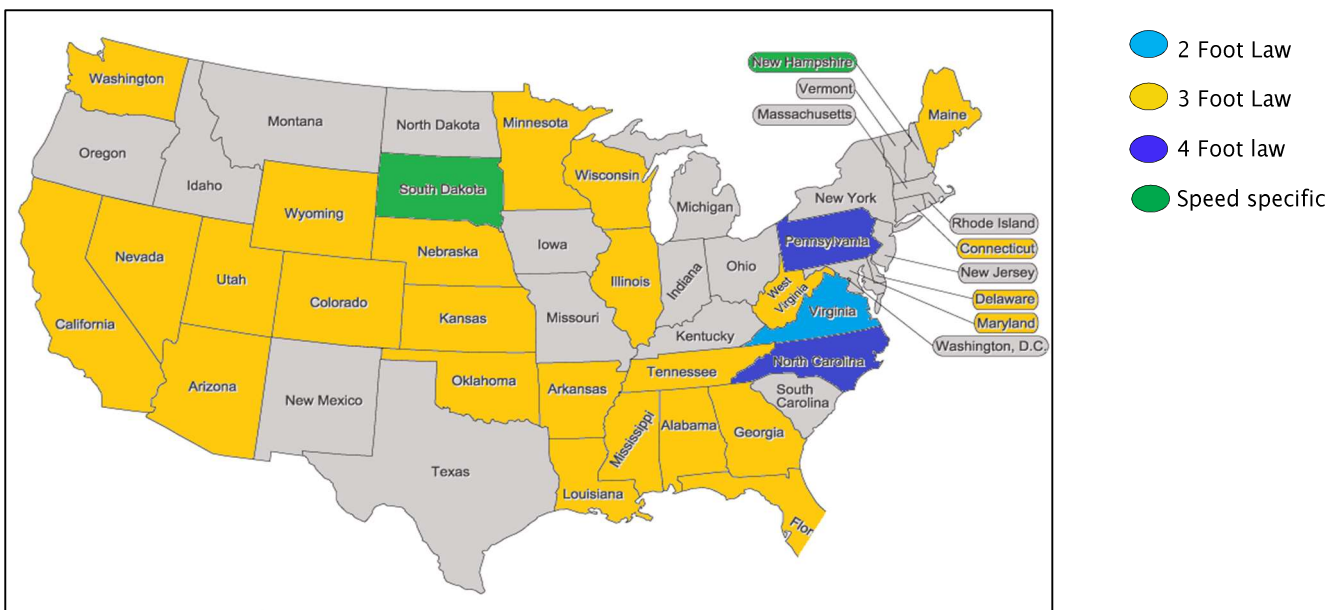
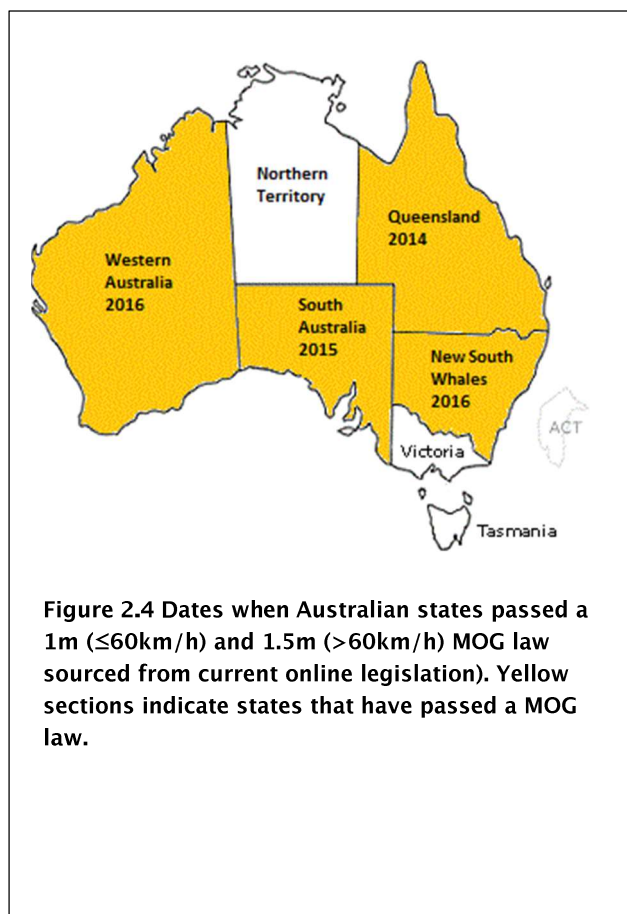


Figure 2.3 Mapping of current MOG laws in the USA (sourced from current online legislation)



In many cases, the MOG law is seen as a necessary improvement on 'safe distance' cyclist overtaking laws, which require motorists to provide a 'safe' distance during overtaking manoeuvres but do not specify the size of this distance (making them practically unenforceable: Brown, Farley, Hawkins, & Orthmeyer, 2010). To address such shortcomings, the introduction of a MOG law has been seen as a logical improvement on existing legislation as it is perceived as being able to:

- Ensure that cyclists are provided with sufficient space (enhancing both actual and perceived safety; The Amy Gillett Foundation, 2013).
- Give cyclists more legal grounds when they are endangered or hit (Brown et al., 2010).
- Act as an education and awareness tool by prompting more conversations to be had regarding cycling and its potential (Brown et al., 2010; New Zealand Cycling Safety Panel, 2014).

Alongside these more practical benefits, the introduction of a MOG law has also been seen as a step towards a more cycling friendly transport culture (Amy Gillett Foundation, 2013) – a quality that is paramount for establishing long-term safe cycling systems (Pucher & Buehler, 2008).

Table 2.1 European countries with MOG laws in place

Country	Distance	Date passed
Belgium	1 metre	1975
France	1 metre	2003
Spain	1.5 metres	2003
Portugal	1.5 metres	2014

Based on the current popularity of this rule and its perceived benefits (as well as coroner inquests into publicised cyclist deaths, such as Steve Fitzgerald and Jane Farrelly, that were caused by unsafe overtaking; Mok, 2013), the New Zealand Cycling Safety panel recommended that the current New Zealand legislation on the passing distance of cyclists by motorists be reviewed and that the introduction of a MOG law be considered for implementation in the New Zealand context.

2.5 What is the supporting evidence for MOG laws?

Despite the present attractiveness of MOG laws, the rationale behind their implementation has, in many cases, been emotionally driven where, in response to a cycle related fatality (or a personally experienced near-miss or injury), cycling advocates will push for the law under the premise that 'something has to be done to address cyclists safety' in the belief that legislating a MOG law will do just that (Brown et al., 2010). Illustrating this point, the Amy Gillett foundation (who were the key proponents of the passing of a MOG law in Queensland, Australia) explicitly outlined the profile of a number of cyclists who were killed by overtaking motorists in 2013 in a series of overtaking incidents. The document then further



states that such events call for the implementation of MOG law as it would ‘improve the safety of bicycle riders’ because it will ‘provide drivers with a clear, easily recognised measure when overtaking bicycle riders’. It can be said that, while these approaches have undoubtedly good intentions, unfortunately, in almost all reported cases, very little empirical evidence has been provided to support the claim that this rule is the most appropriate option and that it can produce the desired effects.

Given the lack of presented evidence, a comprehensive review of relevant academic literature was conducted to ascertain what is currently known about motorists overtaking cyclists and any other relevant factors influencing passing distances. Furthermore, correspondence was sought with various international road safety experts (see Table 2.2). The following sections address three fundamental questions that require empirical answers if the MOG law is to be introduced in New Zealand. Each question will be addressed by drawing from both published research and the information gathered from correspondence with overseas experts.

Table 2.2 Details of correspondence with international experts

Country	Role/Department	Law
United Kingdom	Road Safety Policy Advisor, Department of Transport	No
Hungary	Research Professor, Deputy Head of Centre for Road Safety	No
Austria	Austrian Road Safety Board Member	No
South Australia	Principal Advisor, Road Safety – Land Transport Safety Branch	Yes
Australian Capital Territory	Road Safety Manager, Legislation, Policy and Programs - ACT government	Yes
Georgia	Executive Director – Georgia Bikes	Yes
Oklahoma	Oklahoma Bicycle and Pedestrian Coordinator	Yes
Florida	Florida Bicycle and Pedestrian Coordinator	Yes
New Hampshire	Intermodal Facilities Engineer, Rail and Transit Bureau	Yes
Pennsylvania	Pennsylvania Bicycle and Pedestrian Coordinator	Yes
Nebraska	Nebraska Bicycle and Pedestrian Coordinator	Yes
Tennessee	Tennessee Pedestrian and Bicycle Coordinator	Yes

2.5.1 Why 3 feet/1 metre?

Across the existing documented reports (Brown et al., 2010; The Amy Gillett Foundation, 2013) and the correspondence with experts, very little empirical evidence has been provided to justify why the specific distance (most commonly 3 feet/1 metre), was deemed the most appropriate (and safe) distance. Indeed, Haworth and Schramm (2014) conclude from their comprehensive overview of overtaking distance research that “*there is no clear assessment whether, or under what circumstances, one metre is a safe passing distance.*” Likewise, critics of the MOG law highlight that “3 feet is not a magic number”, and that, while some rationale is given that such a distance is chosen as it allows a cyclist to safely signal when operating a bicycle, there is very little empirical support behind why the specific distances in each case were selected (Brown et al., 2010). Despite these caveats, there is nevertheless a body of cycling safety related research that can shed some light on the relationship between overtaking distances and cyclist safety.

2.5.1.1 Objective safety

The objective or 'actual' risk associated with motorists overtaking cyclists has largely been assessed by proxy of the rates of injuries and fatalities caused by motorist-cyclist collisions (Brown et al., 2010; The Amy Gillett Foundation, 2013). As already mentioned, statistics have shown that crashes which involve a motorist-cyclist interaction are the most likely to result in cyclist fatalities – a finding that is frequently used as a measure of objective cycling risk in the absence of adequate crash and exposure data. In addition, some researchers have employed probabilistic methods by assessing how the common space occupancy (i.e., the chance that the motorist and cyclist will traverse the same space at the same time). Other work monitors actual available physical space, more specifically variation in road shoulder width to examine safety (e.g. Trotter et al., 2015). Trotter, et al. (2015) also cite work by the Transport Agency that shows that there is a negative relationship between crashes (serious and fatal) and shoulder width on low volume New Zealand roads.

Another proxy indicator of safety is the aerodynamic effect caused by a combination of vehicle size and travel speed (i.e., the lateral 'pull' force of the passing air) contribute to collision risk. An example of this is Khan and Langlois's (2011) work, which found that smaller overtaking distances and greater aerodynamic effects are predicted to result in greater risk. Common estimates suggest that a distance of 1 metre in 50km/h zones (FHWA) are required to sufficiently mitigate risk (with greater distances required for greater speeds). Though useful as estimates, these methods have predominately been calculated for heavy vehicles and no specific 'cut off' distance is mentioned as a 'safe' distance for motorists overtaking cyclists more generally.

In a study that crosses over between perceived and actual risk, Sanders (2015) examined the ratio of self-reported near misses to actual hits across a range of common crash types, and found a ratio of 32 near misses to every collision for crashes specifically related to overtaking gaps fewer than 3 feet. However, this still relies on self-report and perceived assessments of gaps. Altogether, it appears that accurate assessment of the objective risk associated with motorists overtaking cyclists necessitates more long term evaluations of injury and crash statistics (potentially by comparing these over time pre and post-implementation of a MOG law in a given context).

2.5.1.2 Perceived safety

Research has also examined the perceived safety or 'comfort' of cyclists and its relationship to the distance given by overtaking motorists. Most importantly, studies show that cyclists prefer to have a buffer space between them and motor vehicles (such as roads with separated bike paths or lanes), and to ride among lower and slower traffic volumes and in wider roads (Antonakos, 1994; Sorton & Walsh, 1994; Tin Tin et al., 2010). This pattern of results is mirrored in a study by Haworth et al., (2014), which revealed that, following the introduction of a MOG law, 80% of cyclists and non-cyclists from their sample agreed that motorists should have to provide at least 1m (<60km/h) and 1.5m (>60km/h) when overtaking⁴. It is important to note, however, that research of this kind has been almost exclusively conducted using planning calculations, self-report measures (surveys) or 'post-hoc' analyses (where video footage of passing events is captured and played back to participants who then rate the level of safety or risk when examining specific passing manoeuvres). Due to the estimation error in calculations, and the biases of self-report measures (which are exaggerated

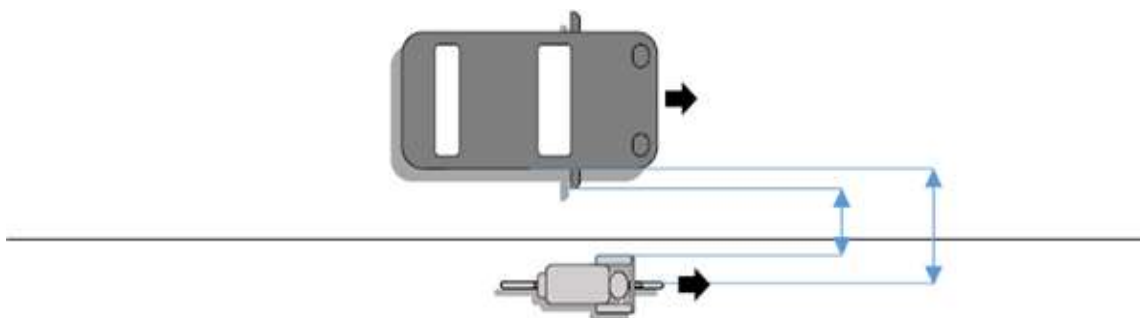


Figure 2.5 Passing clearance and lateral distance (Llorca et al., 2014)

⁴ N = 758.

with larger time lapses), the current methods for assessing perceived risk are limited in their ability to accurately determine a specific distance at which cyclists would feel safe during riding.

To date, the most precise study capturing perceived safety of MOG distances was presented by Llorca and colleagues (Llorca, Angel_domenech, Agustin-Gomez, Ferrer, & Garcia, 2015). The methodology of this study was unique in that, using a single cyclist on an instrumented bike, the researchers measured the passing clearance (the space separating the outermost components of both vehicles), lateral distance (the separation between the central bodies of both vehicles) and speed (Figure 2.5) of passing vehicles; and how these factors were related to perceived risk (by giving the cyclist a short interview after each passing event).

This approach allowed for the examination of not only how the 'closeness' of passing vehicles affected perceived risk but also the influence of 'aerodynamic forces' that were created as a function of the vehicle size and speed. Their results suggest that perceived risk is a function of not only distance, but also the speed and size of the vehicle. The findings from this study implicated that a separation of 1.5m was insufficient at speeds greater than 120km/h (particularly for larger vehicle types) due to the pull of the aerodynamic forces, and recommended distances of 1.5m for speeds below 50km and up to 2.75m for speeds over 120km/h (see Figure 2.6). Though necessitating replication, this study provides preliminary distances and speeds for tolerable levels of perceived risk.

A similar study of this kind by Etemad et al (in progress) is currently underway in New Zealand, which is aiming to capture the relationship between the levels of perceived risk of cyclists and various environmental factors during their commutes (using instrumented bike technology). Of particular relevance, this study will get their participants to 'rate their routes' through short interviews and note any midblock or intersection conflicts (i.e., interactions between a bicycle and motor vehicle, pedestrian or other bicycle such that at least one of the parties had to change speed or direction to avoid the other). The findings from this study may help further our understanding of the relationship between perceived cyclist safety and motorist overtaking distances, particularly in the New Zealand context.

2.5.1.3 Conclusion

Overall, no one specific distance has been found to be the cut-off point for tolerable levels of actual or perceived safety for cyclists when being overtaken by motorists. The current investigation therefore sought to overcome the limitations of the existing research. First, methods other than planning calculations or self-reports were used (i.e., real-time assessments of risk through instrumented bike technology) as this greatly enhances the precision and accuracy of collected distance and speed data and their relationship to perceived risk. Second, a greater number and variety of participants were used given that research has shown that the distance perceived as 'safe' varies according to the level of experience of the rider (with more experienced riders requiring less space; Chaurand & Delhomme, 2013; Haworth et al., 2014; Hunt & Abraham, 2007; O'conner & Brown, 2010). Last, not much is known regarding cyclists' ability to judge lateral distances (Haworth & Schramm, 2014), which may influence how they feel and behave during passing manoeuvres. This however goes beyond the scope of the current investigation and so future studies should be considered to examine this factor directly.

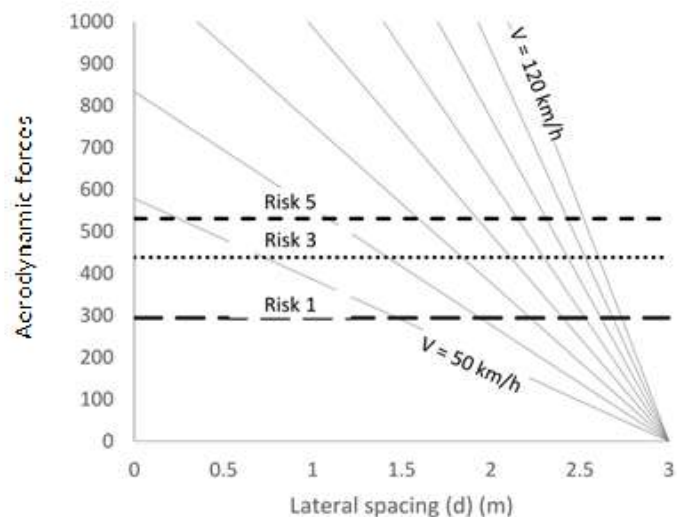


Figure 2.6 Relationship between lateral distance, speed and perceived safety, where the risk 1 denotes an 'acceptable level of risk' and the (Llorca et al., 2014)



2.5.2 How much space do motorists give cyclists already?

It is frequently implied that the primary purpose of a MOG law is to ensure that cyclists are given 'sufficient' space during overtaking manoeuvres (Brown et al., 2010; The Amy Gillett Foundation, 2013) - a rationale that also implies that motorists do readily provide sufficient space and that sufficient space is greater than 3 feet/ 1 metre. However, there are virtually no baseline measures available of the amount of space given by motorists to cyclists in a given area prior to the implementation of a MOG law. Despite this lack of empirical evidence supporting the passing of legislation, there are a number of academic studies that provide some information regarding the distances given to cyclists by motorists during overtaking manoeuvres.

2.5.2.1 Average MOG distances and levels of non-compliance

Table 2.3 summarises the average distances given by motorists overtaking cyclists (as well as the percentage of passes that would be classified as 'unsafe' under the assumption that 3 feet/1 metre is a safe distance) as reported in a number of studies.⁵ It is interesting to note that almost all of the average passing distances exceed 1 metre or 3 feet and that the level of non-compliance and number of unsafe passing manoeuvres vary considerably across different studies, locations, sites, speeds, infrastructure facilities and rider behaviours.

Table 2.3 Average overtaking distances and percentages of unsafe passes

Location	Article	Average passing distances ⁶	Percentage of close passes
Brisbane (Law)	Schramm & Watson, (2016)	2.20m (before MOG law) 2.54m (after MOG law)	0% to 50%+ below 1 and 1.5 m depending on the specific road and speed limit
Canada (Law)	Mehta, Mehran, & Hellinga, (2015)	1.34m (2 Lane – no cycle lane) 1.53m (2 Lane – cycle lane) 2.91m (4 lane – cycle lane) 2.83m (4 lane – no cycle lane)	12% below 1m
Florida (No law at time of study)	Harkey & Stewart, (1997)	1.83m (wide curb lanes) 1.98m (paved shoulders) 1.80m (bicycle lanes)	-
Maryland (Law)	Love et al., (2012)	1.46m (3m lane) 1.52m (3.33m lane) 1.76m (3.37m lane)	16% below 1m
New Zealand	Trotter et al., (2015)	2.12m (rural roads over 60km/h)	18% below 1.5m (speed above 60km/h)
Spain (Law)	Llorca et al., (2014)	-	9% below 1.5m
Taiwan (No law)	Chuang et al., (2013)	1.52m (motorcycle) 1.68m (car) 1.71m (small truck) 1.5m (bus) 1.72m (large truck)	16% below 1m
UK (No law)	Parkin & Meyers, (2010)	1.13m (with cycle lane) 1.69m (without cycle lane) 1.6m (20 mph) 1.7m (30mph)	-

⁵ As these studies were focussed on safety and compliance in relation to a specific threshold they focussed only on reporting close passes at these distances (instead of looking at even closer distances).

⁶ All measurements were means with the exception of the Brisbane case that used a median as their measure of central tendency.

Location	Article	Average passing distances ⁶	Percentage of close passes
UK (No law)	Walker, Garrard, & Jowitt, (2014)	1.75m	24% to 43% below 1m (depending on site)
Wisconsin (Law)	Chapman & Noyce, (2012)	1.95m (cycle lane) 1.92m (no cycle lane)	0.5% below 3 feet

2.5.2.2 Factors influencing passing distances of motorists overtaking cyclists

Potentially the most consistent finding across the studies mentioned is that the specific overtaking distance given by a motorist to a cyclist is influenced by a variety of factors (see Table 2.4 for a summary). Firstly, McHale and Stewart, (2014) suggest that motorists tend to give a 'relative' amount of distance depending on the absolute lane width of the road, with smaller road widths resulting in smaller passing distances (at speeds of 80km/h or below). In accordance with such findings, other studies have shown that other factors that reduce the amount of overall available space (such as the presence of oncoming traffic, large vehicles, the cyclists distance from the kerb, high traffic volume) are associated with smaller overtaking distances (Dozza, Schindler, Bianchi-Piccinini, & Karlsson, 2016; Harkey & Stewart, 1997; Kay, Savolainen, Gates, & Datta, 2014; Carlos Llorca et al., 2014; Mehta, Mehran, & Hellinga, 2015; Parkin & Meyers, 2010; Shackel & Parkin, 2014; Walker, 2007).

This body of research suggests that motorists (using a variety of vehicle types) are providing cyclists as much space as they can and/or is convenient, given the space provisions. Aside from space, some studies have found that speed also influences passing distances. In many cases, greater speeds tend to be associated with greater passing distances – relative to that of lesser speeds (Schramm et al., 2016). Some personal demographic characteristics have also been found to influence the amount of space cyclists are given by overtaking motorists such as gender and riding behaviour, (i.e., female riders and inexperienced appearing riders tend to be given more space; Chuang et al., 2013).⁷ Interestingly, a study by Walker (2007) found that cyclists were not given more room when further from the curb, questioning the belief that 'owning the lane' ensures that the cyclist is given more room by the overtaking vehicle.

Table 2.4 Summary of factors that influence the overtaking distance given by motorists to cyclists

Factor	Effect
Vehicle type	Larger vehicles tend to give less distance
Speed	Motorists tend to give more space in higher speeds
Road surface condition	Smaller passing distances in poor conditions
Physical Lane separation	Smaller passing distances without lane separation
Gender	Smaller passing distances for males
Cyclist behaviour	Less variation/higher speed/smaller wheel angle/ further from road edge – smaller passing distance
Lane width	Smaller passing distances with narrower roads
Oncoming traffic	Smaller passing distances with the presence of oncoming traffic
Painted Cycle lanes	Mixed results: cycle lanes are associated with smaller and greater passing distances (varies across studies)

⁷Earlier research by Walker, (2007) suggested that certain clothing types resulted in particular passing distances, with those not wearing helmets, dressed as women and wearing high visibility clothing tended to be given more space. However, a recent (and more comprehensive) study by Walker, Garrard, & Jowitt, (2014) found that the only clothing type that produced significantly different passing distances were high visibility police officer uniforms (with no difference of passing distances found between commute, racer, novice, casual or high visibility clothing types). Given that the scope of this research focuses on 'the majority,' the influence (or lack of) clothing is not considered relevant for this context.



2.5.2.3 Summary

Given the uncertainty and variability of passing distances, one critique of the MOG law has been that the lack of adequate baseline measures means that it is not known what effect the law would have on driving behaviours (particularly in specific contexts). In fact, there is a possibility that the law may actually 'decrease' the amount of space that cyclists are given by motorists during overtaking manoeuvres as, some critics of the MOG law suggest that it may lead drivers that previously gave ample room may 'only' give 3 feet/1 metre as this is identified as the 'safe distance,' highlighting the need for well-selected distances and effective education campaigns.

Overall, it seems that motorists consider a wide range of factors when judging and deciding how much distance to give cyclists when overtaking, and therefore, these factors must be taken into consideration when assessing this phenomenon. More baseline measures are needed that assess the space given in a variety of contexts (using instrumented bicycle technology such as in Dozza & Fernandez, 2014; Dozza et al., 2016) and how this relates to cyclists' perceived and actual safety. Only then will it be possible to clearly determine the degree of the problem and whether a MOG law is the best way to address it.

2.5.3 Does the law work?

Due to the general lack of baseline measures of motorists overtaking cyclists (as well as the unclear specification of what a safe distance is), it is still relatively uncertain how effective MOG laws are for improving driving behaviour, safety perception and actual safety (i.e., the rate of cycling related crashes related to the overtaking manoeuvres of motorists). This gap in supporting evidence was highlighted by our Florida correspondent who stated that *"The three-foot law was never tested and, to my knowledge, has never been evaluated. It was simply implemented by fiat from the legislature and we've all been dealing with it ever since."* Nonetheless, two studies (conducted in Baltimore, Maryland and in Queensland, Australia) have made concerted efforts to evaluate the MOG law in their respective locations.

2.5.3.1 Baltimore, Maryland

A 3-foot minimum passing distance law was passed in Baltimore, Maryland in 2010 under the premise that motorised vehicle passing can be intimidating for cyclists and close passes are physically destabilising. Following this, Love and colleagues (2012) conducted an evaluation in 2011 to assess the efficacy of the law. Unfortunately, however, as no baseline measures of passing distances were taken prior to the law's implementation, only cross-sectional 'snap shot' levels of non-compliance were captured.

The specific methodology of this study entailed the video-recording of 586 vehicle passes using a video-capturing device mounted to the back of a hybrid bicycle. A total of five cyclists (four male, one female) participated in this study during their morning and evening commutes. The results from this study revealed an average rate of non-compliance of 16%, with slight variations depending on whether the cyclists were in a standard lane (17% passes unsafe) as compared to a shared cyclist-motorist lane (23% passes unsafe) and cycle lanes (0% passes unsafe). Figure 2.7 and Figure 2.8 give visual examples of a 3-foot pass as compared to a 5-foot pass captured by the study's equipment.



Figure 2.7 Example video capture of a 5-foot pass (Love et al., 2012)

Using linear modelling, the researchers found that lane width, bicycle infrastructure, and street identity were all significant influencing factors on the degree of space given by motorists to the study participants (cyclists). Consistent with some previous research, their results showed that greater lane width and the presence of cycle lanes were associated with greater passing distances. Regarding the effects of street identity, it was found that the degree of non-compliance varied significantly from street to street, with the highest level reaching 28% (9 out of 32 passes).



Figure 2.8 Example video capture of a 3-foot pass (Love et al., 2012)

While this research has set a good precedent for the need to evaluate passing distances (and the potential influencing factors), the authors of this study do acknowledge that the study can only act as a baseline measure in of itself as it was not known what proportion of passes fell below 3-feet prior to the introduction of the law. Furthermore, no assessments of perceived safety of cyclists (by drivers or cyclists) were taken, and therefore it is unknown whether the law (and any related education efforts) had any attitudinal or perceptive effects (e.g., drivers being more aware of cyclists) in addition to any objective behavioural changes.

2.5.3.2 Queensland, Australia

Queensland was the first Australian state to implement a MOG law, which stipulated that overtaking vehicles must give cyclists a minimum of 1m at the posted speed limits of 60km/h or below and 1.5m at speeds exceeding 60km/h. Because of the novelty of this law in Australia at the time, the MOG law was introduced under a two-year trial period that commenced in April 2014. Upon the completion of this trial, CARRS-Q assessed the effectiveness of the law regarding its:

- 1 practical implementation;
- 2 impact on road users' attitudes and perceptions; and,
- 3 impact on road safety (Schramm et al., 2016).

To achieve these aims, the assessment included interviews with police officers across the Queensland region (N = 21); a survey of cyclists (N = 3013) and motorists (N = 4332); an observational study looking at motorist passing distance behaviours; and an injury and crash analysis. It is important to acknowledge, however, that although efforts were made to capture baseline passing distances before and after the implementation of the MOG law, technical and data collection difficulties made this assessment unachievable.⁸ Furthermore, no baseline measures of road user perceptions and attitudes were taken⁹ – thus, the following findings reflect people's perceptions of change (rather than representing objective measures of change).

Drawing across all of the components of the CARRS-Q research, in general, the MOG law was perceived as having made some improvements to driver behaviour, and consequently to cyclist actual and perceived safety. More specifically, survey results revealed that 25% of cyclists and drivers reported that drivers gave 'a lot more space' than they used to when overtaking cyclists; while 50% of cyclists and 40% of drivers indicated that drivers gave a 'little more space.' Similarly, 73.2% of cyclists and 59.5% of motorists agreed or strongly agreed that they have observed motorists giving bicycle riders more room than they used to. This perception was mirrored in the police interviews where the police

⁸ The study used road-side video recording devices to catch passing distances. However, many of the images were obscured due to other vehicles, obstacles and other obstructions, and consequently, the data on the whole was not deemed suitable for analyses. Data from one site was appropriate for analyses, however, this road had a relatively wide carriageway and found no passing manoeuvres below 1m before or after the law (hence, no notable differences were found).

⁹ Attempts were made to compare the self-reported attitudes and perceptions towards the MOG law from previous surveys. However, differences in sample size and type made comparisons too difficult and so the authors conclude that future examinations are needed for reliable before and after self-reported results.



officers agreed that the law (despite enforcement challenges, described further in Section 2.6.1) had improved cyclists' safety on the road. Lastly, some preliminary estimates (using police crash reports) suggest that there may have been a decrease in cyclist-related crashes during the trial period (though, more robust assessments using crash statistics and hospital admissions were not possible due to the small sample of related incidences in the two-year time span and thus the results should be interpreted as suggestive only).

Despite these encouraging results, the findings also suggest that the MOG law has not been entirely effective for, or equally accepted by, all road users (particularly motorists). Indeed, the survey results show that only 33.6% of the respondents thought that the rule would make it safer for cyclists and, while 95% of cyclists supported the new law, only 52.5% of drivers did (30% of drivers indicating that they now had more empathy for cyclists and 23% saying that they were annoyed at having to give cyclists so much clearance). These perspectives were also reflected in reported rates of non-compliance, where, on roads with speed limits of 60km/h, 25.3% of cyclists and 36% of drivers reported that drivers failed to comply with the MOG law 'most of the time' or 'almost always,' with similar findings regarding non-compliance on higher speed roads over 60km/h (25.1% cyclists and 32.2% drivers). Although it is entirely possible that these findings reflect a genuine inefficacy of the MOG law to produce behaviour change, the study also suggests that this pattern may be in part due to common challenges associated with MOG laws, such as the difficulty in enforcement and education and awareness raising efforts; and difficulty for some road users to accurately judge 1 or 1.5 metres.

2.6 Challenges associated with MOG laws

Echoing the sentiments from the CARRS-Q survey participants and police officers, the international documentation as well as correspondence with international experts revealed three common challenges with the introduction of a MOG law. Each of these challenges are discussed in more detail in the following sections.

2.6.1 Enforcement

Adequate enforcement is the most commonly raised challenge associated with the MOG law (in both official documents as well as among our correspondents). This perception stems from the fact that enforcing a MOG law not only requires the police officer to judge the specific distance in question, but also requires the officer to attain evidence that justifies a potential breach (in the instance that the infringement is taken to court). Thus, another reason for the dissatisfaction that some from the CARRS-Q survey had with the MOG law relates to the difficulty in enforcement – with 80% of cyclists and 50% drivers reporting that they felt that the MOG road rule was being enforced 'not much' or 'not at all.' Such views were resonated in the police officer interviews where enforcement was identified as the greatest challenge associated with the MOG law. Difficulty in acquiring sufficient evidence was cited as the main reason why enforcement proved to be so challenging, and most officers were reluctant to issue infringements based on these grounds (only three of the 21 officers had given MOG citations in the past two years). However, these sorts of issues are overcome in other existing laws, such as following distance laws (Land Transport Road User Amendment Rule, 2005), which require complex judgements to be made (in terms in determining accurate distances between moving vehicles across multiple speed criteria). In recent discussions on enforceability in Australia, there are suggestions that difficult to enforce rules are still effective in that they can act as a deterrent as well as a penalty (Parliament of Victoria, 2016). More specifically, that they can 1) encourage a shift in behaviour for those that are rule-compliant, and 2) still provide a mechanism to allow enforcement for those events where there is a clear violation (i.e. a breach of the rule by 0.5m as opposed to 0.1m; Parliament of Victoria, 2016).

Nearly all of our correspondents (both those who have and have not implemented the rule have) mentioned that the law is very difficult or not suitable for enforcement, with a number of sources indicating that the law is generally only enforced in response to a collision, complaint or as a secondary violation. According to our Tennessee correspondent, the most innovative MOG law enforcement method to date was developed by a City of Chattanooga police official who reportedly used an instrumented bicycle (called the BSMART) to issue infringements (see Figure 2.9 for a picture of said bicycle). Though this technique only captures passes that are less than 3-feet from the riding police officer (and not from other

riders) and no formal documentation or evaluation of this enforcement method has been released to date, the technology is rapidly advancing and is awaiting assessment in a variety of places (Laker, 2016; Turner, 2016)¹⁰.

On the whole, difficulty in MOG law enforcement has resulted in two overarching perspectives. On the one hand, the impracticality of enforcement (and lack of supporting research of its effectiveness) has deterred some from supporting its implementation. Our Florida correspondent reports that, due to enforcement issues, their police officers have suggested a 'move over' law that would require the motorist to simply move into another lane when overtaking a cyclist (akin to more standard motor vehicle overtaking laws). This correspondent further critiques the premise (and lack of supporting evidence) of the law and states that *"the three foot clear law, while hailed by many as a victory, may really be a hollow victory because of its unenforceability."*



Figure 2.9 BSMART instrumented bike used to enforce rule in Tennessee (Healey, 2015)

Contrasting with this view, other officials see enforcement as a secondary purpose to the MOG law, and actually perceive it as primarily an 'education and awareness raising' tool, rather than a method of penalising close passes (Australian Department of Planning Transport and Infrastructure., 2012; Brown et al., 2010). The aforementioned article regarding the City of Chattanooga instrumented bike reflected such a perspective, where the officer reportedly used each pull-over situation as an opportunity to educate the driver regarding the law and would not issue a citation if the motorist appeared to be genuinely interested in (and unaware of) the MOG law in that state. Similar educational approaches could be employed with more traditional enforcement options where police officers make a judgement call on the passing distance and subsequently follow up with a warning to the motorist.

In summary, enforceability of MOG laws remains a challenge, especially given the difficulty in acquiring sufficient evidence to support infringements. In saying that however, even if not always easy to enforce, it does appear to be the case that the MOG law is seen as acting as a catalyst for engaging in conversations about cyclist safety and consequently raising motorist awareness of their behaviours during overtaking manoeuvres (which may be an integral part of reducing cycling crash statistics in the future).

2.6.2 Education and awareness

2.6.2.1 Education/awareness campaigns specifically relating to the introduction of a MOG law

Sufficient and effective education and awareness raising campaigns have been mentioned as being one of the most important factors (and challenges) associated with the implementation of a MOG law (Brown et al., 2010; Schramm et al., 2016; The Amy Gillett Foundation, 2013). In almost all cases, some form of education or dissemination of information regarding the law complemented its introduction. The type and scope of such campaigns, however, varies considerably across locations. In some cases, information about the law was widely disseminated using a variety of communication methods (such as billboards, posters, stickers, t-shirts and public announcements), with our New Hampshire correspondent saying that applicants for drivers licences in New Hampshire are now includes test material on the 3-foot law (alongside other bicycle related statutes).

¹⁰ Similar approaches have been employed in Canada and the UK where instrumented bike technology is used to educate rather than punish non-compliant drivers.

In other cases, however, information about the law is primarily distributed to enforcement authorities, whether that be explicitly through letters and workshops, or more indirectly by integrating information about the law into established training sessions, manuals and guidelines (see Brown et al., 2010). There also appears to be a great deal of variation regarding the degree to which MOG laws are incorporated into the wider transport systems. For instance, in New Hampshire and Tennessee, specific ‘3-foot’ signs were created (see Figure 2.10) though the signs were later determined to be non-compliant with highway guidelines and subsequently removed. Similar signage has been implemented elsewhere, particularly in Australia with the now relatively well known ‘a metre matters’ movement and accompanying signs (see Figure 2.11)¹¹. Similar signage was used by Trotter et al., (2015) in the investigation of motorist overtaking behaviour on rural roads in Waipa, New Zealand.



Figure 2.10 Temporary 3-foot sign in New Hampshire (received from New Hampshire Correspondent)

Other areas have made little to no specific efforts to erect relevant signage or markings related to the law (e.g., Nebraska and Florida). Such inaction may be in part due to the law being a low priority for relevant officials, as described by our Georgia correspondent who stated that “Based on the levels of investment in awareness campaigns from state highway safety officials thus far, the 3’ law is a low priority for state leaders.” Alternatively, it may be the case that some are reluctant to invest in signage due to the lack of supporting evidence for their effectiveness.

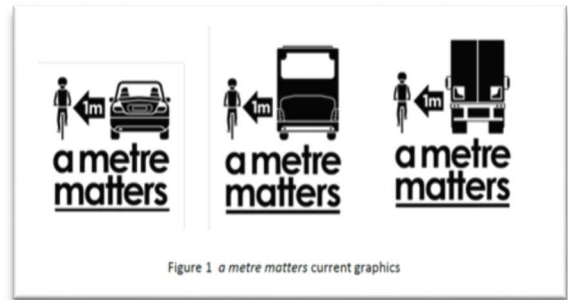


Figure 2.11 Example signs relating to the 1m law gap campaign (The Amy Gillett Foundation, 2013)



Figure 2.12. Sign used in study by Kay et al., (2014)

Indeed, our Tennessee correspondent stated that “I keep getting requests for 3’ foot signage as is attached, but I have no data to back up whether or not these signs actually work and driver compliance increases.” A study by Kay et al and colleagues (2014) in Michigan provides some support for this scepticism as their results indicate that the introduction of warning signs with supplementary ‘share the road’ plates (see Figure 2.12) did not significantly increase overtaking distances (though no specific MOG law was in place in Michigan that specified a particular overtaking gap distance).

It is unfortunately the case that, as these laws have generally not been evaluated, the effects of any complementary education and awareness raising campaigns on road user behaviour are still unknown. However, the evaluation of Queensland education and awareness campaign that accompanied the MOG law roll out presents useful information regarding people’s perceptions of and attitudes towards the campaign at different stages of its implementation. Furthermore, linkages can be made between the education efforts and some of the results from the CARRS-Q evaluation of the MOG law – bringing insight into the effectiveness of these campaigns. The following

sections outline this process and any relevant findings.

¹¹ Note that development and distribution of these signs predate the introduction of a MOG law.



Queensland, Australia: General Road Safety Perception Survey

From 24 February to 24 April 2014 (Footprints Market Research, 2014), the Department of Transport and Main Roads/BCM formed a community panel (N = 100) of everyday Queensland drivers to better understand risky driving behaviours in an effort to develop more effective interventions and education campaigns to encourage positive (safer) behaviours (using both qualitative and quantitative methods). While this study assessed a broad range of driving related attitudes, a particularly relevant finding is that most of the panel members felt that all road users have a responsibility to 'share the road' and be considerate to one another. Furthermore, 'ensuring safe distances' was mentioned as one of the key components of achieving this goal. When asked how aware participants were of the new MOG law (which was implemented earlier that year), 59% responded that they had seen or heard advertising regarding the law. Table 2.5 presents the sources by which participants gained this information.

Table 2.5 Sources by which participants were exposed to MOG advertisement

Advertising seen/heard	n=58
TV	18%
In the newspaper	15%
Radio	15%
Online advertising	9%
Social media	7%
On buses	5%
Digital billboards	3%
I haven't seen this advertising	41%

Importantly, 41% of the participants¹² indicated that the advertisement had made them want to change their behaviour when driving around cyclists. This was coupled with 97% of respondents indicating that the advertisement was clear and that they understood the premise of the law.

Introduction of MOG law: Education campaign roll out and evaluation

Following consultation with the community panel, a specific MOG campaign was launched that aimed to communicate changes to legislation that resulted from the Queensland Parliamentary Committee inquiry into cycling issues (Document sent from Queensland Correspondent, 2014). The key message of this campaign was to raise awareness of the new MOG law ("New rules for getting along") as well as to educate people around what this practicality would entail ("Stay wider of the rider"). To assist with the spread of the campaign, a social change strategy was employed that aimed to engage community participation.

Information was disseminated through a range of media outlets (including radio, outdoor activities, cycling events, digital billboards, bus and taxi backs, animated infographics, online surveys, digital advertising, press, social media, the TMR website and TMR volunteer efforts). Additionally, cooperation was sought with key stakeholders such as bicycle Queensland, Queensland police service and the RACQ (an Australian Motoring and Travel service).

Subsequently, a market research evaluation of this campaign was conducted that ran between the 5-12 November, 2014, which surveyed 500 Queensland drivers on their perceptions and attitudes towards the law and the accompanying campaign (Research, 2014). Relevant findings from this evaluation include:

- 14% of respondents indicated that they sometimes or often do not allow adequate space or show courtesy to cyclists

¹² The report does not specify whether this is 41 % of all the participants or only from the ones who had seen the advertisement prior to the study.



- Regarding the most recent adverts, recall was predominately related to cyclist safety (67%)
- Majority of the information was transmitted via television, followed by billboards and radio
- 80% of respondents agreed with the statement “I am more aware of the distance cyclists need from other vehicles to be safe” and 72% agreed with the statement “I am more aware and positive about sharing the road with cyclists”
- 73% of Queensland drivers were aware of the rule and 80% reported having changed their behaviour since the introduction of the rule.

Relationship between education campaign roll out and 2015 MOG law evaluation

Using the results from the 2015 CARRS-Q evaluation, important linkages can be made between education and awareness campaign and levels of awareness and knowledge of both passing distance safety as well as the MOG law in Queensland. Specifically, the results from the evaluation report showed that people were generally aware of the law and its basic premise (98.5% cyclists and 96.8% of motorists). Thus, the introduction of an official MOG law appears to have been effective for increasing awareness regarding this issue. However, public correspondence with CARRS-Q also revealed some common misunderstandings regarding the law (such as how the road rule would apply in different conditions such as parked cars and the presence of debris). What is more, the study revealed that a number of participants (both cyclists and motorists) were not aware of many existing road rules regarding cyclists. The combination of these results suggests that, while levels of awareness were high, more effective education and awareness raising efforts are warranted that not only inform people of the MOG law but also to educate them about cyclist safety more generally and the various policies in place to help protect them.

Supporting this claim, Pucher and Buehler, (2008) highlight that one of the most fundamental components of having a successful cycling culture (as is the case in Denmark, Germany and the Netherlands) is the provision of cycling safety education and training for both the cyclists (who are taught safe cycling behaviours and rules at a young age) and motorists, who are frequently reminded of cyclist vulnerability and the need to be aware of their presence on the road. Interestingly, the authors emphasise that these education initiatives are particularly effective when coupled with strict enforcement of all cyclist related road rules (for both cyclists and motorists), which reinforces to road users the need to take responsibility for ensuring the safety of their roads.

Thus, the CARRS-Q report provides valuable preliminary evidence regarding the perceptive and self-reported behaviour changes that can result from a MOG related education and awareness raising campaign (see Queensland Government 2014 for a summary of the Queensland education campaigns and evaluations). However, further and more rigorous investigations are needed to assess the efficacy of education campaigns (as well as any associated signage and road marking efforts) regarding objective road user behaviour changes as well as attitudinal/perceptive changes).

2.6.2.2 Education/awareness campaigns and efforts focusing on improving how motorists overtake cyclists or ‘share the road’ campaigns

As no evaluations are available on the effectiveness of education/awareness campaigns regarding the introduction of a MOG law specifically (aside from the Queensland case); a review was conducted on the effectiveness of education/awareness campaigns and initiatives aimed at improving road user behaviour more generally. Particular attention was paid to ‘share the road’ campaigns, which aim to encourage better road user interactions (including motorist and cyclists). This review allowed for an assessment of how effective educative initiatives alone may help improve cyclist safety on this issue.

Numerous education campaigns have been implemented in an effort to help raise awareness of the road safety needs of all road users (including motorists, pedestrians and cyclists) and to encourage safer road-user behaviours. Baglo, Habib, & Peterlin, (2013) work is particularly instrumental in this case, where the investigators conducted a comprehensive review of various Canadian, American, New Zealand and Australian road safety campaigns and extracted the key factors that were associated with the more effective campaigns. While this review revealed that there are a variety of approaches to road safety campaigning, the authors point out that, unfortunately, few of the reviewed jurisdictions had

established goals, objectives or evaluation criteria prior to the implementation of a campaign. Following this, few municipalities reported having undertaken evaluations of said campaigns – with only three out of 12 counties having conducted an evaluation of the campaign’s success. Table 2.6 presents the three campaigns that were evaluated.

Looking across these evaluations, it can be noted that the campaign’s effectiveness was largely measured by memorability (i.e., how many, and how easily, people recalled information regarding the campaign) and self-reported knowledge of and support for the premise of the campaign. The exception to this was the City of Edmonton ‘Heads up’ campaign that compared pedestrian collisions before and after the introduction of the campaign and found a 6% reduction in reported collisions (exceeding its 5% target).

A similar pattern regarding campaigns and their evaluations can be found in 2013 Seattle’s bicycle master plan white paper, which focuses on road user behaviour change campaigns (10 of which were related to sharing road space). Similar to the Canadian review, this paper shows that, out of the 16 included campaigns, eight provided no evaluation. Additionally, five other campaigns were not found to be associated with any desirable effects (i.e., reduction in crashes). Lastly, the seven campaigns that were evaluated focused on the memorability of the campaigns and support for their premise. Two of the campaigns (‘Be Street Smart’ in Washington DC and ‘How We Roll’ in Ohio) did find that people reported being more knowledgeable regarding the topic information of the campaigns – though no measurements were examined to assess behavioural changes.

Contextualising this within the New Zealand setting, several ‘share the road’ campaigns have been implemented that aim to educate and encourage motorists and cyclists to give each other attention and space when on the road. Example campaigns include the ‘don’t burst their bubble’ 2003 campaign, Bike Taupo’s 2005 introduction of 1.5m overtaking gap signage (that has since been replicated elsewhere), and the most recent ‘see the person – share the road’ campaign (just to name a few; see Bike Taupo, 2005; Cambridge & Francis, 2006a, 2006b; Transport Agency, 2016c). Regarding evaluation, some preliminary findings from the ‘see the person – share the road’ campaign suggest that it is having the intended effect, with Figure 2.13 illustrating high levels of approval from sample of 491 participants. In saying this however, the campaign is still early in its implementation, with the most recent findings showing that 74% of the participants indicated that they have not seen the advertising for this campaign (Transport Agency, 2016c). Thus, though initial results are promising, long-term evaluations are needed to get a fuller picture of the campaigns effectiveness as, similar to the aforementioned campaigns, it focuses on self-report measures of the campaign itself. Thus, follow-up investigations (whether of this campaign or a new campaign) would benefit from capturing perceived and actual behavioural changes over time as well as rates of crash/injury statistics relating to cyclist-motorist interactions.

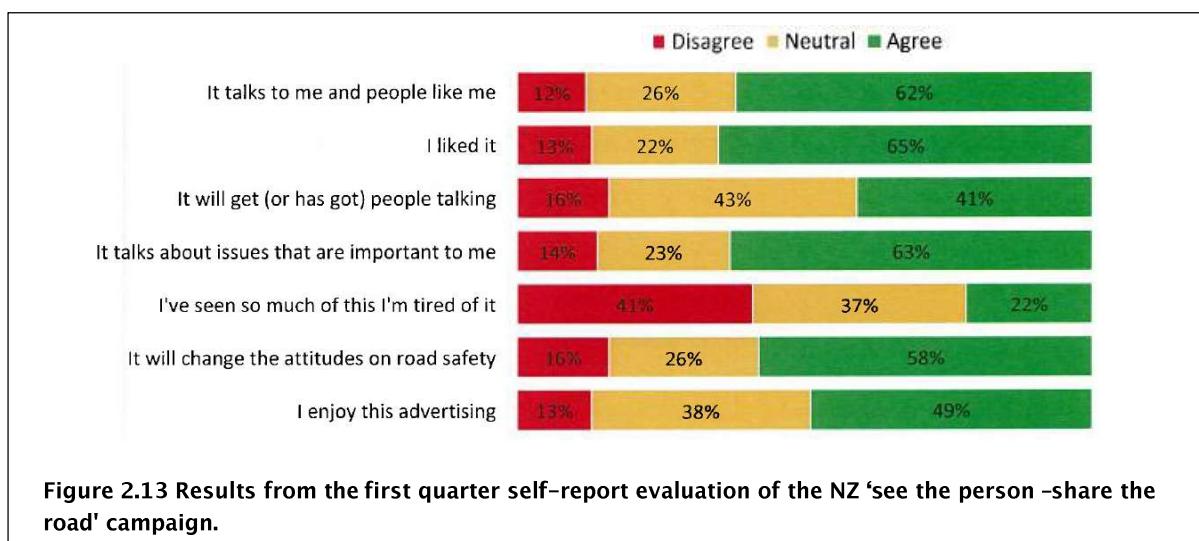


Table 2.6 Descriptions and evaluations of three road safety campaign's in Canada (Baglo et al., 2013)

Country	Target Audience and Intent	Approach	Evaluation
Haliburton County "Share the Road" March 2009- March 2010	The intent of the campaign was to increase the knowledge of motorists and cyclists about how to safely share the road. http://www.cyclehaliburton.ca/sha_retheroad.htm	The campaign approach included radio ads, a brochure, a "walk and roll" commuter's guide, the installation of "Share the Road" signs, and the promotion and support of the annual commuter challenge.	Objective: to increase knowledge of drivers and cyclists about how to safely share the road, to increase awareness of general community about sharing the road with cyclists, increase cyclist's skills in order to share the road, increase participation in commuter challenge that encourages active transportation, improve supportive infrastructure Outcome: 39.7% of people reported having heard of the campaign 4/10 times, 73.3% stated they heard about the campaign by viewing of the 'share the road signs' and other media was viewed by 30-40% of respondents. 57% reported that the campaign was useful for communication road safety issues (n = 250)
City of Edmonton "Heads up! Look out for each other" September- December 2010	The intent was to raise pedestrians' and drivers' awareness about safety at pedestrian crossings http://www.toronto.ca/transportation/publications/pedestrian_safety/index.htm	The campaign message was spread through print ads, posters, brochures and street signs. Police officers handed out brochures and educated pedestrians and drivers about crosswalk and intersection safety. Students from the Guru Digital Arts College created four short videos with safety tips for pedestrians and drivers that were shared on the Transforming Edmonton Blog and on the City of Edmonton YouTube channel.	Objective: to reduce the number of pedestrian injuries and fatalities, (aiming to reduce pedestrian collisions by 5%), to ensure that communication materials share common brand and are identifiable and to attract media and social attention. Outcome: pedestrian collisions decreased by 6% from previous year. An online survey found 43% agreed that the campaign increased community awareness. However, 53% thought that they were not more cautious as a result of the campaign – perhaps due to public perception that road safety is a social problem not an individual problem (no reported N).
City of Toronto "We're all pedestrians" 2003-2005	The intent of the campaign was to encourage, pedestrians cyclists and drivers to be careful on the road	The campaign message was promoted through 220 posters on transit shelters, 500 curb side garbage bins across the city for five weeks, and one streetcar that travels on various routes over a 12-week period. Posters were also placed in libraries, community centres, schools and other locations.	Objective: raise public awareness about responsibilities of drivers and cyclists, ensuring the safe sharing of the roadway, increase motorists awareness of bike lanes, encourage cyclists to use bicycle routes and follow road rule and educate the public about bike route markings and their meanings Outcome: 37% (without aid) recalled campaign message (55% with aid). 65% agreed that campaign message is important issue and 53% stated that the campaign provided them with the information necessary to share the streets safely. 65% stated the campaign convinced them that it is important for cyclists and motorists to be safe the road (n = 444).

2.6.2.3 Summary

On the whole, the most noteworthy finding is unfortunately that campaigns often go unevaluated, and if they are, the evaluations are generally focused on the memorability of the campaign and retention of the information/key knowledge that the campaign was aiming to address. However, despite these caveats, the findings from the City of Edmonton campaign evaluation suggests that a concrete behaviour change can result from education and awareness raising efforts. Learning from such instances, Bagloe et al (2013) looked across the various campaigns and conducted focus groups to extract key elements that appear to make campaigns more successful.

Results from their efforts revealed the following key components:

- 1 Campaigns should have a specific objective (and not a generic goal or aim)
- 2 When possible, non-conventional approaches should be undertaken as they are better at capturing public attention, as well as increasing awareness and encouraging the public to reconsider safety messages that they may have tired of through traditional media
- 3 Aesthetically designed materials should be used that effectively capture attention (which enables the dissemination of information)
- 4 Campaigns should have catchy slogans that are effective at capturing the public's attention while also addressing the specific campaign's objective in a clear, concise and clever way.

Corroborating with these points, a conference paper by the Amy Gillett Foundation reports that elements that catch the public's attention (such as humour) should be employed. Moreover, the authors argue that one of the most important factors for promoting road safety messages is consistency, followed by repetition of messages. Indeed, many of the share the road campaigns that have been implemented in NZ follow similar principals regarding media communication, framing and community involvement (Cambridge & Francis, 2006a). However, both Baglo et al., (2013) and Johnson, Gaudry, and Katz, (2013) emphasize the need for more well-defined 'before and after' evaluations that accompany continuous coordination with enforcement and engineering bodies, as well as local community members, who will enable the campaigns to succeed. Moving forward, the best approach appears to be to draw lessons from the existing successful campaigns (outlined in the points above) as well as less successful ones (as is the case with those that did not achieve an effect), while also making efforts to deliver campaigns cooperatively with other relevant authorities (particularly enforcement agencies) to help ensure its integration into the public domain.

2.6.3 Ability to judge lateral distances

A less frequently mentioned (though potentially highly relevant) factor is the ability for people to accurately judge the set passing distances in question. Highlighting this fact, 10.2% of cyclists and 18.9% drivers from the CARRS-Q study reported having difficulty in actually performing the law – specifically in scenarios where the absolute space available is reduced (i.e., high traffic situations/multiple traffic lanes). This is supported by research suggesting that drivers often have difficulty in judging lateral distances, particularly during movement (Baumberger, Flückiger, Paquette, Bergeron, & Delorme, 2005; Levin & Haber, 1993). Such a pattern may actually be advantageous as, if educated, road users may exercise more caution and slow down in an effort to pass safely under uncertain circumstances. On the other hand, this could lead to overcompensation where motorists give 'too much' space in instances where it is not safe to do so (i.e., when there is oncoming traffic or poor visibility). Similarly, the same principle applies to cyclists who may perceive a greater number of 'unsafe' overtaking manoeuvres than is actually the case, due to the difficulty in judging a specific peripheral distance while out riding (a pattern that may vary according to the size of the passing vehicle). Once again, however, there is scant research that has examined the actual abilities of motorists and cyclists to judge the lateral distance during overtaking manoeuvres between these vehicles (and specifically to less than a 1 or 1.5m distance). Such information would be invaluable for the development of subsequent education campaigns that can inform

motorists to give as much space as possible when is appropriate (i.e., when a safe gap opens up in the oncoming traffic).

2.6.4 Overall summary

Overall, the CARRS-Q evaluation has made the most significant contribution to our understanding of the effectiveness of a MOG law (and associated education campaign). Nevertheless, it is still relatively uncertain what effect the law has on the behaviour of motorists. Drawing from their research, it appears that the introduction of the MOG law in Queensland, Australia had a notable perceived effect in that both cyclists and motorists felt that the law had improved cyclist safety to some extent. However, the lack of baseline measures means that it is unknown to what degree these perceptions reflect behavioural changes.

Alongside the potential benefits, the CARRS-Q evaluation also identified some noteworthy challenges with the implementation and enforcement of a law such as this one. The sentiments of many experts, authorities and researchers alike, highlight that one of the biggest challenges to a MOG law has to do with enforcement (and particularly acquiring sufficient evidence to issue a citation). The second challenge highlighted by this research is the need for adequate education and awareness initiatives that adequately inform the public not only of safe overtaking behaviour (regardless of the law) but also of its implications (which could in turn create opportunities for increased cyclist empathy and more positive motorist-cyclist interactions). Finally, this study, among others, has highlighted the need to assess both cyclists' and motorists' abilities to accurately judge 1 or 1.5m passing distances as inaccuracy may result in unintentionally close passes or false close-reporting on the behalf of the cyclists. It was necessary to consider all these factors carefully when considering the purpose and expected outcome of implementing a MOG law in New Zealand.

2.7 Knowledge acquisition summary

Legislation mandating the specific distances that motorists are required to give to cyclists during overtaking manoeuvres (i.e., MOG laws) has been passed in a number of countries and states across the world, including the US, Australia and parts of Europe. Its popularity can be attributed to the fact that these laws are seen as enhancing cyclist safety by obliging motorists to give cyclists 'more' room when overtaking, consequently making them more aware of cyclists as vulnerable road users that warrant care and attention.

Despite this popularity however, key pieces of empirical evidence are lacking to support the claims made from these laws. Firstly, although cyclists do report feeling safer with greater separation or distance from motorised traffic, there is very little evidence to support the claim that any specific distance is a 'safe cut-off' for cyclists (putting to question the commonly selected distances of 1 metre or 3-feet). Secondly, there are virtually no baseline measures of motorists overtaking cyclists prior to the implementation of such laws, nor have there been analyses regarding changes to crash and injury statistics (which are one of the key desired outcomes). This makes it difficult to assess the extent of the problem (i.e., the frequency of which motorists overtake cyclists unsafely as well as rates of crashes) meaning that the examination of the effectiveness of such laws post implementation practically unachievable. Finally, further research is therefore needed that can answer these fundamental questions with the support of empirical evidence (whether that be through measuring behavioural changes or through wider performance indicators such as crash and injury rates in particular areas).

With respect to the practicalities of implementing and running a MOG law, enforcement was identified as a key issue as it is generally difficult to acquire sufficient evidence to support an infringement of the law (both regarding the specific distance that was given to the cyclists as well as detecting which party was at fault). It is therefore important to consult relevant enforcement authorities (New Zealand police officials and officers) to determine the feasibility of a law that they would be expected to support and enforce.

Education campaigns were seen as an essential accompaniment to the passing of a MOG law. However, when examining the details of campaigns relating to MOG laws as well as campaigns encouraging the safe 'sharing of

roads', findings revealed a general lack of baseline measures of the problematic behaviours in question (e.g., unsafe passes/sharing of roads) and relatedly a lack of robust or conclusive evaluations on such campaigns. Thus, no definitive education campaigns can be identified as being more effective for the purpose of encouraging safer overtaking behaviours than others. Nevertheless, lessons can be drawn from existing campaigns to extract key campaign elements to be considered for the development of an education campaign in New Zealand. This includes; the setting of a clear and consistent objective for the campaign (while dispelling any associated myths about the law); using non-traditional, creative and catchy messages to attract audience attention; stipulating specific outcome measures; and (perhaps most importantly) conducting before and after assessments of these outcome measures to evaluate the success of said campaigns. It is advisable that key stakeholders are consulted regarding the importance and make-up of potential education campaigns complementing or replacing the law to help inform any future campaign development.

Drawing from the findings (and lack thereof) from the knowledge acquisition phase, it is recommended that the following research steps be taken for the purpose of developing a more robust and clear understanding regarding the feasibility of introducing a MOG law in the New Zealand context; as well as providing guidance around the development of future complementary or alternative education campaigns aiming to improve motorist overtaking behaviours of cyclists.

2.7.1 Next stages for further investigation

- 1 Conduct a crash analysis using the Crash Analysis System (CAS) to identify the type and frequency of recorded crashes involving cyclists and motorists while overtaking movements have been recorded. This dataset can be used to determine the type of movement codes that contribute to crashes where motorists are overtaking cyclists (including where a cyclist has lost control due to a motorist overtaking). The findings from this analysis will then inform any subsequent field data collection and analysis by giving guidance around factors worthy of consideration on the New Zealand road network.
- 2 Collect on-road field data of motorists overtaking cyclist's behavioural patterns. It is important that this is done in a variety of settings (on varying road types with different widths and gradients; and in different traffic conditions) in rural and urban areas as research has shown that overtaking distances given by motorists to cyclists are influenced by a range of infrastructural and environmental factors. This will give researchers a quantifiable baseline measure of overtaking behaviours that can be used to a) determine the extent to which the law is needed by examining the frequency of motorists overtaking cyclist at 'unsafe' distances, and b) to assess the effectiveness of any action (law or behaviour change campaign) that is implemented in the future by comparing whether there are actual behavioural differences in overtaking behaviours before and after the said action.
- 3 Assess the relationship between overtaking distances and perceived rider safety to determine the parameters of a potential MOG law (i.e., what is a 'safe' distance). It is also important that this process employs a specifically selected sample pool of participants that caters for a range of rider experience levels and riding styles given that research has shown that these factors have an impact on how much space riders feel are safe as well as how much space they are given. Thus, this approach will give researchers a quantifiable 'safe' distance that overtaking motorists should provide to cyclists while at the same time providing a context to understand how this distance varies according to personal rider factors.
- 4 In line with previous literature and expert opinion, it is recommended that the feasibility and practicalities of a MOG law be discussed with New Zealand stakeholders to capture a wide range of informed perspectives, brainstorming potential problems (and solutions to said problems). This will not only add to our understanding of the feasibility of the law, but will also be invaluable for informing any future development of behaviour change educational campaigns. To achieve this, a range of methods are recommended including both one-on-one in-depth interviews with selected key stakeholders (such as cyclists and police authorities) as well as a stakeholder workshop/focus group where such stakeholders are given the opportunity to

exchange ideas and further develop an overall picture of both the problem (cycling perceived and actual safety) and solution (MOG law or otherwise).

- 5 Given the multitude of factors involved in determining the feasibility of a MOG law in New Zealand (i.e., current overtaking behaviours, specific 'safe' distances, variation on measures due to infrastructural, environmental and personal rider factors, practicalities of enforcement and education), an expert discussion on the costs and benefits of each option should be considered to produce well-informed recommendations that examine their strengths and weaknesses.

The successful completion of these tasks will empirically evaluate the feasibility of introducing a MOG law in New Zealand, while also providing invaluable research to the field that will greatly enhance our understanding of what is needed in this space.

3 Methods

3.1 Overview

The project methodology was divided into eight phases (see Figure 3.1).

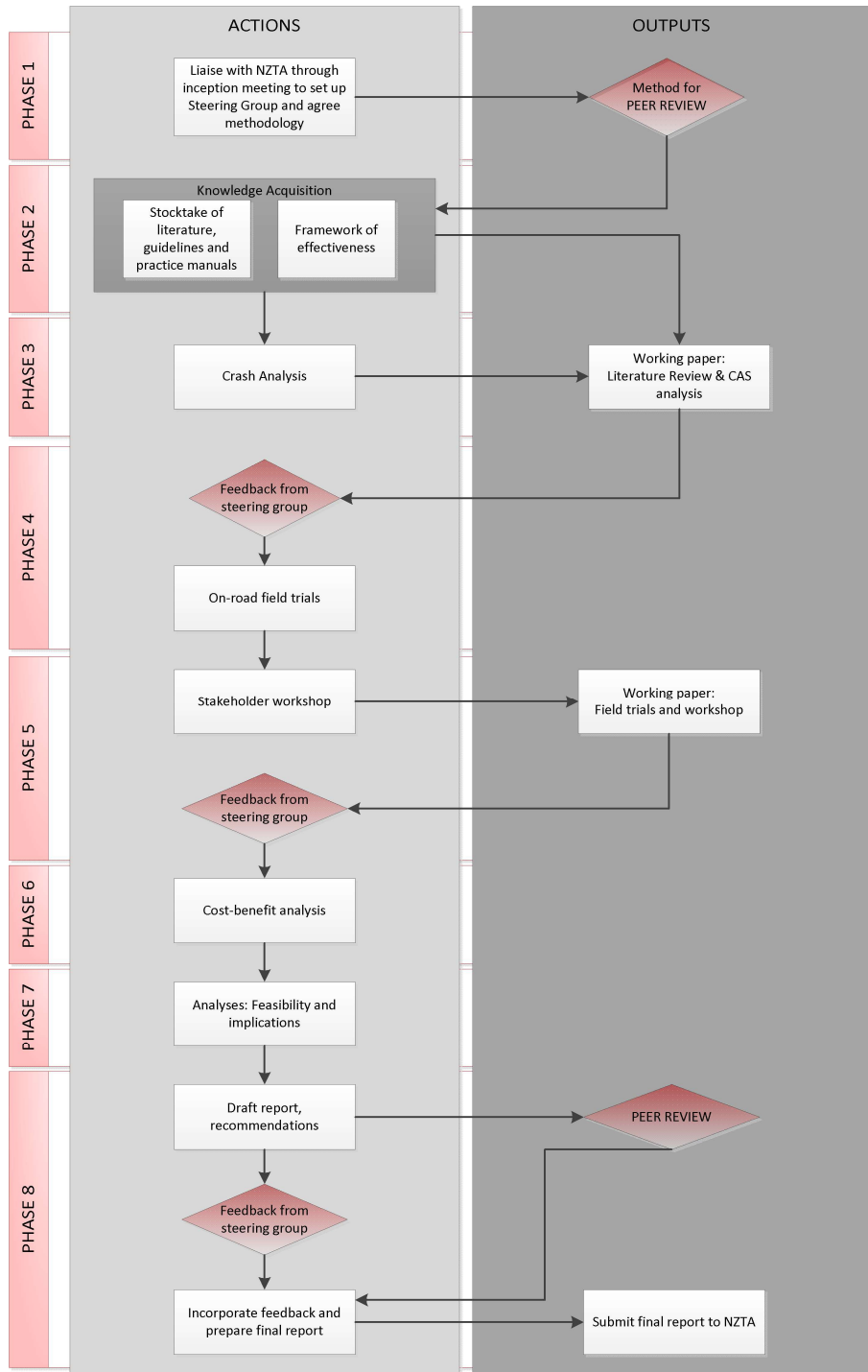


Figure 3.1 Project milestones overview

After the inception phase (Phase 1: Inception), a review of relevant literature and best practice was conducted (Phase 2: Knowledge acquisition). Following this, a crash analysis was performed (Phase 3: CAS) to inform the subsequent quantitative field data collection (Phase 4: On-road field trials). Additionally, a qualitative data-collection phase (Phase 5: Stakeholder workshop) was conducted in parallel with the field-data collection, which consisted of one-on-one interviews, a stakeholder workshop and police focus groups. Having collected all relevant data, the final stage involved a discussion of the costs and benefits that would be associated with a rule change under a range of scenarios (Phase 6: Cost benefit discussion).

The last phases of this investigation involved the incorporation of findings from the knowledge acquisition and data collection phases into recommendations for assessing the feasibility and practicality of implementing a MOG law in the New Zealand context as well as identifying scope for any complementary/alternative education campaigns. These sections were firstly prepared as a draft report that was submitted for peer review (Phase 7), followed by the completion of the final report for the Transport Agency (Phase 8).

The following section outlines the methods for these first six phases.

3.2 Crash analysis of space related incidents involving motorists and cyclists

Cycle crash data for crashes relating to road space in the Wellington Region as well as New Zealand as a whole was sourced from the Transport Agency's Crash Analysis System (CAS) for the 10-year period 2006-2015. This dataset provides information on the road users and vehicles involved in each incident, the movements of each party involved, and the cause of all reported crashes. Information for the number of fatalities, serious and minor injuries is also provided (New Zealand Transport Agency, 2012).

The CAS data extraction, and analysis of interactions during the study, focused on movement codes as presented in the CAS interpretation guide. The following 'space related' crashes involving cyclists and other road users/vehicles are discussed in the results of this report. For CAS reporting, the movement is attributed to the 'key vehicle' for each crash (see Table 3.1). Note that, in our study, interactions with motorists do not represent a crash, but rather signify an uncomfortable event with increased perceived risk from the rider's perspective.

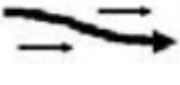

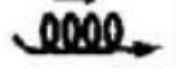
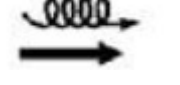
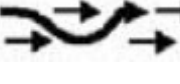
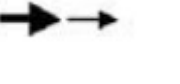
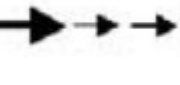
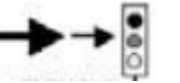




There are additional CAS movement codes that have a space element to them that were not included for this analysis. Movements such as doors opening from parked vehicles, vehicles pulling out from the shoulder, and vehicles turning across cyclists from the left will all influence a rider's position on the road and potentially the space between them and overtaking vehicles. However, these movement codes were omitted from the exploration of CAS records, so that only vehicle movements that would be impacted by a minimum gap rule were included.¹³

3.3 Field data collection

To formulate a baseline of passing distances of motorists overtaking cyclists on rural and urban roads in New Zealand, field data was collected in the greater Wellington and Wairarapa regions by getting study participants to ride an instrumented bicycle that is specifically designed to capture passing distances and speeds of overtaking motorists (as well as some other road related variables). The development and use of this technology, participant recruitment, and data collection processes are outlined below. Additionally, a brief outline of the relevant geographical areas is provided to give context to the results.

¹³ The rationale for this narrow definition was because CAS only produces a record of crashes, and we cannot infer that these wider sets of codes would influence a MOG law. For example, riders cycling further into the lane as a precaution against car doors opening (movement code EE) would influence a minimum gap rule, but that is not what is being examined here.

Table 3.1 CAS codes for cyclist-motorist space-related crashes

CAS movement diagram	CAS movement code	CAS movement description
	AA	Pulling out or changing lane to right
	AC	Cutting in or changing lane to left
	AD	Overtaking vehicle lost control
	AF	Overtaken vehicle lost control
	AG	Weaving in traffic
	FA	Rear end slower vehicle
	FD	Rear end in queue
	FE	Rear end at signals
	GA	Rear of turning vehicle
	GB	Left turn side swipe
	GE	Overtaking vehicle
	GF	Two turning

3.3.1 The instrumented bicycle unit

As the passing distance and speed during overtaking manoeuvres are frequently mentioned as the two most important motorist behaviours that are likely to impact cyclist actual and perceived safety, the instrumented bicycle technology was developed to be able to capture:

- How much space motorists currently provide when overtaking cyclists
- The speeds at which motorists pass cyclists.

To this end, a cohort of 48 selected participants (with varying degrees of riding experience – see participant recruitment section below) rode along rural and urban routes using Opus' Instrumented Bicycle Units that measured these behaviours of interest over a period of eight weeks (collecting a total of 1429 rural and 4319

urban motorist-cyclist interactions over 68 hours of total riding time). The details of the development equipment and calibration process is described Appendix C).

3.3.2 Selected test areas

To achieve the study aims, it was important that appropriate trial locations be selected that are suitable for testing interactions between motorists and cyclists in both rural and urban settings. The selection of trial locations began by addressing the following questions:

- Which locations have the most road width, topography and geometry variability (in both rural and urban areas)?
- Where are the most popular/highly used cycle routes?
- Which locations are likely to have a high rate of motorist-cyclist in interactions?
- Which locations are practical for effectively coordinating participant recruitment and the running of trials (including health and safety considerations, hand-overs, maintenance and calibration of the instrumentation, uploading of data)?

Given that Opus Research is based in Wellington, the final selected locations were located in the Greater Wellington region. The urban test site was within the Wellington metropolitan area and the rural test site was within the Wairarapa region (see Appendix D for details).

3.3.3 Participant recruitment

3.3.3.1 Procedure

Participants were recruited using a variety of convenience-sampling methods including a range of promotional materials and distribution techniques (see Appendix E for more detail). The promotional information invited individuals to register their interest in participating in the trial by completing a short online survey. Cyclist's responses to this 'expression of interest' were used by the researchers to engage in a filtering process to select a sample of participants for the on-road trial across a range of individual and rider specific variables. Specifically, participants were screened on:

- **Demographic variables** (such as age and gender) as research has shown that these variables can impact the lateral distance given by oncoming motorists, with studies showing that participants that are perceived as female tend to be given more space than those perceived as being male (Chuang et al., 2013; Walker, 2007).
- **Rider profile** including cycling history, cycling experience, cycling ability (novice, intermediate, advanced or expert) riding style and fitness as research suggests that levels of riding experience has an impact on the perceived safety of passing distances and speeds with the general trend being that more experienced riders tend to require less space (Haworth et al., 2014; Hunt & Abraham, 2007; O'conner & Brown, 2010).
- **Trial considerations** Willingness to ride on different road types, in different traffic, environmental and lighting conditions, different gradients and hours available to ride.

Participants were informed that they would be offered an incentive for their ride times and that they could receive bonuses for completing a full four hours of riding (the maximum trial ride time compensated for), and for referring other cyclists who went on to register interest in the trial (see Appendix E for more detail).

Expressions of interest were received from 368 individuals across the Wellington metropolitan area and the Wairarapa. An ongoing filtering process was undertaken as expressions of interest continued to be submitted. Regardless of the order of submission, riders were identified who had the greatest level of fit to the target sample quota. Cancellations were replaced with a rider with the same characteristics, (though this was not always

possible). The final sample consisted of 46 riders, with varying characteristics (see Table 3.2). The target sample quotas were identical for the urban and rural based cyclists.

Table 3.2 Final sample of participants

Rider experience	Actual sample		
Group 1 Expert	Urban	N = 5	2 females / 3 males All age groups
	Rural	N = 4	1 females / 3 males Ages 45 – 65+
	Let's Ride	N = 8	3 females / 5 males All age groups
Group 2 Advanced	Urban	N = 5	2 females / 3 males All age groups
	Rural	N = 5	2 females / 3 males All age groups
	Let's Ride	N = 7	1 female / 6 males All age groups
Group 3 Intermediate	Urban	N = 3	1 female / 2 males All age groups
	Rural	N = 3	1 female / 2 males All age groups
	Let's Ride	N = 0	
Group 4 Beginner	Urban	N = 3	2 females / 1 male All age groups
	Rural	N = 2	2 females Ages 18 – 34
	Let's Ride	N = 1	1 female / 0 male Age 18 - 24

The ability group allocated to each cyclist (1 = Expert, 2 = Advanced, 3 = Intermediate, or 4 = Beginner) was based on the participant's responses to five key questions in the initial expression of interest survey:

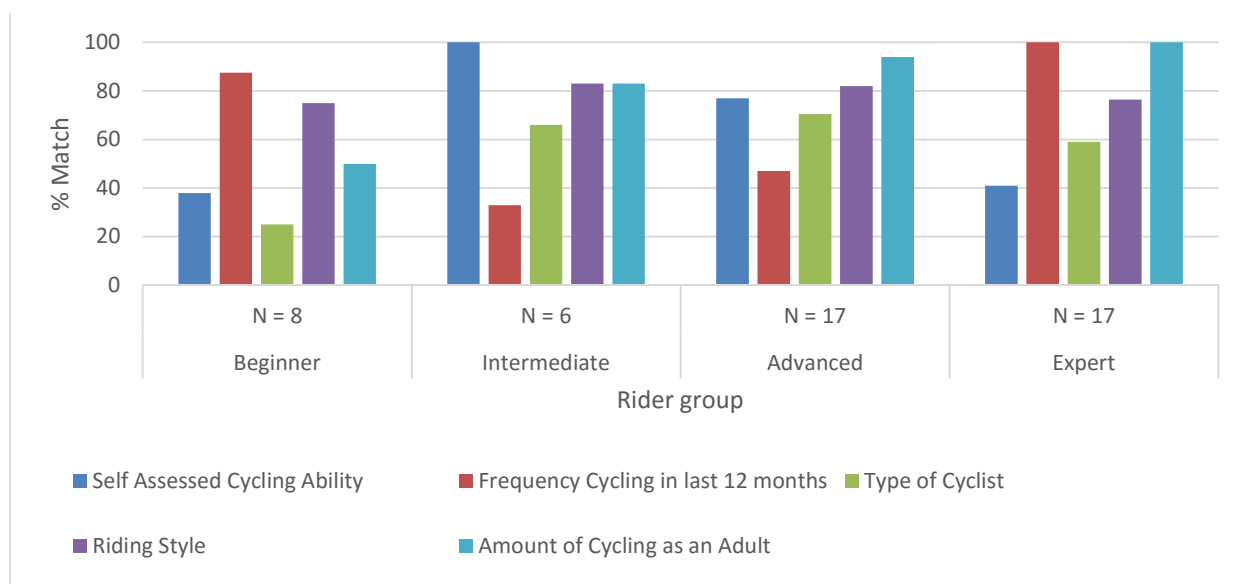
- 1 What level of ability do you have as a cyclist?
- 2 How often have you cycled in the past 12 months?
- 3 How would you describe yourself as a cyclist?
- 4 Which riding style best describes you as a cyclist?
- 5 In general, how much cycling have you done as an adult?

Beginners and experts were less likely to self-assess themselves into group 4 and 1 respectively, and classification for these two groups was based predominantly on the frequency of cycling in the past 12 months and riding style. The history of cycling as an adult was another good indicator for expert cyclists. For the classification of intermediate and advanced cyclists, self-assessed ability was a more accurate indicator when combined with riding style and history of cycling as an adult. The survey questions and associated responses used as the criteria for group allocation are outlined in Table 3.3. The extent to which participants responded to these questions matched the criteria for their final group allocation is illustrated in Figure 3.2.

Table 3.3 Criteria for study group allocation

Survey Question	What level of ability do you have as a cyclist?	How frequently have you cycled in the past 12 months?	How do you describe yourself as a cyclist?	How would you describe your riding style?	How much cycling have you done as an adult?
Criteria for beginner group	Beginner	Not at all / Occasionally	Timid / Cautious	Avoidant / Defensive	Hardly any / A little
Criteria for intermediate group	Intermediate	Occasionally / Sometimes	Cautious	Defensive / Middling	A little / Some / Quite a bit
Criteria for advanced group	Advanced	Regularly / Often	Confident but Cautious	Middling / Assertive	Some / Quite a Bit / A Lot
Criteria for expert group	Expert	Often / Frequently	Quite Confident / Confident	Middling / Assertive / Aggressive	Some / Quite a Bit / A Lot

Figure 3.2 Extent to which survey responses matched group allocation criteria



3.3.4 Data collection process

3.3.4.1 Pre-ride procedure

Once selected through the filtering process, riders were:

- Contacted to confirm their inclusion in the trial
- Booked into the riding schedule on convenient days and times for them to ride
- Provided with general information about the trial process and operation of the bicycle, including a short video clip on how to start up and shut down the bike (see audio clip) <https://www.youtube.com/watch?v=V1x6hn87vF8&feature=youtu.be>
- Provided with an email confirming drop-off and pick-up arrangements for the bike
- Invited to complete an online 'pre-ride survey' where information about their previous experience interacting with motorists (behaviour types, incidents and near misses) was requested.

Participants commuting into either Wellington or Masterton CBDs were requested (where convenient) to drop the bikes at the Opus office in Wellington or with the owner of Happy Valley Cycles (Masterton), so the bikes could be ridden by additional riders during the day. The ability to accurately assign downloaded data from multiple rides to the appropriate cyclist was achieved by maintaining a detailed and up-to-date scheduling-system combined with the ability to identify the different rides by the time tagging associated with starting up and shutting down the instrumentation.

3.3.4.2 Route selection process

When contacted to confirm their inclusion in the study, the participants were asked to provide a rough idea of which types of routes they would be cycling, whether they were their usual commuting routes, recreational routes, researcher selected routes or a combination of these. Full details of the actual routes ridden were provided in the participant's post-ride surveys.

Figure 3.3, Figure 3.4 and Figure 3.5 illustrate the geographical spread of routes ridden by the trial cyclists in Wellington (Figure 3.3), the Hutt Valley (Figure 3.4) and the Wairarapa (Figure 3.5). The green dots illustrate the vehicles passes detected and the red dots are the 'event' button presses following an uncomfortable interaction with another vehicle.

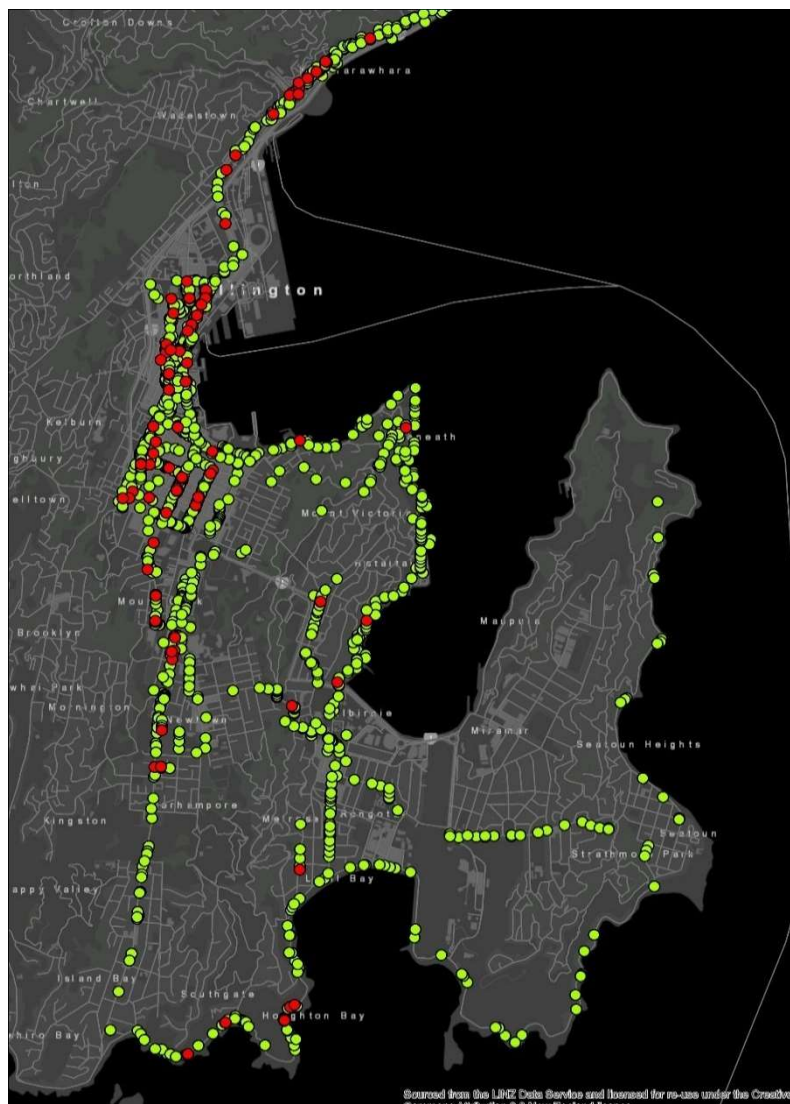


Figure 3.3 Trial routes ridden across Wellington city (Basemap credit: LINZ Data Service)

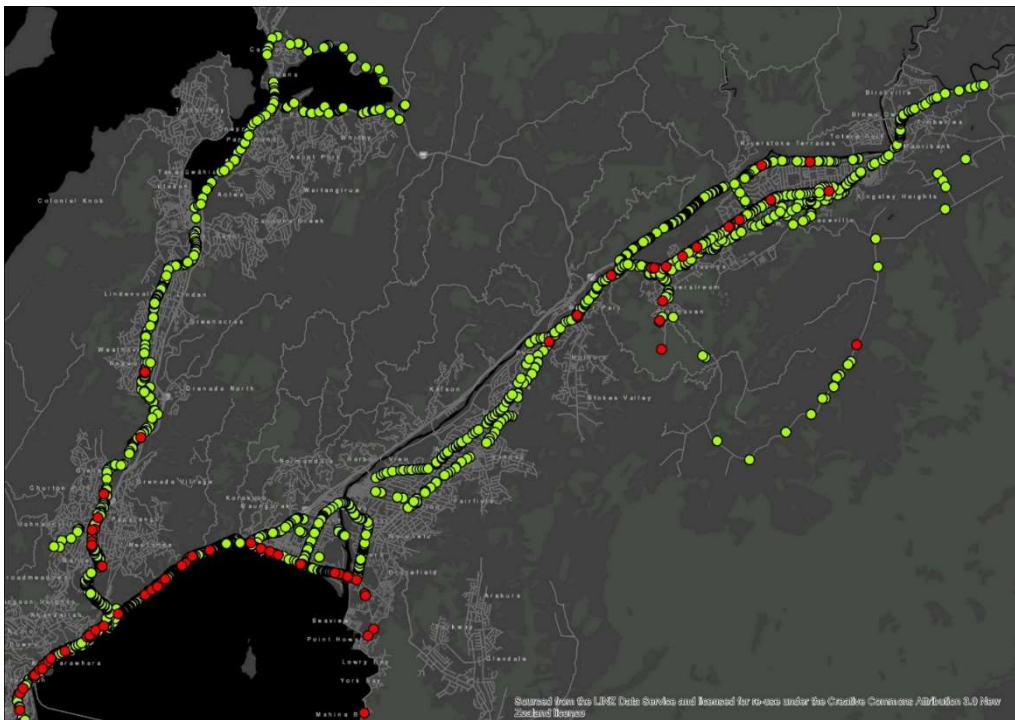


Figure 3.4 Trial routes ridden throughout the Hutt Valley (Basemap credit: LINZ Data Service)

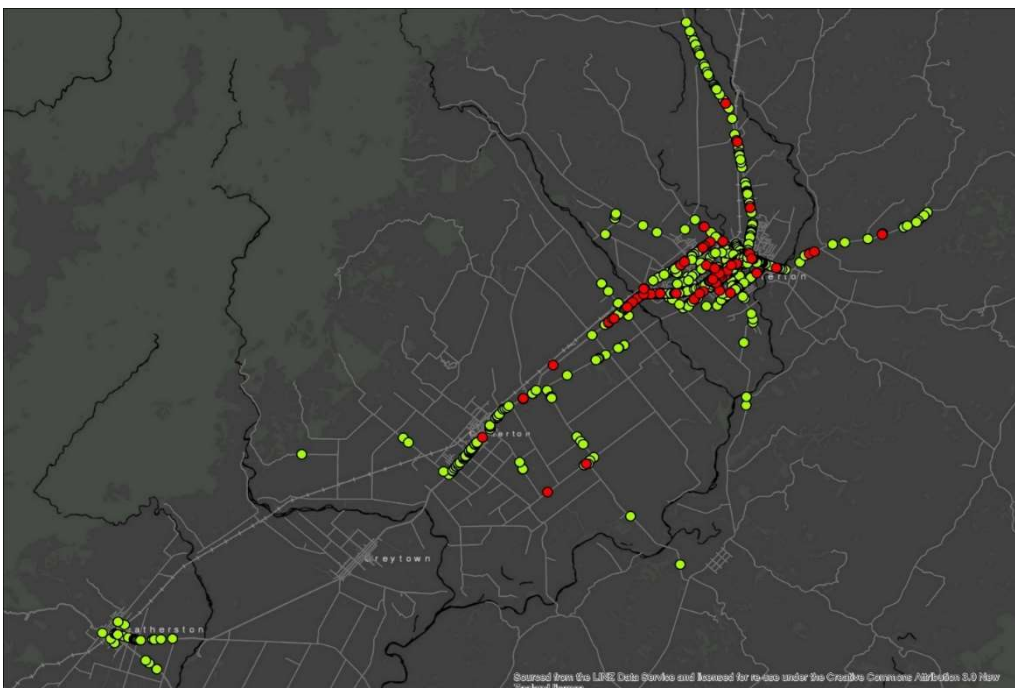


Figure 3.5 Trial routes ridden throughout the Wairarapa (Basemap credit: LINZ Data Service)

In the final weeks of the trial, a review of Wellington CBD road-network coverage was undertaken and based on this information, to optimise the number of different road traffic environments being ridden across the CBD, the “Let’s Ride’ event was organised. This event used a pre-determined researcher defined route of approximately 30 mins ride-time that took cyclists along a variety of inner city and arterial routes that included interaction with a variety of different infrastructure features.

The main advantages of this route selection approach were:

- The participant selected routes provided data-collection to occur in naturalistic settings (as the participants rode as they normally do on a route they usually ride on) therefore enhancing the real-world validity of the results.
- The pre-selected route used for the 'Let's Ride' event enabled data capture across the full range of road types present through-out the Wellington CBD, including interaction with a diverse number of infrastructure features, adding an extra level of richness and variety to our analyses and results.

3.3.4.3 Data coding of camera captures

The participant cyclists were asked to press the 'event button' button every-time they experienced an uncomfortable interaction with another road user; a short button press for some discomfort, and a long button press for an extremely uncomfortable experience. Every time one of the cyclists pressed the event button to indicate that they had experienced an uncomfortable interaction with another road user, a flag was recorded in the video footage and the data recording stamped to log the sensor data captured around the event.

All the flagged 'button press' events had the associated video footage manually reviewed by a member of the research team and the circumstances of the event were coded using the vehicle movement coding classification used for CAS crash data analysis (see Figure 3.6). This included, for example, the direction of travel of the offending vehicle in relation to the bicycle (e.g. oncoming or travelling in same direction) or the type of manoeuvre being undertaken by the offending vehicle at the time of the cyclists button press (passing, turning, merging, parking, reversing etc.). Additional information was coded in relation to the presence or absence of a road shoulder, approximate width of any available shoulder, plus any additional comments specific to the event such as apparent excessive speed, interaction effect with other vehicles, environmental conditions.

VEHICLE MOVEMENT CODING SHEET

For use with crash data from CAS (Version 2.8 May 2010)

	TYPE	A	B	C	D	E	F	G	O
A	OVERTAKING AND LANE CHANGE	PULLING OUT OR CHANGING LANE TO RIGHT	HEAD ON	CUTTING IN OR CHANGING LANE TO LEFT	LOST CONTROL (OVERTAKING VEHICLE)	SIDE ROAD	LOST CONTROL (OVERTAKEN VEHICLE)	WEAVING IN HEAVY TRAFFIC	OTHER
B	HEAD ON	ON STRAIGHT	CUTTING CORNER	SWINGING WIDE	BOTH OR UNKNOWN	LOST CONTROL ON STRAIGHT	LOST CONTROL ON CURVE		OTHER
C	LOST CONTROL OR OFF ROAD (STRAIGHT ROADS)	OUT OF CONTROL ON ROADWAY	OFF ROADWAY TO LEFT	OFF ROADWAY TO RIGHT					OTHER
D	CORNERING	LOST CONTROL TURNING RIGHT	LOST CONTROL TURNING LEFT	MISSED INTERSECTION OR END OF ROAD					OTHER
E	COLLISION WITH OBSTRUCTION	PARKED VEHICLE	CRASH OR BROKEN DOWN	NON-VEHICULAR OBSTRUCTIONS (INCLUDING ANIMALS)	WORKMAN'S VEHICLE	OPENING DOOR			OTHER
F	REAR END	SLOWER VEHICLE	CROSS TRAFFIC	PEDESTRIAN	QUEUE	SIGNALS	OTHER		OTHER
G	TURNING VERSUS SAME DIRECTION	REAR OF LEFT TURNING VEHICLE	LEFT TURN SIDE SWIPE	STOPPED OR TURNING FROM LEFT SIDE	NEAR CENTRE LINE	OVERTAKING VEHICLE	TWO TURNING		OTHER
H	CROSSING (NO TURNS)	RIGHT ANGLE (90° TO 110°)							OTHER
J	CROSSING (VEHICLE TURNING)	RIGHT TURN RIGHT SIDE	OPPOSING RIGHT TURNS	TWO TURNING					OTHER
K	MERGING	LEFT TURN IN	RIGHT TURN IN	TWO TURNING					OTHER
L	RIGHT TURN AGAINST	STOPPED WAITING TO TURN	MAKING TURN						OTHER
M	MANOEUVRING	PARKING OR LEAVING	U-TURN	U-TURN	DRIVEWAY MANOEUVRE	ENTERING OR LEAVING FROM OPPOSITE SIDE	ENTERING OR LEAVING FROM SAME SIDE	REVERSING ALONG ROAD	OTHER
N	PEDESTRIANS CROSSING ROAD	LEFT SIDE	RIGHT SIDE	LEFT TURN LEFT SIDE	RIGHT TURN RIGHT SIDE	LEFT TURN RIGHT SIDE	RIGHT TURN LEFT SIDE	MANOEUVRING VEHICLE	OTHER
P	PEDESTRIANS OTHER	WALKING WITH TRAFFIC	WALKING FACING TRAFFIC	WALKING ON FOOTPATH	CHILD PLAYING (INCLUDING TRICYCLE)	ATTENDING TO VEHICLE	ENTERING OR LEAVING VEHICLE		OTHER
Q	MISCELLANEOUS	FALL WHILE BOARDING OR ALIGHTING	FALL FROM MOVING VEHICLE	TRAIN	PARKED VEHICLE RAN AWAY	EQUESTRIAN	FALL INSIDE VEHICLE	TRAILER OR LOAD	OTHER

* = Movement applies for left and right hand bends, curves or turns

New Zealand Government

Figure 3.6 NZTA CAS Vehicle movement coding

3.4 Qualitative data collection

To better understand the potential benefits and challenges (and solutions to said challenges), associated with the implementation of a MOG law in New Zealand, a series of qualitative methods (i.e., one-on-one interviews, a stakeholder workshop and a police focus group) were employed to capture existing perspectives on the topic while at the same time examine how such perspectives shift when exposed to certain information (developing starting ideas for potential education and awareness programmes that could complement the introduction of such a law). All three of these approaches are described in turn in the following sections.

3.4.1 One-on-one interviews

Four one-on-one interviews (Cyclists n = 2, Police Officer n = 1, Road Transport Expert n = 1) were conducted with key stakeholders in order to: a) capture initial perceptions of the feasibility and possible implications of introducing mandatory minimum overtaking gaps when overtaking people on bicycles in New Zealand (as well as touching on wider cycling safety issues), and b) identify the most suitable stakeholders for the subsequent workshop and particular questions that should be raised in such a workshop.

A semi-structured interview method was employed where the researcher used a series of prompts to guide discussion while at the same time allowing topics to emerge freely throughout the conversation (enhancing the richness and depth of the data collected). All participants were given a short brief of the context of the project and were asked to complete consent forms regarding the anonymised use of quotes from the discussions.

3.4.2 Stakeholder workshops

Following the face-to-face interviews, a workshop was conducted in order to give key stakeholders an opportunity to discuss the barriers and solutions for implementing a minimum passing distance rule in New Zealand as well as the potential use of alternative/complementary education and promotional campaigns for encouraging appropriate public awareness and behaviour change. To enhance innovative thinking, the workshop was informed by the face-to-face interviews and existing knowledge, giving participant's greater scope for thought-leadership in this space.

3.4.2.1 Stakeholder recruitment

A list of potential organisations and representative individuals to recruit for the workshops were provided to the NZTA Project Manager who offered some further suggestions of potential attendees. All prospective stakeholders were contacted by email with a broad explanation of the research matter (albeit referred to as 'cyclist-road user interaction' unless individuals wrote to request more specific topic information), and were provided a link to a website where they could identify their ability for a number of different potential timeslots. The timeslot that suited the greatest number of attendees was selected and calendar invites were sent to probable attendees.

Workshop participants included representatives from the following stakeholder groups:

- The NZ Police
- General motorists (Automobile Association)
- Different types of cyclists including faster road cyclists
- Cycle advocates (Cycle Aware Wellington)
- NZ Cycle Trial Project Manager (Ministry of Business, Innovation, & Employment)
- Cycle skills trainers
- Couriers/Small-, local-, and urban truck drivers (NZ Post)
- Long-haul freight truck organisations (NZ Trucking Association, Toll, Road Transport Forum)

- Local and long-distance bus drivers/operators (Bus & Coach Association)
- Local government NZ (including from Auckland Transport, Wellington City Council)
- New Zealand Motor Caravan Association Inc.

In addition, representatives from a motorcycle organisation (BRONZ), a mountain biking organisation, and taxi and ride-hailing groups (NZ Taxi Federation, Uber), NZ Transport Agency, other cycling groups, Ministry of Transport, and Christchurch City Council were invited but did not attend.

Materials to be used for the workshop, including a PowerPoint and descriptions of the exercise to be completed, were provided to the client in advance of the workshop for comment. This resulted in some minor changes to the content.

3.4.2.2 Workshop procedure

Table 3.4 is a description of each step of the workshop and purpose of each step. For the group discussions (Stages 2-4), each of the three groups (whose members changed during the course of the day) explored a particular question. The prompts used by the facilitators to guide each group's discussion of a specific question are provided in Appendix B.

Table 3.4 Stakeholder workshop procedure

Workshop stage	Description
<p>Stage 1: Establishing 'off the-cuff' opinions</p>	<p>In order to get a sense of the participants' general 'first impressions' of cycling safety in New Zealand and how it relates to the distance cyclists are given when being overtaken by motorists, each participant completed a short survey at the start of the workshop assessing his or her initial perceptions of:</p> <ul style="list-style-type: none"> • Levels of space and safety currently given to, and needed by, people cycling when being overtaken by a motor vehicle in different road environments. • How a mandatory passing distance may affect cyclist safety and comfort, and consequently, to what extent the participant supports/opposes the law. <p>Following this, participants will complete the survey again at the end of the workshop to assess for any changes in perspectives.</p>
<p>Stage 2: Initial discussions on the feasibility and implications of a MOG law in NZ</p>	<p>To more comprehensively capture people's initial views on the feasibility and implications of a MOG law in NZ, the aim of the second stage was to generate group discussion on three key topics (see below) by breaking out into groups (with each group discussing one of the three questions and then reporting back to the group). The three initial questions for discussion were:</p> <ol style="list-style-type: none"> 1 How would a mandatory passing distance law affect cyclist safety and comfort? 2 What impact would a mandatory passing distance law have on other road users and network efficiency? 3 What are the conditions/places/times that such a law would be difficult to implement and what provisions would need to be put in place to overcome them?
<p>Stage 3: Assessing informed opinions on the MOG law</p>	<p>A presentation of key evidence-based research findings to-date was given to the workshop participants, which included key international research and best practice findings (from the Knowledge Acquisition Phase) and New Zealand specific crash data (from the Crash Analysis Phase). The three key questions for discussion were:</p> <ol style="list-style-type: none"> 1 What should the minimum overtaking distance be? 2 What is the extent of the problem (i.e., of motorists overtaking cyclists)?

	<p>3 Would such a law work in NZ?</p> <p>The workshop facilitators then again initiated break-out group discussions regarding three key questions (with each break-out group reporting back to the whole group at the end).</p>
<p>Stage 4: Problem Solving</p>	<p>To encourage more concrete 'real world' discussions around the feasibility and implications of a MOG law in NZ, participants were presented with three key scenarios to discuss as a whole group. The three scenarios were:</p> <ol style="list-style-type: none"> 1 A single mandatory overtaking distance vs a graduated (e.g., different distances in different situations) minimum passing distance law. 2 Behaviour change initiative with NO mandatory requirements (i.e., the law) vs behaviour change supported by a mandatory requirement. 3 Mechanism for introducing and enforcing any legislated minimum overtaking distance (e.g., 1m at speeds below 60km/hr and 1.5m for speeds above 60km/hr), including associated education behaviour change campaigns. <p>Aiding this process, the participants were asked to produce a 'pro' and 'con' list for each option that was discussed, allowing the participants to 'weigh up' the strengths and weaknesses of each option, enabling them to make more balanced and informed decisions.</p>
<p>Stage 5: Wrap-up</p>	<p>To give participants a slight break from discussion, they firstly completed the post workshop survey (which included an additional question asking them whether the workshop has changed their view of MOG laws).</p> <p>The final part of the workshop was used to wrap up the discussions and give people an opportunity to provide any additional feedback/comments regarding a MOG law in NZ as well as cycling safety (and motorist/cycling interactions) more generally.</p>

3.4.2.3 Workshop administration

An audio-recording device was turned on during the 'whole group' discussion to aid the write-up of the results as well as for capturing useful quotes from the participants themselves. Consent forms were distributed and collected at the beginning of the workshop to inform the participants regarding the recording of their discussions and acquire their consent. Length of workshop was four hours.

Throughout the workshop, facilitators took note of any shifts in perceptions during said discussions (both during the small group discussions as well as whole group feedback), paying particular attention to what information altered views. Moreover, the facilitators used prompts and questions to aid and guide discussion in order to capture perceptions on key issues and solutions.

3.4.3 Police focus group

In order to gain a better understanding and appreciation of the practical and feasibility issues around the possible introduction of a MOG law for the individuals and organisation responsible for monitoring and enforcing it, a focus group was arranged with police officers in the Wellington Transport Police division. The focus group followed a semi-structured narrative approach as outlined in Table 3.5.

Originally between five to eight attendees were expected to attend the focus group, however, due to the nature of their work and requirement to attend to matters urgently as and when they arise, only two officers were able to attend the whole two-hour period. Similarly, to the stakeholder workshops the focus group attendees were asked to provide consent for their views and discussion points to contribute to the qualitative data collection pool of ideas and opinions. The discussion was audio-recorded to assist with the write-up.

Two researchers attended the focus group, one to facilitate the discussion, the other to take notes, in order to optimise data capture of the key points raised. Immediately following the end of the discussion, the researchers reviewed the narrative schedule and added additional notes while the conversation was still fresh in their minds.

3.4.4 Discussion of costs and benefits

To develop a clearer understanding of the impact that a potential MOG law could have in the New Zealand context, a broad discussion of possible costs and benefits were considered worthwhile at this stage of the investigation to assist the Transport Agency in assessing whether to continue considering the rule change necessary to make such minimum distances mandatory. As neither the costs nor the benefits associated with such a rule are well-defined or available at present, this discussion is qualitative in nature, supplemented by consideration of some possible scenarios using numbers assumed for illustrative purposes.

Table 3.5 Semi-structured narrative approach

Semi-structured narrative	Unveiling the story	Discussing the issues
Invite high level story-telling about existing cycling culture and experience	Cycling in NZ – How safe is it?	<ul style="list-style-type: none"> • How safe is it to cycle in New Zealand? • Where does cycling sit in our safety culture?
Encourage more focused thinking to identify key unsafe motorist behaviours	Exploring motorists over-taking behaviours	<ul style="list-style-type: none"> • What are the key safety factors for cyclists on NZ roads? • How much is about motorist behaviour, cyclist behaviour or the infrastructure? • Examples of where cycle safety has been improved
Highlight passing distance for in-depth investigation of the issues for cyclists and motorists	Spotlight on passing distance	<ul style="list-style-type: none"> • To what extent is the behaviour of motorists overtaking cyclists a safety concern? • Aspects of overtaking behaviour impacting on safety • Infrastructure features impacting on passing behaviour
Introduce the concept of an MOG law, explore initial views, ideas, potential pros and cons	What would an MOG law look like?	<ul style="list-style-type: none"> • What should the legal requirement for an MOG be? • Are there places where it would not be appropriate? • Is there a cycle safety need for an MOG law in NZ? • How would motorists and cyclists respond to an MOG law? • Would it impact on the relationship between cyclists and motorists? • Would the law have any impact on network efficiency? • Is a MOG law a good solution?
Facilitate in-depth discussion on the feasibility and practicality of enforcement	Practical considerations and implications for enforcement	<ul style="list-style-type: none"> • Are there any benefits to making an MOG a legal requirement? • How could a law be enforced? • What would the barriers be to enforcement? • What resources would be required? • How would you evaluate success?
Consider supporting measures and alternatives	Promotion, education, awareness	<ul style="list-style-type: none"> • Which types of safety campaign are most effective? • Which organisation is most appropriate to champion an MOG law? • What messages are likely to be most effective? • Can we build off social rules around courteous driving behaviour/a social code of conduct for road users? • Is there a target audience to reach?

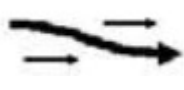

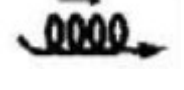
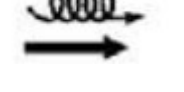
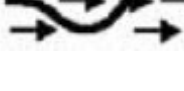


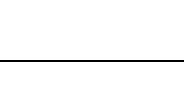
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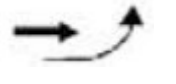


4.1 Crash analysis of incidents relating to space using CAS

To help inform the size of the safety issue, a simple analysis of crash records in the CAS database was completed, to better understand how a rule might add benefit and context to cyclist-vehicle interactions captured during this study. Table 4.1 shows overtaking gap related crash statistics between 2006 and 2015 for the Wellington Region compared to New Zealand.

The most frequent gap related CAS movement code attributed to vehicle – bicycle crashes in the Wellington region involved a driver side swiping a cyclist while making a left hand turn across their path (25%, movement code GB). Drivers cutting in while changing lane to the left (18%, movement code AC), rear-ending a slower moving cyclist (16%, movement code FA) and hitting a cyclist when pulling out or changing lanes to the left (13%, movement code AA) were also prevalent in the selected crash records from 2006 to 2015. Wellington’s cycle crash history were mirrored in the data for all New Zealand over the same period (Table 4.1).

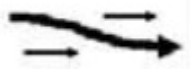

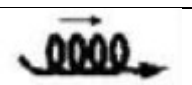

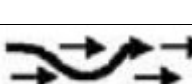
Table 4.1 Space-related crash statistics from the CAS database between 2006 and 2015 for the Wellington Region and New Zealand.

Movement code	Movement diagram	Wellington Region (2006-2015)		New Zealand (2006–2015)	
		Count	Percentage	Count	Percentage
AA		38	13%	268	14%
AC		53	18%	295	15%
AD		9	3%	26	1%
AF		24	8%	114	6%
AG		0	0%	4	0%
FA		49	16%	366	19%
FD		7	2%	34	2%
FE		10	3%	36	2%

Movement code	Movement diagram	Wellington Region (2006-2015)		New Zealand (2006-2015)	
		Count	Percentage	Count	Percentage
GA		10	3%	52	3%
GB		75	25%	611	31%
GE		13	4%	69	4%
GF		11	4%	65	3%
Total		299		1,940	

There is some variation in the distribution of crashes by movement type and severity (Table 4.2) for the New Zealand between 2006 and 2015. Based on the figures below fatalities resulting from overtaking and lane change (AA) and rear-end (FA) movement types are over-represented relative to their prevalence in overall crash statistics.

Table 4.2 Severity of space-related crashes in New Zealand (2006-2015)

Movement code	Movement diagram	New Zealand (2006-2015)					
		Fatalities		Severe injuries		Minor injuries	
AA		12	30%	46	15%	168	14%
AC		4	10%	46	15%	186	15%
AD		2	5%	8	3%	17	1%
AF		2	5%	24	8%	70	6%
AG		0	0%	1	0%	3	0%

Movement code	Movement diagram	New Zealand (2006-2015)					
		Fatalities		Severe injuries		Minor injuries	
FA		17	43%	80	25%	229	19%
FD		0	0%	5	2%	28	2%
FE		0	0%	1	0%	17	1%
GA		0	0%	6	2%	33	3%
GB		2	5%	74	23%	402	33%
GE		0	0%	16	5%	43	3%
GF		1	3%	9	3%	35	3%
Total		40		316		1,231	

4.2 Field data collection

The following is a descriptive summary of the field data that was collected during the study period:

- 6268 overtaking observations recorded
- 68 hours of rider data
- 4319 observations were recorded in Wellington and 1429 observations in Wairarapa
- 3743 number of observations by male and 2525 by female
- 956 number of observations by beginner riders, 983 by intermediate riders, 2919 by advanced riders, and 1410 by expert riders
- 1120 number of observations by people aged 18-24, 1295 by 25-34, 968 by 35-44, 1318 by 45-54, 873 by 55-64 and 694 by 65 and over
- 3557 observations were recorded on urban road (posted speed limit of 60km/h and below) and 1181 observations were recorded on major arterials and rural roads (70km/h and above). The total of these figures

(4738) represent 75% of all recorded observations in the study that could be attributed to the road network using a valid GPS position.¹⁴

4.2.1 Self-limiting of rides

Based on the responses of the rider screening survey there appeared to be little correlation between rider experience, age, and gender with environmental conditions that caused riders to self-limit their riding to avoid uncomfortable conditions (see Table 4.3). There was some evidence of variation within groups, where less experienced riders were more likely to self-limit riding on dark routes with no road lighting, while in contrast more experienced riders were more likely to self-limit riding on routes with moderately fast flowing traffic. Females were more likely to self-limit riding on dark routes with road lighting present compared with males, suggesting a relatively low level of comfort for riding at night among females in our study group.

Table 4.3 Correlation between rider experience, age and gender and environmental conditions

Conditions	Experience (Beginner=1, Intermediate=2, Advanced=3, Expert=4)	Age (18-24=1, 25-34=2, 35-44=3, 45-54=4, 55-64=5, 65+=6)	Gender (Female=1, Male=2)
Steep uphill terrain	0.084	-0.161	0.132
Steep downhill terrain	0.107	-0.151	0.020
Heavy traffic volume	0.160	-0.127	0.073
Wet weather	0.137	-0.174	0.092
Windy weather	0.037	-0.083	0.064
Dark with road lighting	-0.085	-0.164	-0.278
Dark with no road lighting	-0.226	0.038	-0.20
Moderately fast flowing traffic	0.223	-0.100	-0.058
Fast flowing traffic	-0.064	0.048	-0.077

¹⁴ Because of the frequency of data capture, a valid GPS position could not always be recorded at the moment of recording due to poor connectivity with satellite systems. This is more common for data capture in urban areas where objects such as buildings interrupt GPS signals.

4.2.2 Recorded overtaking gaps

Table 4.4 describes the overtaking observations recorded during the study, and stratifies the observations by urban (60km/h and below) and major arterial and rural (70km/h and above) speed limits. As expected, the minimum closest (5th, 10th, and 20th percentile) and median recorded overtaking gaps were slightly larger on rural compared to urban roads. Relatively few recorded overtaking gaps were within the 1.0m and 1.5m thresholds of interest for this work, indicating that a low proportion of overtaking manoeuvres may be affected by the introduction of a law based on this study.¹⁵

This does not reduce the effectiveness of such a law change in New Zealand or overseas, as very few crashes also occur relative to the total number of passes. Rather, it is likely that the number of crashes is more closely related to the small percentage of 'very close' passes where the margin of error for road users is small and any misjudgement of position or timing can lead to a collision or rider fall.

The minimum gap observed on the urban road network (34cm) was not flagged by the rider (Female, 18-24 years, Advanced), while the minimum gap observed on major arterials and rural roads (65cm) was flagged by the rider (Female, 55-64 years, Expert) as an uncomfortable (or high perceived risk) event.

Table 4.4 Descriptive statistics of overtaking gap for recorded observations

	Overtaking gap (m)		
	All recorded observations	Observations on urban roads (60km/h and below)	Observations on major arterials and rural roads (70km/h and above)
Minimum (m)	0.34	0.34	0.65
5 th Percentile (m)	1.24	1.23	1.40
10 th Percentile (m)	1.40	1.40	1.56
20 th Percentile (m)	1.61	1.59	1.75
Median (m)	2.05	2.02	2.19
Maximum (m)	4.68	4.68	4.66

¹⁵ Note: The overtaking gap was taken from the outside handle bar of the bicycle, so the actual gap may be less than this at times, as riders sometimes have their elbows protrude beyond the handlebars. Similarly, the gap detected on the vehicle was likely to relate to the body of the vehicle, as opposed to the closest possible point of contact to a cyclist (i.e. the wing mirror). This may mean that, 1) observed gaps were slightly smaller, and 2) that rider comfort thresholds were conservative (as the gap was actually closer to contact based on this criteria).

The distribution of overtaking gaps recorded on urban (60km/h maximum posted limit) roads was approximately normal with a slightly positive skew and longer tail with increasing gap distances (Figure 4.1). The data was distributed around a mean of 2.22m with a standard deviation of 0.81m.

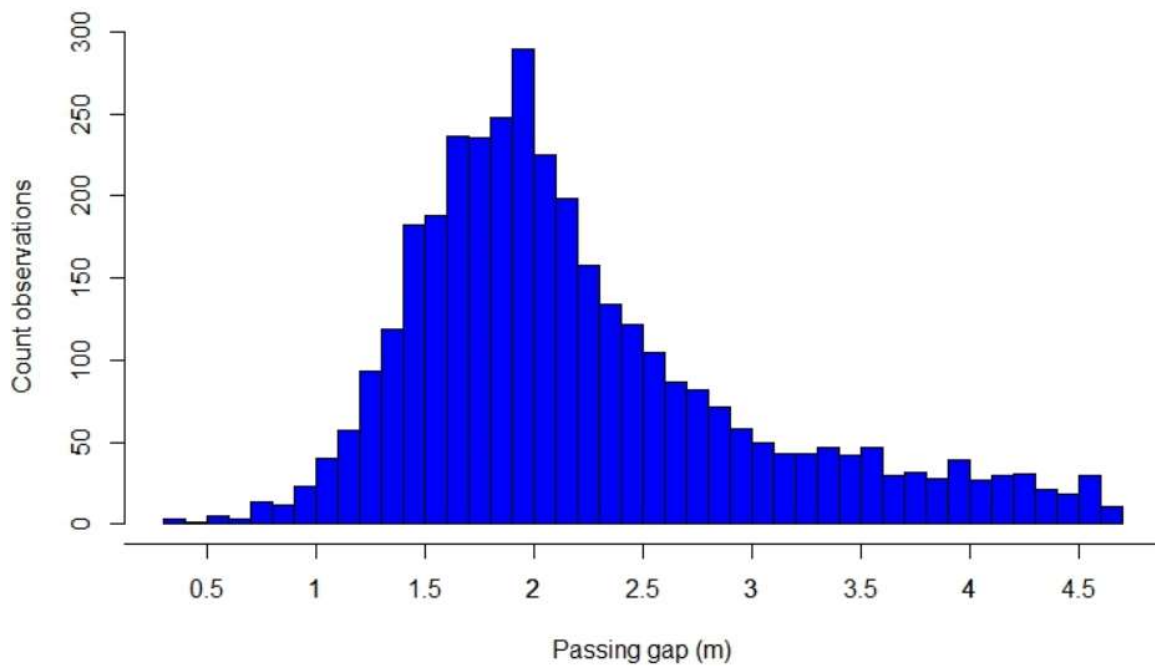


Figure 4.1 Overtaking gap distribution on urban Roads (60km/h and below)

The distribution of overtaking gaps recorded on major arterials and rural (70km/h minimum posted limit) roads was also approximately normal however there was a positive skew and a cluster of increased observations of relatively high gap distance in the upper tail (see Figure 4.2). The data is distributed around a mean of 2.39m with a standard deviation of 0.82m.

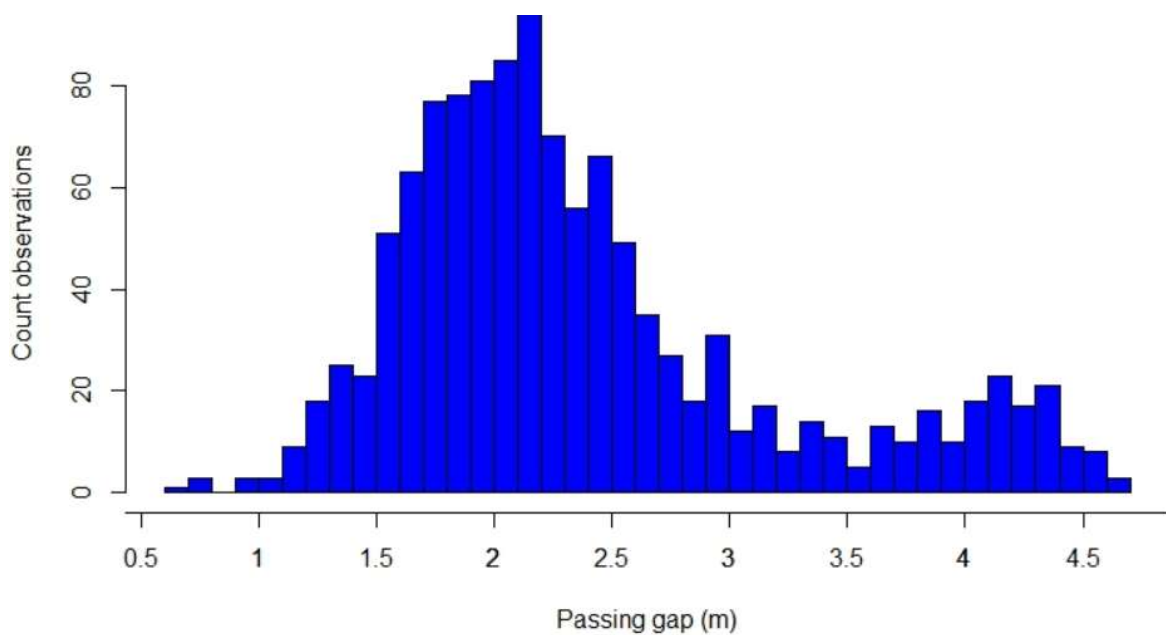


Figure 4.2 Overtaking gap distribution on major arterials and rural roads (60km/h and above)

4.2.2.1 Exposure to overtaking gaps

If a two-stage MOG law were in place during the study period our riders would have experienced some level of illegal overtaking behaviour on their rides (Table 4.5). Of the interactions that could be attributed to urban type speed limit zones 1.7% were within 1m, while on major arterials and rural type speed limit roads 7.2% were within 1.5m.

Table 4.5 Exposure to overtaking gap - number of vehicles that were recorded overtaking at specified distances

Overtaking Gap (m)	All recorded observations		Urban roads (60km/h and below)		Major arterials and rural roads (70km/h and above)	
	Count	Percentage	Count	Percentage	Count	Percentage
0.00 – 0.49	7	0.1%	4	0.1%	0	0.0%
0.50 – 0.99	78	1.4%	57	1.6%	7	0.6%
1.00 – 1.49	685	12.7%	483	13.6%	78	6.6%
1.50 – 1.99	1749	32.4%	1195	33.6%	346	29.3%
2.00+	2882	53.4%	1818	51.1%	750	63.5%

4.2.3 Rider flagged 'uncomfortable' or 'high perceived risk' events

To monitor rider discomfort, riders pressed an 'event' button to flag interactions with motor vehicles where they felt a heightened sense of discomfort or perceived risk from an interaction. Each flagged interaction recorded during the study was examined using video footage captured at the time of each event. For comparability with crash records in the CAS database, the vehicle-cyclist interactions were classified using the CAS Vehicle Movement Coding Sheet (refer to Figure 3.6, section 3.2 for code definitions), even though no crashes occurred during data collection of this study. No inference was made about the reason for the button press as individual riders were not spoken to after each ride or shown their videos to describe what they perceived as risky about a given situation.

Table 4.6 presents the number of these vehicle movement interactions compared with the same movement codes for cyclist-involved crashes in Wellington during the period 2006-2015. Rider flagged interactions relating to vehicle overtaking and lane changing movements (CAS codes AA, AC and AF) made up 86.6% (n=159) of all recorded uncomfortable events for this study. This compares to only 19% of CAS crash records relating to these types of space-related movements.

Over half of Police recorded driver – cyclist crash movements in this analysis were for drivers making a turn across the path of the cyclist from a head on position (32%, movement code LB) and drivers pulling out of an entranceway or side street across the path of a cyclist (23%, movement code JA). However, these types of movements were flagged by riders in only 3% of the study's recorded incidents.

This disparity highlights the difference between perceived safety and actual safety of cyclists on the road network. Vehicles overtaking were likely to be perceived as a high risk situation because of the frequency of occurrence, the fact that both the bicycle and vehicle were moving at speed, and factors such as noise and vehicle size. However, these types of interactions on the road rarely resulted in a crash. Cyclists were less concerned with passing a parked vehicle because it was not moving, it was only if someone suddenly swung open their door that it became a threat. Likewise, a car waiting to enter a road would not be a large threat unless the driver decided to cut across the cyclist's path where there was not a sufficient gap.

Overall, 19 of the 184 events (about 10%) were flagged as severely uncomfortable, as indicated by a button press of two seconds or more. Over the total 68 hours of ride time this is one severe event approximately every 3.5 hours or accounts for 0.3% of all driver and cyclist interactions recorded during the study.

Table 4.6 Distribution of vehicle movements with rider flagged interactions compared with the same movement codes for cyclists involved in crashes during the period 2006-2015

Movement code	Rider flagged interactions		Wellington Region CAS (2006–2015)	
	Count	Percentage	Count	Percentage
AA	2	1%	38	6%
AC	10	5%	53	9%
AF	147	80%	24	4%
BA	2	1%	7	1%
EE	13	7%	93	15%
FA	4	2%	49	8%
JA	2	1%	140	23%
LB	3	2%	196	32%
MA	1	1%	19	3%
Total	184	100%	423	100%

As shown in Table 4.7, analysis of video footage captured at the time of each rider flagged interaction showed that parked vehicles were present in 28% of interactions, and that the majority of uncomfortable events occurred when an oncoming vehicle was not present (91% of interactions).¹⁶ Also, for urban speed zones the median distance offered by vehicles was lower when there was an oncoming vehicle by about 0.16m (at 1.32m compared with 1.48m with no oncoming vehicle; see Table 4.8). The majority (89%) of rider flagged interactions did not occur at intersections.

In terms of motor vehicle type, trucks and buses were over-represented in the likelihood of discomfort, with 26% of interactions being flagged, when these vehicle types make up only 7.2% of vehicle kilometres travelled in New Zealand (Ministry of Transport, 2014b). Although some flagged events related to the presence of cyclists or pedestrians, their presence in flagged events may have been under-represented, as during pre-ride briefings, riders were asked to flag uncomfortable events with a focus on motor vehicles.

Table 4.7 Presence of different factors in rider flagged interactions

Factor	Description	Percentage
Oncoming vehicle present	Yes	9%
	No	91%
Shoulder Space	No shoulder	47%
	Tight shoulder	25%
	Full shoulder or cycle lane	28%
Parked vehicles present	Yes	28%
	No	72%
At an intersection	Yes	11%
	No	89%

¹⁶ Although any finding must be interpreted carefully, as exposure rates (e.g. to oncoming vehicles, parked vehicles, different shoulder spaces, or intersections) were not estimated.

Factor	Description	Percentage
Presence of other road user vehicles by type	Car or light van	71%
	Bus or truck	26%
	Pedestrian	2%
	Cyclist	1%
	Multiple users	2%

4.2.3.1 Overtaking gaps and the observed road environment

Table 4.8 Oncoming vehicles and overtaking gaps

	Observations on urban roads (60km/h and below)		Observations on major arterials and rural roads (70km/h and above)	
	Oncoming vehicle, n=7*	No oncoming vehicle, n=68	Oncoming vehicle, n=0	No oncoming vehicle, n=21
Minimum (m)	0.80	0.52		0.92
5 th Percentile (m)		0.71		0.95
10 th Percentile (m)		0.89		0.98
20 th Percentile (m)		1.05		1.07
Median (m)	1.32	1.48		1.37
Maximum (m)	1.77	3.10		3.14

*Care must be taken interpreting this data due to low numbers, comparisons between groups are unlikely to be definitive, 50th percentile only has been reported due to these limitations.

Shoulder space appeared to have played a role in uncomfortable events, with no shoulder or a tight shoulder being observed as being present in 72% of interactions (see Table 4.7). Within urban roads looking at the smallest uncomfortable gaps (based on 5th percentile data), these were often provided to those riding with a full shoulder/cycle lane (about 20cm less space; see Table 4.9). Which may indicate that riders with greater space (i.e. with a full shoulder/cycle lane) were more tolerant of the close events, perhaps as they perceived they had greater control, with space available to move away from close vehicles. However, on the whole the median distance in urban roads was only lower for those with a tight shoulder (about 1.3m compared with about 1.5m for the tight and full shoulder conditions). This could indicate an overall expectation effect, where riders generally expected closer gaps when riding on urban roads with no shoulder, such that expectations of what riders believe a reasonable distance would be influences their assessment of discomfort. Within major arterials and rural roads, the data was too limited to make any relative assessments of discomfort based on shoulder space.

Table 4.9 Road shoulder width and overtaking gaps

	Observations on urban roads (60km/h and below)			Observations on major arterials and rural roads (70km/h and above)		
	No shoulder, n=33	Tight shoulder, n=16	Full shoulder/cycle lane, n=25	No shoulder, n=5*	Tight shoulder, n=13	Full shoulder/cycle lane, n=3*
Minimum (m)	0.52	0.65	0.57	0.98	0.95	0.92
5 th Percentile (m)	0.82	0.88	0.68		1.01	
10 th Percentile (m)	0.85	1.10	1.02		1.11	
20 th Percentile (m)	0.91	1.28	1.28		1.28	
Median (m)	1.27	1.52	1.49	1.21	1.94	1.07
Maximum (m)	2.86	3.10	3.05	1.41	3.14	1.74

*Note: Care must be taken interpreting this data due to low numbers, comparisons between groups are unlikely to be definitive, 50th percentile only has been reported due to these limitations.

4.2.3.2 Discomfort and overtaking gap by rider group

Table 4.10 provides an overview of passing gap distances recorded during overtaking movements where riders had signalled a level of discomfort. They showed that in urban settings, expert riders were the least uncomfortable with the smaller overtaking gaps, while advanced riders were the most uncomfortable with small overtaking gaps, flagging uncomfortable moments at a median distance of 1.67m. On major arterial and rural high-speed roads, beginner riders were the most uncomfortable with smaller overtaking gaps, flagging uncomfortable moments at a median overtaking distance of 1.10m. Intermediate riders were the least uncomfortable with small overtaking gaps, with a median flagged gap of 3.05m. These findings did to some extent relate to exposure to different riding environments, as could be seen within the cumulative comfort findings, where novice riders had lower comfort thresholds.

In total, 159 interactions between riders and other road users were flagged as creating an uncomfortable or high perceived risk situations from our riders' perspective when a vehicle overtook the rider (Table 4.10).¹⁷ This was one event for approximately every 40 recorded overtaking manoeuvres in the study or one every 25 minutes of recorded riding. The majority of flagged events were on urban roads, at an average of one flagged event for every 31 recorded overtaking events. On major arterials and rural roads the 43 flagged events equate to one in every 28 recorded overtaking events. Beginner and advanced riders had the highest rate of flagged events in the study, with an average of one press in every 29 and 28 recorded overtaking movements respectively. In contrast, intermediate and expert riders had a comparatively low rate of flagged events with one in every 109 and 108 recorded overtaking movements respectively (however, the numbers were too low to reliably say that this finding would hold across a larger sample).

The relatively low number of flagged events for some strata of experience and road network type meant it was difficult to infer much from any analysis, the small sample sizes were likely subject to the random nature of whatever passing distances they happened to be exposed to. In urban areas, which have the majority of presses, it was expected that drivers would pass more closely to cyclists and for cyclists to be exposed to a greater number of vehicles on the road – potentially influencing their perceptions of risk. Of interest however, were the passes which were not flagged, and any evidence of the thresholds of comfort and discomfort different experience groups had, which was presented in the following section.

Table 4.10. Flagged events by rider experience and road network type

Experience	Urban presses (n)	Arterials and rural presses (n)	Total presses (n)	Rate per total observed passes*
Beginner	29	4	33	1/29
Intermediate	7	2	9	1/109
Advanced	67	37	104	1/28
Expert	13	0	13	1/108
All	116	43	159	1/40

*Note: The relatively small numbers here for Intermediate and Advanced riders mean these rates should be interpreted with care.

4.2.3.3 Rider acceptance of overtaking gaps

Rider 'acceptance' of overtaking gaps provided to them by drivers was determined by the number of observed overtaking movements within a range that were not flagged by our riders as uncomfortable or high risk (Table

¹⁷ Note: The lower numbers here relate to less location-based data, due to GPS signal loss, see also the start of Section 4.2.

4.11).¹⁸ As expected on all road types there was increasing rider acceptance of overtaking gaps as the distance between riders and the vehicle increased. On urban roads, where international guidance points to a recommended 1m safe overtaking gap, there is evidence of relatively low acceptance of very close passing gaps (less than 0.5m) though the numbers of observed passes in the lowest range are very small. Somewhat more surprisingly is the small amount of flagged events for passes between 0.5m and 0.99m, with 81% of observed passes not flagged by the rider. At distances of 1m and above on urban roads our riders were relatively comfortable with the majority of overtaking movements.

There were relatively few overtaking gaps below 1m recorded on major arterial and urban roads during the study suggesting that overall there is a low rate of very close passing taking place on the region's roads currently. On these roads with posted speed limits of 70km/h and above larger recommended gap of 1.5m is advised, and we see increasing rider acceptance of overtaking movements for range above 1m.

Table 4.11 Overall rider acceptance of overtaking gap by range

Road type	Overtaking gap (m)	Observed	Buttons	Acceptance	Cumulative acceptance
Urban <=60km/h	0.00 – 0.49	4	2	50%*	50%
	0.50 – 0.99	57	11	81%	79%
	1.00 – 1.49	483	32	93%	92%
	1.50 – 1.99	1195	27	98%	96%
	2.00+	1818	9	100%	98%
Major Arterial and Rural >60km/h	0.00 – 0.49	0	0		
	0.50 – 0.99	7	3	57%*	57%
	1.00 – 1.49	78	10	87%	85%
	1.50 – 1.99	346	4	99%	96%
	2.00+	750	4	99%	98%

*Note: Care must be taken interpreting these acceptance levels with such low observed exposure to passing gaps in this range.

Because of the particular interest in beginner riders (in relation to improved comfort leading to increased rider uptake), further examination of overtaking gap acceptance for beginner riders only was also examined. This shows a similarly increasing acceptance of driver overtaking behaviour, as the space given to riders' increases. Table 4.12 presents results for urban roads, as there were only two flagged events from beginner riders on major arterial and rural roads during the study. Compared to the overall study group, beginner riders had a lower acceptance of overtaking gaps under 1m, though care must be taken when interpreting this information due to relatively low numbers of observed overtaking movements at this distance.

Table 4.12 Beginner rider acceptance of overtaking gap by strata

	Overtaking gap (m)	Observed	Buttons	Acceptance	Cumulative acceptance
Urban <=60km/h	0.00 – 0.49	1	0		
	0.50 – 0.99	11	6	45%	50%
	1.00 – 1.49	94	8	91%	87%
	1.50 – 1.99	231	9	96%	93%
	2.00+	309	1	100%	96%






¹⁸ Table 4-11 presents 102 flagged events compared to the 159 events in Table 4-10, this is due to no match being made between the button press event and processed data from the bicycle unit for some events. Therefore, geocoding and attribution to a particular rider is still valid, but a measured gap for the event cannot be determined.

4.3 Qualitative data collection

4.3.1 One-on-one interviews

As noted in section 3.5.2, four one-on-one stakeholder Interviews were held to inform the full stakeholder workshop by identifying key themes in relation to cycling safety in New Zealand generally, and the potential benefits and issues associated with implementing a MOG law in New Zealand. The key themes that emerged from these interviews are depicted in Table 4.13.

Table 4.13 Key themes emerging from one-on-one interviews

New Zealand Police	Road Transport Forum
<ul style="list-style-type: none"> • Generation of drivers coming through now who haven't grown up cycling, resulting in them having less tolerant perspectives and behaviours toward cyclists. • Questions around whether cyclists' expectations of safety issues can actually be met by MOG law. Speculation that a MOG law may increase scrutiny of cyclist behaviour/issuing of infringement notices to cyclists. • A view that the police are unlikely to be able to prioritise enforcement of MOG law due to limited resources and more pressing issues that are easier to defend in court. 	<ul style="list-style-type: none"> • In terms of existing cyclist/truck interactions, the perception that cyclists may not understand the limited visibility of areas surrounding trucks from cabs and cycle into blind spots. • Issues with acceleration/deceleration /manoeuvring with trailers for trucks means that there needs to be a mutual understanding between cyclists and truck drivers on how to best accommodate for these factors and these factors should be taken into account in considering a MOG law. • Perspective that a MOG law would only work with complementary education campaign. • Questions around whether cyclists should also be responsible for keeping distances (e.g. at traffic lights). 
Cyclist 1: Pro Law	Cyclist 2: Against Law
<ul style="list-style-type: none"> • Cycling is predominately safe in New Zealand. • Most overtaking manoeuvres are 'far enough,' - it is certain situations/pinch points where unsafe passes are common (mainly due to unawareness on the part of the motorist). • Behaviour change campaign wouldn't suffice without a MOG law as people can't be held accountable for unsafe behaviours. • Law is enforceable given the provision of camera footage (which could be fitted to the bicycle itself). 	<ul style="list-style-type: none"> • Cycling is not inherently safe in New Zealand (i.e., would not recommend commuting by bicycle to others despite having done so personally for over 30 years). • Close overtaking gaps are part of a much larger problem that goes largely unnoticed due to defensive actions of cyclists (and a bit of luck). • A MOG law may not be the best option as, if it is not practical to follow, it may create more problems (i.e., greater driver/cyclist animosity). • Prefer vulnerable user law rather than a MOG law. 
<ul style="list-style-type: none"> • Both cyclists agreed that there needs to be more education/awareness around a) safe road user behaviours b) the vulnerability of cyclists and how bicycles actually function c) anticipating the behaviours of each other appropriately (motorists and cyclists) the holistic benefits of certain types of transport (i.e., why bicycles are good to have on the roads) and e) cycling related laws. All of this is seen as tapping into a shift in culture. • Benefits of law may be that a) it can give cyclists retrospective ability to follow up on unsafe passes, b) may deter unsafe passes, c), will bring the topic of cyclist safety into public discourse, d), without enforcement, and may help educate the small 1% who are unsafe, e) might encourage cycling. • Cons of law may be that a) it would be very difficult to enforce, b) without enforcement, law may become practically irrelevant, c) may be difficult to judge distance in some instances and d) would be difficult to implement one law that would apply to all roads and contexts. • Passing speed is just as problematic as passing distance. 	

4.3.1.1 Key themes

Education and awareness

Two key themes emerged from across all four interviews. Firstly, it was noted several times that there is a general lack of understanding between (and of) cyclists and motorists and consequently more education is needed to help address these gaps. Specifically, it was mentioned that, due to diminishing numbers of people cycling in childhood, the current and upcoming generations of motorists are unaware of the functionality of the bicycle (how it manoeuvres and its space requirements while in motion) as well as the vulnerability of cyclists themselves and how the behaviour of motorists impacts the safety of the cyclists. Conversely, it was mentioned that cyclists are generally unaware of the visibility and manoeuvrability limitations of larger vehicles (particularly trucks), making it practically difficult for them to see a cyclist approaching from behind and alter their course in time to provide them with sufficient room.

Practicality of MOG law

The second key theme that emerged was related to the key practical issues of a MOG law regarding its enforcement and its 'followability' (i.e., the ease of which motorists could realistically abide by said law). With respect to enforcement, it was generally understood that it would be difficult to attain sufficient evidence (though cyclist number 1 reported that camera footage was a feasible avenue). It was also mentioned that, for the law to function, it requires adequate enforcement – which, according to our police interviewee, would be difficult to do both in terms of its practicality but also in terms of resource allocation (e.g., having individual police officers riding instrumented bicycles with a back-up car to stop the passing vehicle requires a substantial investment and, given the low overall numbers of cycling injuries/fatalities, this is unlikely to be prioritised). In regard to followability, it was mentioned that it is not advisable to introduce a law that is not practical for motorists to follow. Provisions would need to be put in place to make following the law 'easy' as, if the law is difficult to follow, it is likely to create more animosity between cyclists and motorists and motorists may attribute their frustration to the presence of cyclists (rather than the legislation).

4.3.1.2 Topics identified for further discussion

Across three of the four interviews, a disparity in views emerged regarding how safe cycling is and what the main issues are. For that reason, questions addressing these elements were included in the workshop survey and discussions. Additionally, a disparity in views also emerged among interviewees regarding the appropriateness of a MOG law for addressing said safety issues. As can be noted in the two cyclist interviews, although both participants were experienced cyclists who had been cycling for numerous years, one cyclist appeared to be for and the other somewhat against the introduction of a MOG law (due a difference in views regarding its practicality). To tease out these different perspectives, questions regarding the practicality of the law were emphasised in the workshop. Lastly, both cyclist interviews raised the issue that speed during overtaking manoeuvres is as important as the distance given, and consequently, speed was included as a prompt in the workshop discussions.

4.3.2 Stakeholder workshops

A four-hour stakeholder workshop was held on Tuesday, 12 July 2016 at Opus central Wellington offices at the Majestic Centre on Willis St. The format of the workshop followed the aforementioned methodology, including a survey at the beginning of the workshop and again at the end, an 'information intervention' presentation, and numerous group discussions. Table 4.14 shows the background information of the workshop participants.

Table 4.14 Background information of workshop participants

Organisation	Cyclist	Motorist
Automobile Association	√	√
Auckland Transport	√	√
Auckland Transport	√	√
Bus and Coach Association	√	√
Cycle Aware Wellington	X	√
Greater Wellington Regional Council	√	√
Ministry of Business, Innovation and Employment	√	√
New Zealand Police	√	√
New Zealand Post	X	√
NZ Trucking Association	√	√
NZ Motor Caravan Association	X	√
Road Transport Forum NZ	√	√
TOLL NZ	√	√
Wellington City Council	X	√
Wellington Centre for Cycling NZ	√	√

The results of the workshop are presented in order of the three key areas of interest: a) the current perceptions of cycling safety issues relating to overtaking of cyclists by motorists in New Zealand, b) the feasibility of a MOG law and c) avenues for moving forward. Where appropriate, any notable shifts in perception are recorded to highlight the potential impact of the workshop itself and thereby showing trends in how education and awareness raising discussions can affect perceptions. Lastly, the participants overall support or opposition towards a MOG law in New Zealand is described as well as summary of the key takeaway messages.

4.3.2.1 Perceptions of the safety of current overtaking distances in New Zealand

Findings from the survey undertaken at the start of the workshop revealed that 'overly close' overtaking manoeuvres of cyclists were perceived being a significant concern to cycling safety, with 80% of stakeholders indicating that motorists overtaking cyclists too closely is a problem for cycling safety in New Zealand, 'somewhat', 'quite a bit', or 'a lot'. Notably, this increased to 85.7% in the second survey, showing that the degree to which this was seen as a problem increased after the workshop (highlighting a greater level of sensitivity to the issue).

In terms of the actual space given by different vehicle types, stakeholders reported that different vehicles give a variety of overtaking gaps -ranging between 0.5m–3.0m. A substantial amount of variation emerged both between stakeholders as well as for the estimate range of distances given by individual stakeholders. Indeed, some of the stakeholders reported that large vehicles tend to give more space when overtaking cyclists, whereas others reported smaller vehicles (i.e., cars) tend to provide larger gaps.

When asked at what frequency 'overly close' passes occurred, a level of agreement emerged from the group discussions that the majority of overtaking manoeuvres were of a safe distance but that the small minority that passed too close were a considerable problem, as exemplified by the following quote:

The average is fine but it is the spread that is the concern.

When asked how much space a vehicle *should* give when passing a cyclist, many respondents actually stated similar or even smaller distances to what motorists are reportedly already giving. The variation in estimated desirable overtaking gaps can be explained by the fact that, throughout the workshop, it was frequently mentioned that there are several influential factors that alter how much space should and can be given. Firstly, from the motorist point of view, it was highlighted that the built environment and oncoming traffic impact the amount of space motorists can reasonably give to cyclists when overtaking. Secondly, from the cyclist's point of view, it was pointed out that the appropriate size of the gap is influenced by the size of the passing vehicle and its speed. Illustrating this point, one participant stated that the distance that should be given to cyclists when being passed is dependent on:

... the environment, speeds, and infrastructure.

This point was reiterated throughout the workshop, which highlighted that the distance that can and should be provided depends on the environment (including infrastructure, traffic and speed).

4.3.2.2 Feasibility of introducing a MOG law in New Zealand

Having established a clearer view of 'the problem' (i.e., the extent to which close overtaking manoeuvres impact cycling safety in New Zealand), the prospect of a MOG law was introduced. Initially, in order to capture relatively unbiased views, no other information was provided other than a brief description of what such a law would entail (i.e., it would mandate that motorists provide cyclists with a pre-specified distance during overtaking manoeuvres). Subsequently, an information intervention was provided that allowed the facilitators to capture any changes to perspectives in the discussions that followed.

Pre information intervention views of the MOG law

Cyclist safety and comfort

Participants were asked to discuss the extent to which a MOG law would and would not improve cyclist safety/comfort. The responses from these discussions are separated into the potential benefits and limitations that a MOG could have in this respect. The key points on these topics are summarised in Table 4.15.

Table 4.15 The impact of a MOG law on cyclist safety and comfort - benefits and limitations

Benefits	Limitations
<ul style="list-style-type: none"> • An MOG law might raise awareness about the vulnerability of cyclists as road users and the importance of safe overtaking behaviours. Therefore, a MOG law may increase the distances given to cyclists (which would be beneficial to cyclist safety and comfort). • Most motorists already endeavour to give an adequate distance during overtaking manoeuvres (and most often succeed). However, there are motorists who may want to provide an adequate distance but may not know what that distance should be and so a MOG law would help clarify this. • Creates the potential for more scrutiny to be placed on cyclist law adherence (which could enhance safety as well as improve the relationship between cyclists and motorists). 	<ul style="list-style-type: none"> • Some scepticism that a new law on its own would improve safety issues given that there are already laws in place regarding the overtaking of cyclists by motorists. • There is a possibility that a MOG law could give cyclists a false sense of security and actually make them less safe. Drivers may actually give less space than they currently do if the prescribed space is less than their standard provision. • There is a risk of an MOG law increasing cyclist safety but forcing vehicles into performing less safe driving behaviours (e.g., driving into oncoming traffic to achieve a minimum gap) and therefore may shift risk rather than reduce it. • The law may create greater animosity between cyclists and motorists if motorists become frustrated in situations where it is difficult to adhere to an MOG law (e.g., on winding roads).

Other factors

Aside from the law itself, discussions were had regarding the other contextual factors that could enable or inhibit the success of a potential MOG law. Specifically, it was mentioned that cultural issues, such as road rage or a

lack of understanding of cyclist needs, may undermine the efficacy of the law. As such, it was mentioned here (and elsewhere throughout the workshop) that a complementary education campaign would be key to enabling MOG law success. Elaborating on this topic, it was highlighted that an education campaign should both highlight the reasons for the law (i.e., that cyclists are vulnerable road users) as well as teaching people how to follow the law appropriately (e.g., a programme that shows what 1.5m looks like in different environments). Lastly, it was acknowledged that some resistance to the law is to be expected, but that, if supported appropriately, could actually be used constructively, as one stakeholder quoted:

It'd be a shame to let public fury [about an MOG law] go to waste.

Impact on other road users and network efficiency

It has been postulated that one of the possible ramifications of a MOG law could be an impact on other road users and on network efficiency. To further explore this, the participants were asked to discuss what the impact of a MOG law could have in this respect.

On the whole, the general perspective that emerged was that a MOG law would have a minimal 'actual' impact on the road network for a number of reasons. Firstly, it was highlighted that most motorists already provide a sufficient amount of space anyway (and therefore any delays that would occur would be happening to a small minority of the road user population). In saying that however, there would be a period of uncertainty when a MOG law is first rolled out and so there may be some levels of overcompensation (i.e., motorists given more than is required). Thus, it was once again recommended that a MOG law would need to be complemented by an education campaign that described what 1m or 1.5m metres looks like, when, and how the specific MOG varies under different conditions.

Secondly, the point was raised that, although the lost time over the course of the entire journey would be minimal (as cyclists are infrequent and cause minor delays), there would be disparity between the 'actual' and 'perceived' impact of the MOG law on network efficiency. Illustrating this perspective, a stakeholder part of a trucking company that recently put stricter regulations in place to hold the company driver's accountable for their speeds stated that there was:

...no impact on our schedules from rigorously enforcing the speed limit.

Mirroring the sentiments from earlier discussions around the 'teething phase' of introducing new regulations, this stakeholder went on to describe the process of perceptive change in his company (highlighting the disparity between 'actual' and 'perceived' impacts on network efficiency).

Initially a lot of them were against it, after a bit of experience – they say, hell, life's easier, I get home I'm not as tired at night and got my work done.

When considering how to mitigate the impact of a MOG law on network efficiency, other provisions that would need to be put in place to enable a MOG law to function properly were discussed. The most common topic was that there isn't adequate infrastructure in many places in New Zealand to support a MOG law (or even cycling in general). It was mentioned by one of the stakeholders that the introduction of a MOG law can only be seen as one component of a larger picture, stating that:

This [law] is just one of the things that you need to do. So, if we roll out with this, then the whole idea of providing infrastructure that allows the rule to operate well is probably really important. If on narrow winding country roads, or narrow urban roads, you are expecting one and a half metres, then perhaps from a city council point of view or civil engineering point of view...it may create opportunities for more passing lanes, wider shoulders...as this would allow people who want to act in accordance to the law to do so sensibly and easily.

A point however was raised by a stakeholder from the Wellington City Council who highlighted that, in many cases, there isn't the funding, or the physical space, to implement such infrastructural changes. Complementing

this view, it was mentioned that the network (lost time) effect would be minimised by improved road sharing techniques through encouraging greater cooperation.

Implementation challenges and potential mitigation provisions

In order to develop a more comprehensive idea of the feasibility and practicality of a MOG law, the participants were asked to discuss the potential implementation challenges and respective mitigation provisions associated with the introduction of a MOG law. Table 4.16 highlights the key challenges that were raised and associated provisions that could assist in overcoming them.

Table 4.16 Key raised implementation challenges (and potential mitigation options) of a MOG law in New Zealand

Implementation challenge	Potential mitigation
Space constraints <ul style="list-style-type: none"> Narrow roads Parked cars Oncoming traffic 	<ul style="list-style-type: none"> Allow the use of flush medians for the purpose of overtaking cyclists safely Grading of roads for cycle-friendliness (where road users could plan their trips depending on the routes most suitable for them) Put in cycle lanes (painted or structured) to separate cyclists from heavy vehicles
Weather conditions <ul style="list-style-type: none"> Wind may make cyclist more vulnerable and thus needing more space 	<ul style="list-style-type: none"> Make motorists aware of the influence of the environment on cyclist behaviour and safety and encourage them to be attentive to the conditions when overtaking Pay attention to speed as much as distance
Road environment conditions <ul style="list-style-type: none"> Visibility around corners Low visibility at night 	<ul style="list-style-type: none"> Improve street lighting Require cyclists to wear more visible gear/use lights at night
Cyclist behaviours <ul style="list-style-type: none"> Riding in large numbers 	<ul style="list-style-type: none"> Encourage cyclists to pull over to let vehicles pass when appropriate Encourage cyclists to use cycle lanes (when it is safe to do so)

Other factors

Several factors were raised that, while not directly related to a specific challenge (and said solution) of the introduction of a MOG law, warranted attention if it is to be successful. Echoing the discussion points from earlier on in the workshop, effective communication, education and training was frequently raised as a necessary component to both adequately inform people about a MOG law (and its application in different contexts), as well as develop a culture of 'courtesy' where road users are more aware of how bicycles function, the needs of cyclists and what can be done to help enhance road network safety and efficacy on the whole.

In addition to education, the improvement of road infrastructure was raised once again to support any cycling safety initiatives (whether that be a MOG law or otherwise). However, one stakeholder raised an interesting point that some trucking companies have already put policies in place regarding safe overtaking manoeuvres of cyclists, and they have done so with no infrastructural changes (challenging the priority of infrastructure to this end).

Lastly, bringing together many of the aforementioned themes, it was repeatedly mentioned that there needs to be a large scale 'cultural' change in how the road network and road users are perceived. More specifically, the prioritisation of motorised traffic was challenged, and the alternative was suggested to consider each situation from various road user perspectives. This is well illustrated by an anecdote from one of the police stakeholders, reading:

The conversation needs to be looked at from all types of road users...because in that instance [a narrow road in Christchurch with only 3m wide carriageway not providing enough space for cyclists] maybe trucks shouldn't go down that road. It may be that actually, you should only use a certain size of truck in urban areas. I think it's wrong to look at it from one user, I think you need to look at it from all users and say is that vehicle suitable for this network? Classic example of a truck

driver saying...my truck is X wide and there is only X for cyclists. And maybe that's the wrong type of truck for that road. I think you need to look at it from all road users and I'm meaning from your pedestrian through to a large truck or bus, and they each may have a place on the network or not if you're going to go down that route.

Post information intervention views of the MOG law

Having captured initial views of passing distances in New Zealand as well as relatively unbiased views of a potential MOG law, the second part of the workshop aimed to assess how (if at all) perspectives changed or shifted when the stakeholders were exposed to more detailed information. To this end, they were provided with a short presentation giving them background information on cycling safety in New Zealand as well as research looking into MOG laws and passing distance behaviours more generally. For ease of interpretation, the discussion points that were similar to and different from the previous section are summarised in Table 4.17.

Table 4.17 Key raised implementation challenges (and potential mitigation options) of a MOG law in New Zealand

Discussion points	What should a minimum distance be?	What is the extent of the problem (i.e., motorists overtaking cyclists in an unsafe way?)	Would a MOG law work in New Zealand?
Similar to previous	<ul style="list-style-type: none"> Most motorists give enough space (small minority that don't) Law should educate that small minority Around 1m seems about right (not practical to give more than this) Distance is not the only factor (speed and weather) Everyone should be driving to the conditions (mutual awareness) 	<ul style="list-style-type: none"> Most passes are safe, it is the 1% that needs to be targeted explicitly (either by law or by education campaigns or both) Do not feel safe cycling in NZ (unless in urban areas with cycle lanes) Road environment (e.g., shoulders, lane width, debris) exacerbate the problem Adequate infrastructure is key 	<ul style="list-style-type: none"> Success is dependent on the accompanying education campaign It depends if it's enforceable and practical to follow Without evidence to support it, it may actually decrease the amount of space given to cyclists (i.e., only have to give 1.5m when they previously gave 2m)
Different to previous	<ul style="list-style-type: none"> No sufficient 'proof' for selecting any particular distance Beneficial to have consistent legislation with Australia Asking cyclists to pull over when riding in groups is dangerous Safe distance may be less than 1m given a slow speed of the motorist Open roads are separate issue to urban areas (faster speed differential between cyclist and motorist) 	<ul style="list-style-type: none"> Insufficient evidence to give a definitive answer (more data is needed) Anecdotes are not evidence Need to conduct a trial in one area for a set period of time before making it a nationwide rule The greater the speed, the more distance should be given Tension between overtaking a cyclist safely and being forced into oncoming traffic (a possible shift in risk rather than reduction) 	<ul style="list-style-type: none"> Success should be measured by an increase in the distance given to cyclists when being overtaken Education campaign should be targeted at both motorists and cyclists (joint responsibility) Should cater to the New Zealand context (physical and cultural) Difficulty in getting the information to all road users (existing problems around people not knowing existing road rules)

Other factors

In addition to the prompt questions given above, several other topics emerged that were worthy of note. Firstly, it was mentioned that, although not a direct measure of success, a MOG law may improve the perception and actual safety of cycling. Consequently, it may lead to greater cycling uptake – which would have benefits for both

the New Zealand population as well as may attract greater cycling tourism from overseas (making New Zealand more attractive and profitable).

Additionally, consistent with previous discussions, it was stated that an accompanying education campaign was essential for the MOG law success. What was different however, is that the stakeholders formed more clear ideas around what such an education campaign should entail. It was specifically mentioned that it should be 'positively' framed in such a way not to disparage motorists, but to create a culture of care and of mutual responsibility between cyclists and motorists, as summarised by the following quote:

The awareness campaign would need to be targeted at both drivers and cyclists. If you just target drivers, you could be seen as vilifying them – rather than saying it's a joint responsibility, we share the road, and actually take the opportunity to encourage more considerate behaviours from cyclists too.

To enable this process of education, it was also mentioned that any messages that are included in education or awareness raising campaigns should be consistent, both in the media and from the authorities on the ground who are responsible for enforcing the law, exemplified by the following statement:

One of the biggest challenges of such a rule is getting the information out to all road users – this is one of the problems where there are changes but half the people don't know that there are changes and you need consistent interpretation from law enforcement too.

4.3.2.3 Avenues for moving forward

The primary purpose of the first two stages of the workshop was to capture initial perspectives, and then allow people to further develop them and come to a level of agreement on key topics. The last stage of the workshop allowed people to refine people's views and encourage them to make 'decisions' regarding the best ways to move forward. Aiding this process, a whole group discussion was initiated where the stakeholders were asked to look at the relative merits and limitations of two key scenarios as well as wider supporting mechanisms. Table 4.18 portrays the discussions had regarding the various types of MOG law (Scenario 1). Table 4.19 portrays discussions had around additional or alternative education campaigns related to overtaking behaviours (Scenario 2).

Table 4.18 SCENARIO 1: A single mandatory overtaking distance vs a graduated (e.g., different distances in different situations) minimum overtaking gap law

Single overtaking gap law		Graduated overtaking gap law	
Merits	Limitations	Merits	Limitations
<ul style="list-style-type: none"> One distance is easy to understand (e.g., 1m or 1.5m) – although the use of a decimal place is too minute) A single distance is easier to promote to all road users (including tourists) – as it is consistent and simple Could build on existing education campaigns in Australia (e.g., a metre matters) Makes it feel more 'fair' as everyone has to give the same amount 	<ul style="list-style-type: none"> Difficult to enforce (doesn't matter what the specific distance is) Doesn't account for varying risk (i.e., how the amount of space that can and should be given varies according to situation and environment) Difficult to implement in New Zealand as it would be difficult to follow the law on many points of the road network. 	<ul style="list-style-type: none"> Some evidence from Queensland that supports a graduated law as being effective (i.e., survey participants felt that there has been an improvement) Such a law would be similar to Australia – which helps homogenise legislation (consistent for travellers) It addresses relative risk (both perceived and objective risk) – in that it accounts for 	<ul style="list-style-type: none"> The evidence from Queensland is 'self-reported' and therefore doesn't support actual behaviour change More difficult to enforce Road network differences between Australia and NZ Difficult to adhere to by other road users (the 1% who are the problem already struggle to follow simple/existing road rules) Might cause confusion among motorists (it's a bit arbitrary).

Single overtaking gap law		Graduated overtaking gap law	
Merits	Limitations	Merits	Limitations
	<ul style="list-style-type: none"> The 'a metre matters' campaign was critiqued in that it wasn't seen as practice 	<ul style="list-style-type: none"> varying speed conditions Gives a necessary general message that, at higher speeds, cyclists need more space. Provides the cyclist with more distance from large trucks (addresses aerodynamic effects) 	<ul style="list-style-type: none"> Speed is not always the only factor for graduating the law (e.g., car doors opening – in urban areas)

Table 4.19 SCENARIO 2: A behaviour change campaign with no mandatory requirements (i.e., the law) vs a behaviour change campaign supported by a mandatory requirement

Behaviour change (no law)		Behaviour change (with law)	
Merits	Limitations	Merits	Limitations
<ul style="list-style-type: none"> Could achieve similar results (a perceptual shift followed by a behavioural change) to a MOG law with a well-developed "Sharing the road" campaign This option would be quicker to implement as there is no delay in waiting for a law to be passed It would cost less to implement Can get same behavioural change by enforcing existing laws (e.g., seat belt law passed in 1977, but there was a huge increase in seatbelt wearing in 2001 because there was an increase in enforcement) Easier to back and afford an existing law (i.e., safe passing distance) Could make a high profile example of existing legislation and increase consequences 	<ul style="list-style-type: none"> No conclusive evidence to support that such a campaign could work (due to a lack of control measures and subsequent evaluations) People may perceive this approach as being less effective and may be less influential in changing behaviour 	<ul style="list-style-type: none"> The addition of a MOG law would give a behaviour change campaign more legal backing and impact Has the potential to be more motivating and consequently would be easier to incentivise people to change their behaviour Would make it easier for organisations to enforce the behaviour change (e.g., people might say why should we do it?) Creates consistency in what is considered safe overtaking behaviour and what is expected Perceptual changes are likely to be generated by a law 	<ul style="list-style-type: none"> No evidence from Queensland to show example that this combination works better than others (due to a lack of control measures and subsequent evaluations) It has more associated costs It requires enforcement – which may not be feasible (police are already overstretched in their resources and struggle to enforce similar laws such as cell phone use while driving)

SCENARIO 3: Mechanisms for introducing and enforcing any legislated minimum overtaking distance (e.g., 1m at speeds below 60km/hr and 1.5m for speeds above 60km/hr), including associated education behaviour change campaigns¹⁹.

¹⁹ Given the more descriptive nature of these discussions (rather than a list of pros and cons), the results are presented in text instead of the previous two table formats).

Scenario 3 portrays discussions had regarding support mechanisms for enabling the introduction of a potential MOG law.

Education and awareness raising initiatives

Consistent with the comments made throughout the earlier part of the workshop, a well-considered and comprehensive education campaign was mentioned as being a key mechanism for the success of improving overtaking behaviours (whether that be with A MOG law or on its own). To further explore this topic, participants were asked what they think should be included in such a campaign and how it should be run.

In responding to this, one of the most frequently mentioned components was that the campaign must tell a story that the people will 'believe in' so that they take the information on board and own it. With respect to what such a story would entail, several stakeholders mentioned that giving people the reason behind the law or the 'why' it has been passed (and felt that enforcement on its own would not communicate this effectively). A good illustration of the importance of this approach was given by one of the stakeholders who used the 'no smoking campaign' as an example where, initially there was resistance to the introduction of the law (in that the public disagreed with it or thought that it wouldn't work), but once they received some evidence to support it (i.e., health information, data), it was more accepted and endorsed. For a similar approach to be feasible in the instance of a MOG law however, it was mentioned that more data is needed to be able to sufficiently back the claims of the campaign. It is important to note that the background rationale for the behaviour change campaign was seen as imperative whether there is a MOG law introduced or not, and that it should focus on raising awareness of overtaking cyclists safely (and perhaps even of existing laws to this end).

The stakeholders then went on to describe how to inform people about the law itself and the associated behavioural changes that are required. The key elements of such a campaign are described below:

- It should avoid making people feel at 'fault' but rather frame the message in a more positive way by encouraging people to take care because, as one participant put it, "*we all make mistakes*". This would make the campaign appear to be fairer and less punitive. A potential slogan suggested by one of the stakeholders was "*Let's work together and give space to each other.*" If possible, make the message 'light' and 'funny' to grab people's attention and make them more motivated to follow the described behaviours.
- Multiple versions of the campaign should be made that target different groups of people, as one participant put it: "If you want one campaign for both of those groups [i.e., the 99% who are already exhibiting safe behaviours and the 1% who aren't], you're going to get it wrong for both." There should be specific messages to educate the compliant as well as the non-compliant in different ways. This could be achieved by having emphasis put on certain points and having these messages be distributed to specific channels.
- All channels of advertising should be employed to capture as wide of an audience as possible. The message should also not be limited to only current road users as it will also apply to people who construct and design roads.
- To circumvent the potential of people giving 'less' space than they currently do, the campaign should emphasize that a MOG law is the 'minimum' and so also encourage people to give more than that if possible.
- Use real people (not models or actors) to make the message more relatable and authentic.
- Consider creating/reinforcing signage to help inform people of the law (and also give it credibility).

Lastly, some of the stakeholders mentioned that a good example of such an education campaign was undertaken in Tasmania, which interestingly does not currently have a minimum passing distance law in place²⁰. The reason this was seen as a good example was that it used comparisons of more relatable scenarios of space (e.g., a person standing too closely to you when waiting for an ATM) to help illustrate to people (especially those who aren't cyclists) why cyclists need a certain distance when being overtaken by motorists. The humour used in this

²⁰ Follow this link to a video of this campaign <https://www.youtube.com/watch?v=P-9dP6VlNNY>

example was also seen as a positive element as it gave the campaign a positive feel and was not overly focused on punishment/attributing blame.

Enforcement approaches and issues

Once again, reiterating the sentiments throughout the workshop discussions, enforcement was identified as a key mechanism (and challenge) of introducing a MOG law in New Zealand. The primary reason it was seen as difficult was that there are currently no practical methods of measuring the distance between the cyclist and motorist during overtaking manoeuvres.

The participants were then told about overseas examples of instrumented bicycles that captured the distance from the police officer and a passing vehicle. This example was however critiqued in that a) it does not enable the police officer to capture the distance between another cyclist and an overtaking motorist, b) would have health and safety implications for the riding officers (i.e., they'd have to wear certain clothing) and c) there would have to be a near-by squad car to 'chase down' the motorist to issue them a ticket. A counterargument to this was proposed in that a law may provide more legislative backing when there is a collision due to close overtaking behaviours. However, earlier on in the workshop a police officer questioned 'retrospective' enforcement in that there would need to be evidence to show which vehicle deviated from their path and, what is more, these situations are already taken care of by existing police crash report techniques, as he stated "*When there is a crash – that is a completely different line of investigation*"²¹.

Despite the aforementioned difficulties in enforcement, it was also mentioned that the 'threat' of enforcement is critical for behaviour change as it will be more relevant to the 1% who are not currently motivated to overtake with a sufficient distance. Once again however, it was mentioned that the law itself needs to be accompanied by wider initiatives and is only a 'hook' for behaviour change, illustrated by the following quote:

The approach for people who are compliant and who don't want to hurt people – is an education one (a metre matters and a little soft explanation). But for the non-compliant 1%, never gonna reach them anyway, moves into enforcement.

To get a comprehensive view of all supporting mechanisms, the participants were then informed that, in some overseas examples with MOG laws, motorists are exempt from other laws (e.g., passing in no passing zones) to enable them to pass safely. The participant's views were then captured on this point.

Responses to this were that there are dangers with introducing exceptions to such laws as they do serve a purpose, or as one stakeholder put it: "*Yellow line is there for a reason.*" However, some suggested that overtaking a non-motorised vehicle requires a lot less time and is less dangerous, so the exception could permit overtaking cyclists but not of other motorised vehicles. Other suggestions that were brought up were the creating of expectations of when a motorist can give less than the specified distance. A critique of this approach however, was that it creates a contradiction in messages and that the less exceptions there are, the better – in order to keep it simple.

Lastly, it was mentioned that, just because another country (and in particular Australia) has passed this law, it doesn't mean that we should, as commented by a stakeholder that it is "*...really important that we don't make the mistake where we copy legislation... we have to give the enforcement team something to enforce – it has to be practically enforced.*"

4.3.2.4 Support/opposition of an MOG law

As a final measure of the stakeholders' views on the law, the before and after survey included a question that asked them to indicate their level of support or opposition towards a MOG law on a five- point scale, ranging from "strongly oppose" to "strongly in favour." Firstly, it is interesting to note that, there was a relatively even spread of

²¹ This stakeholder had another engagement during the workshop and so was not able to attend the entire workshop. However, his thoughts and comments on this topic that were mentioned earlier in the workshop seemed relevant to this theme and so, though he was not present for this discussion, they were included to show a fuller representation of views.

views from across the sample (despite most of the sample being cyclists as well as motorists), illustrated in Figure 4.3 by the blue bars where most of the participants either opposed or were neutral on the MOG law.

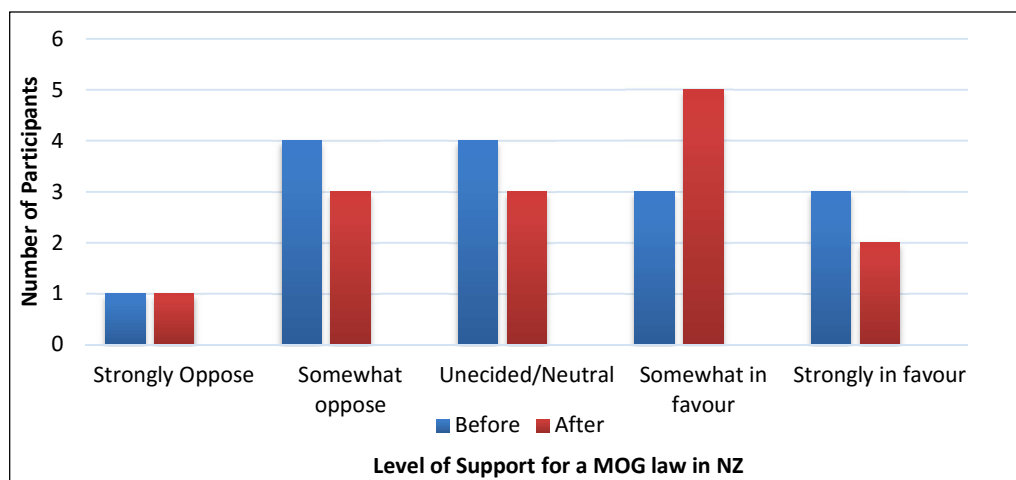


Figure 4.3 Stakeholder support or opposition towards a potential MOG law before and after the workshop

Following the workshop, there appeared to be a balancing out of views (illustrated by the red bars), where there were less opposing and more favourable views (although one participant that previously strongly favoured the law no longer indicated so at the end of the survey)²². These results suggest that for the specific sample of stakeholders present, the workshop shifted their perspectives towards more balanced views of the law. In saying that however, this a small sample of experts on the topic and therefore the results should not be interpreted as being representative of what would occur with the general population.

Looking through the open-ended comments section to this question, the key themes that emerged were:

- Concerns around practicality of enforcement in real time and retrospectively (issues of witnesses being present or not and subjectivity)
- Questions about whether existing laws already address this issue
- Just having an MOG law may not be enough, speed is a big factor also
- Scepticism that New Zealand can really compare itself to other countries with MOG laws that have vastly different infrastructure (such as the US and Australia). Ideally would instead be providing infrastructure to separate cyclists from motorists.

4.3.2.5 Synthesis of stakeholder workshop

Drawing from across all the discussions from the stakeholder workshop, a number of key takeaway messages and points emerged, which were:

- Cycling safety is an issue in New Zealand (many of the stakeholders felt that they do not feel safe cycling on New Zealand roads) and unsafe overtaking of cyclists by motorists significantly contributes to this issue.
- The amount of distance that is given is safe most of the time. However, the 1% of unsafe passes is a considerable problem and does greatly influence actual and perceived safety of cycling.
- The amount of distance that can and should be given depends on the specific context, including the infrastructure, the environment and traffic as well as the experience of the rider themselves. Because of this, care should be taken when comparing the New Zealand roading environment with overseas examples.

²² Note that some stakeholders arrived later on during the workshop and some stakeholders left before the second survey so there are uneven numbers of participants before and after the workshop.

- A MOG law has the potential to improve cycling safety if a) the specific distance is well selected, b) is accompanied by an effective education campaign, c) is well enforced, and d) is supported by improvements and upgrades to infrastructure.
- A MOG law may not be helpful however if a) the wrong distance is selected (and so cyclists are given less space than they are currently being given, b) it's not adequately enforced, c) is difficult to follow, and d) is not accompanied by appropriate education and information initiatives.
- A MOG law is unlikely to significantly impact network efficiency. However, perceptions that it will/does will need to be addressed (as people aren't likely to have an accurate view of its impact).
- Providing people with information and giving them an opportunity to discuss their thoughts (i.e., the workshop itself) can create shifts in people's perceptions and result in more balanced views.
- To make an informed decision regarding whether to introduce a MOG law in New Zealand, more evidence is desirable regarding a) the specific distance that could be considered as safe, b) the extent to which cyclists are currently being overtaken unsafely and c) the effectiveness of any law and education campaigns for changing overtaking behaviours.

4.4 Police focus group

To capture key insights, the focus group findings were written-up immediately after the meeting by identifying key themes, topics and issues that emerged in the discussions. Moreover, specific attention was paid to the relationship between the themes – enabling the researcher to identify a core narrative that adequately represented the point of view of the police officers involved. The following sections outline the key themes as well as relevant sub-topics, issues and potential solutions that were mentioned.

4.4.1 How safe is it to cycle on New Zealand roads?

4.4.1.1 Background context: The road user culture in New Zealand

Cycling safety was considered by one police officer with 30 years daily commuter cycling experience, to rely on cyclists' high levels of attention and pre-meditating the possible actions of other road users (including motorists, pedestrians and other cyclists) in order to 'stay upright and avoid being knocked off'. The ability to enjoy a commuting ride to work appeared to be compromised by the need for sustained vigilance and high levels of alertness through-out the ride.

The police officers suggested that there exists a long cultural history of motorists considering themselves to have priority over and dominating other road users and an increasingly intolerant, self-centred and aggressive approach to sharing the road with others, and that this behaviour was even apparent in some motorists who were also cyclists.

Factors impacting on cycling safety were thought to inevitably vary from city to city and from suburb to suburb. Some of these factors were attributed to the behaviour of other road users, and in other cases were thought to be primarily impacted by the transport infrastructure or riding environment. For example, on a main cycling commuter route down the Hutt Road to the CBD in Wellington, pedestrians walking into the cycleway were a significant concern, while angle parking bays, and narrow lanes with no shoulder were examples of infrastructure features impacting on cyclist safety.

In addition to placing the burden of responsibility on the cyclist to remain alert and attentive to the behaviour and potential actions of other motorists sharing the road, it was also considered the responsibility of cyclists to make themselves as visible as possible when riding on the roads. This emphasis on cyclists taking the defensive approach to riding safely on New Zealand roads supports the cultural perspective of cyclists having fewer rights to ride on the road or be treated as equal road users by motorists. There is an underlying code of conduct for

cyclists to give way to pedestrians, but the hierarchy of responsibility appears to stop there, with motorists failing to give-way to or be considerate of cyclists in the same way.

4.4.1.2 Influential factors on cycling safety

Some of the key factors impacting on cycling safety suggested were:

- **Behaviours** – close passing distance, high passing speed, passing and then cutting in (side swiping), tail-gating, impatience, aggressive interactions, inattention/lack of awareness of cyclists, drivers opening doors without looking for cyclists.
- **Infrastructure** – narrow lane width, lack of shoulder, lack of defined cycle-ways, pinch points, particularly at intersections, on-ramp/off-ramp conflict with merging/turning vehicles, vehicles reversing out of driveways and angle parks.

Examples were also given where consideration has been given to cycle safety, for example a dedicated cycle-way down the Waikato River separated from motor traffic. Another was an example of an effective solution to the failure of motorists to 'see' or consider cyclists when exiting or merging at on and off-ramps along the high speed State Highways. The police officers outlined the plans for cyclists at the new SH2/SH58 intersection in the Hutt Valley, where tunnels dedicated to cyclists will be created that by-pass the main intersection, and associated on and off-ramps, allowing cyclists to continue through the intersection without having to navigate the merging and turning traffic. The police officers maintained that this kind of provision for cyclists should be the standard for all new grade separated intersections.

The presence of dropped curbs on some junction corners that essentially provide cyclists with the opportunity to bypass an intersection were also suggested as a useful tool as they could avoid pinch points at intersections. Questions were raised, however, about whether these are intentional infrastructure features promoting cycle safety, and around the legality of cyclists riding on the footpath and potentially sharing the footpath with pedestrians on these short sections.

Separated cycle-ways were considered the ideal, where they provide a direct, well maintained route for commuter cyclists, although the police officers suggested that, in their experience as cyclists, there was often a lack of clarification about how the space was designed to be shared between pedestrians and cyclists, to minimise conflict.

On the Hutt Road travelling into the CBD, an area of angle parking approaching the Thorndon shopping mall has been designated a clearway between the morning hours of 7am till 9am, the peak time for commuters cycling into the city along this route. The removal of parked cars along this section of road not only creates more lane space for motorists to pass the high numbers of cyclists, but also removes the risk of conflict between cyclists and parking or reversing motorists. While this intervention was specifically introduced to improve cycle safety, it is not a designated cycle-way, and cyclists can still be impacted by bus drivers, whose behaviour varies from the considerate to the aggressive.

4.4.2 Motorists' overtaking behaviours

4.4.2.1 Problematic motorist behaviours that reduce cycling safety

The police officers reported that the main unsafe overtaking behaviours displayed by motorists were passing too close, attempting to pass in an inappropriately narrow road environment, impatience, not hanging back and waiting for there to be enough space to pass safely, passing at high speed, passing and then cutting back in tightly, or passing and then immediately turning directly across the cyclist (side swiping).

4.4.2.2 Contextual and environmental influences on problematic behaviours

In rural environments on open roads, the high passing speeds and speed differentials were considered to be more of a safety factor, while on narrow, winding, rural routes, the timing, speed of passing and choice of location of where to pass were considered more safety critical.

Where roads have not been designed to accommodate both motor vehicles and cyclists, the lack of space, for example on inner city routes with roadside parking where there is an emphasis on minimising travel time and busy schedules, can lead to unsafe passing behaviour, where cars squeeze past cyclists.

The police officers were of the opinion that, given the physical constraints and financial investment to modify infrastructure in order to provide a safer environment for cyclists, behaviour change was a better/cheaper alternative.

An example was given of where cones for roadworks have reduced the size of the road shoulder to the bare minimum on SH2 forcing cyclists to ride in the main traffic lane alongside high speed motor vehicles, with less passing distance available within the lane. On the other hand, at the longer term roadworks for the construction of the new SH1 expressway at Paekakariki, cyclists have been provided for with dedicated cycle-ways, separated from other road traffic that ensures safer passing provision.

4.4.3 Discussing the concept of a minimum overtaking gap law

4.4.3.1 Views on safe passing distances

In terms of whether the current recommendations around passing distance were appropriate to become a legal requirement, there was a feeling that in general a 1m passing distance would be sufficient in low speed urban environments, and also provide enough lee-way to accommodate some change in direction/wobble room for cyclists. The 1.5m passing gap was thought to be generally appropriate for higher speed environments, but on some rural roads it was suggested that there might not be sufficient lane width or suitable geometry to accommodate such a wide passing distance, in which case the combination of a slower speed and choice of suitable passing space would be more critical.

4.4.3.2 Regulatory options for addressing unsafe overtaking distances

The current catch-all infringement for unsafe passing behaviours is 'careless use', for which there is a relatively high threshold of requirements to be met, given the considerable amount of paperwork involved in the reporting process. Having a standalone law relating specifically to passing distance was considered to be helpful from the police officers point of view, in that it would provide an additional tool that police officers could apply to these particular types of infringements.

Enforcement of a potential MOG law

The police officers thought that the legal requirement for motorists to leave a minimum overtaking gap when passing cyclists would be an infrequently applied law, given the necessity for a police officer to directly witness the infringement taking place, and then be able to provide substantive evidence about the actual passing distance observed in order to enforce it. Police officers would be most likely to attend an incident after the event – and probably only in the event of a cyclist being struck and/or injured, at which point it would become a case of 'he said vs she said', with no substantive evidence.

Even in the absence of enough evidence to enforce the law, it was mentioned that its very existence would provide the opportunity for officers to educate motorists and deliver verbal warnings around unsafe passing behaviour.

One officer suggested that it would also provide the opportunity to build up related case laws following collisions, for example, if the motorist passed close enough for the cyclist to touch the vehicle with an outstretched arm, then this could be considered as a 'too close' precedent when considering future cases'.

They also raised the issue that if a law was passed, there would be a group of cyclists who would have expectations and make demands around the law being enforced by the police, which for the reasons outlined above, in most cases would be unrealistic and impractical.

Other wider implications were raised, such as whether there would be the need to ban cyclists from some routes where there was insufficient width to accommodate the new law, or whether there would be pressure for the Transport Agency to engage in road widening projects.

Resource allocation

The allocation of resources to police a new MOG law was discussed, and the general feeling was that the amount of resources allocated depended on the level of risk identified. If cyclists were regularly involved in collisions or 'close calls' on a particular stretch of road then the police would look into it further – perhaps by patrolling the route at key times to identify unsafe behaviours and intercept offending motorists.

They also commented that looking at where unsafe passing distances sit within the bigger road safety picture, that the 'big killers' on New Zealand roads are still speed and non-use of seatbelts, and that they would 'hate to introduce anything that would take resources away from these'.

In practical terms, the police officers commented that while theoretically road patrol officers are constantly monitoring the range of motorist behaviours during the course of their on-road duties, in reality this is compromised by their need to attend to urgent issues (for example getting quickly and safely to the scene of crimes). Even when engaged in less urgent tasks, it was reported that road patrol officers are likely to focus primarily on their immediate task, and then on any high risk behaviours observed. They suggested that for some officers, cyclists did not feature high enough up the priority chain in relation to their other responsibilities.

Effect on the wider roading network

In terms of any impact on a MOG law on network efficiency, the police officers considered this to be minimal – 'you might have to wait a few more seconds before being able to pass safely', but under existing traffic conditions, this would not cause any significant delays. They did wonder whether a substantial increase in the numbers of cyclists on the roads might have an impact on network efficiency. This was thought to be potentially the case on routes where fewer opportunities currently exist to pass safely. However, they also discussed the flip-side of that scenario being that the presence of more cyclists on the roads would probably reflect an equivalent reduction in the number of motorists on the road, which would in turn provide more road-space for safe passing behaviour.

They also raised the idea of the redistribution of parking spaces to provide more road space in inner city environments, where opportunities to make changes to the existing physical infrastructure are limited. The removal of parking bays was suggested as one way to create the space needed to provide a greater number of designated cycle-paths and improved connectivity of cycle-ways across the Wellington urban area, and to provide greater road width for safe passing behaviour. The likelihood of this being realised was, however, thought to be low given the associated loss of revenue to the city council, and the objections of shop owners and the general public around the convenience and practicalities of accessing services in the CBD by localised on-street parking.

The allocation of space in relation to cyclists sharing footpaths with pedestrians was also discussed from a number of angles. Firstly, in terms of the appropriate age for children to be allowed to continue to cycle on the footpaths given their stage of development, and the age at which children are developmentally equipped and should be encouraged to ride on the roads, and how this transition could be supported by parents and schools. Secondly the sharing of space was discussed in terms of the lack of clarification around how the space should be allocated on some shared footpaths, where there are no signs or other visual indications of how cyclists and pedestrians can most effectively and co-operatively share the space.

A MOG law in the wider road safety context: Education and behaviour change

The officers saw benefit in introducing a MOG law as one part of a package of measures delivered to raise motorist's awareness of cyclists as vulnerable road users and the concept of safe passing behaviour (distance and speed).

They also raised the point that there is a long list of laws that hardly ever, or never get enforced, such as the so-called “child smacking” law, or the law requiring motor vehicles to have a sun visor, because in practise it’s extremely difficult to enforce these, but that this does not mean that there should not be a law. While they did not see the introduction of a MOG law as solving the problem, they felt that it was a useful step in starting the conversation and encouraging culture change.

The police officers expressed some cynicism about how well safety campaigns are able to re-educate road users in terms of their driving behaviours, but felt that promoting a fundamental culture change for all road users was a really important factor in promoting cyclist safety. They suggested that if a new MOG law and associated education/safety campaign was delivered and continued to be rolled out and refreshed periodically over a reasonable period of time, it would be a starting point for a change in attitudes and behaviour for all road users that would ultimately enhance safety. Engaging the public in the conversation was seen as key to success, and the police officers felt that an organisation such as the AA would be appropriate to deliver the message, since the police or the Transport Agency would simply be seen as taking a big brother approach. They also suggested that the message would need to be ‘big’ and frequently refreshed so that there would be wide spread dissemination, such that the public would be talking about it and buy into the message. If ownership of the issue by the public at large was established, then this would in turn realise a social pressure to modify behaviour in order to display characteristics attributed to the concept of a ‘good driver’.

They suggested that the types of campaign most likely to be successful were those emphasising the social aspects around how our behaviour as road users impacts on others. They offered examples of the ‘drive social’ campaign, and the ‘Mum’, ‘Teacher’ personalisation of cyclist’s campaign. They felt that these were providing the right kind of message, a more positive reinforcement that could be built on to promote safer passing behaviours. They suggested that any message would be better framed around behaviours that demonstrate ‘good driving’, courtesy to others and social responsibility. They felt that it was more useful to encourage a culture where road users are person/individual focused, to encourage disconnection from adopting or making assumptions based on negative stereotypes attributed to road user groups. They also felt it was important that the message demonstrated equality and fairness, so that rather than one group being encouraged to modify their behaviour for the benefit of another, that all road user groups were included within the code of conduct, such that cyclists and other vulnerable road users also had responsibilities to share the road co-operatively.

The police officers also suggested the wider need to introduce ‘civics’ as part of the school curriculum, where children received education around basic social etiquette during interactions with others, including elements around courteous and safe driving/riding behaviours.

4.5 A discussion on the costs and benefits of a minimum overtaking gap law

Any regulatory change related to a minimum distance between overtaking motor vehicles and cyclists would be in the form of a rule change. In this case, the law making could be done by amending the Land Transport Road User Rule (2004). A law change of this kind would be aimed at improving cyclists’ safety and their safety perceptions by incrementally increasing the minimum overtaking gap. If successful, this would create an incremental increase in cycling numbers (through increasing its attractiveness) and improve the personal safety of cyclists by reducing collisions with motorised vehicles. The benefits of a rule would depend on what is achieved by the rule, or alternatively what would be achieved without the rule to promote a minimum overtaking gap (such as via advertising, education, and behaviour change initiatives). In both cases, the public education component would likely be similar in size, with only some of the content changing.

At the onset of this investigation, this project aimed to conduct an estimation of the benefit to cost ratio related to a minimum cycling gap rule for motorists. However, other sections of this report have shown categorically that the evidence available at this time makes such an estimation impossible with any level of accuracy. So a qualitative

narrative was conducted in its place supplemented by consideration of a range of scenarios using numbers assumed for illustrative purposes.

4.5.1 Costs

4.5.1.1 The process of implementing a rule change and evaluation

Some of the more substantial costs associated with such a rule (though predominately within internal budgets) are the costs of implementing it, both during and following the Government's rule making process. There is some Governmental resistance towards the implementation of rules unless there is a clearly demonstrable need for them. Consequently, the process for implementing a rule can be challenging, particularly when there is a lack of well-defined evidence of its utility. Implementing a rule is not likely to involve an increase in Government expenditure, as resources are finite. Therefore, any extra expenditure would be offset by a reduction in resources pertaining to other projects, which makes opportunity costs pertinent to this discussion.

According to the Transport Agency's website:

Land transport rules are a form of delegated legislation similar to regulations. The Transport Agency produces rules for the Minister of Transport under an agreement made with the Chief Executive of the Ministry of Transport (Transport Agency, 2016a).

There are certain prerequisites that have to be met before such a rule change could be made. It needs to be clearly demonstrated that the rule is worth making and that it is carefully planned. The Government should:

...not propose regulatory change without clearly identifying the policy or operational problem it needs to address, and undertaking impact analysis to provide assurance that the case for the proposed change is robust; careful implementation planning, including ensuring that implementation needs inform policy, and providing for appropriate review arrangements (Ministry of Business, Innovation & Employment, 2016/2017).

The rule needs a risk-based compliance and road policing strategy providing the information to the target group to understand what is expected of them. There must be a post-project review of the process and an evaluation of its impact²³. The rule making process is summarised by the Transport Agency flow diagram (Figure 4.4).



Figure 4.4 Transport Agency Rule Change Process (Transport Agency, 2016b)

The consultation phase includes:

- Publication of a notice of proposed rule-making
- Allowing interested people a reasonable time to make submissions
- Consulting with relevant groups and individuals both within and outside the land transport system
- Making any needed changes and if necessary feeding back.

Figure 4.5, released by the Transport Agency, illustrates the process up to the finalisation and signature of the rule, or alternatively, the discarding of the rule in favour of a different process for achieving the objective or deciding that the objective is not worthy of further action (Transport Agency, 2016b).

²³ Evaluation of the impact of a rule is provided for in the rule making process but there are no guidelines for such evaluations. If evaluations were conducted however, there would be an associated cost.

The material in this figure indicates that the Government holds that rule changes should not be made lightly and that there is therefore a very robust, evidence based process to go through before new rules can be signed by a Minister. Therefore, a rule related to a minimum distance between overtaking motor vehicles and cyclists, along with all rules, will be subject to a high level of scrutiny before implementation. If a rule is controversial, expenditure on the rule making process (although mainly covered by existing internal budgets), may go beyond existing budgets, and represent an opportunity cost related to other uses of the funds.

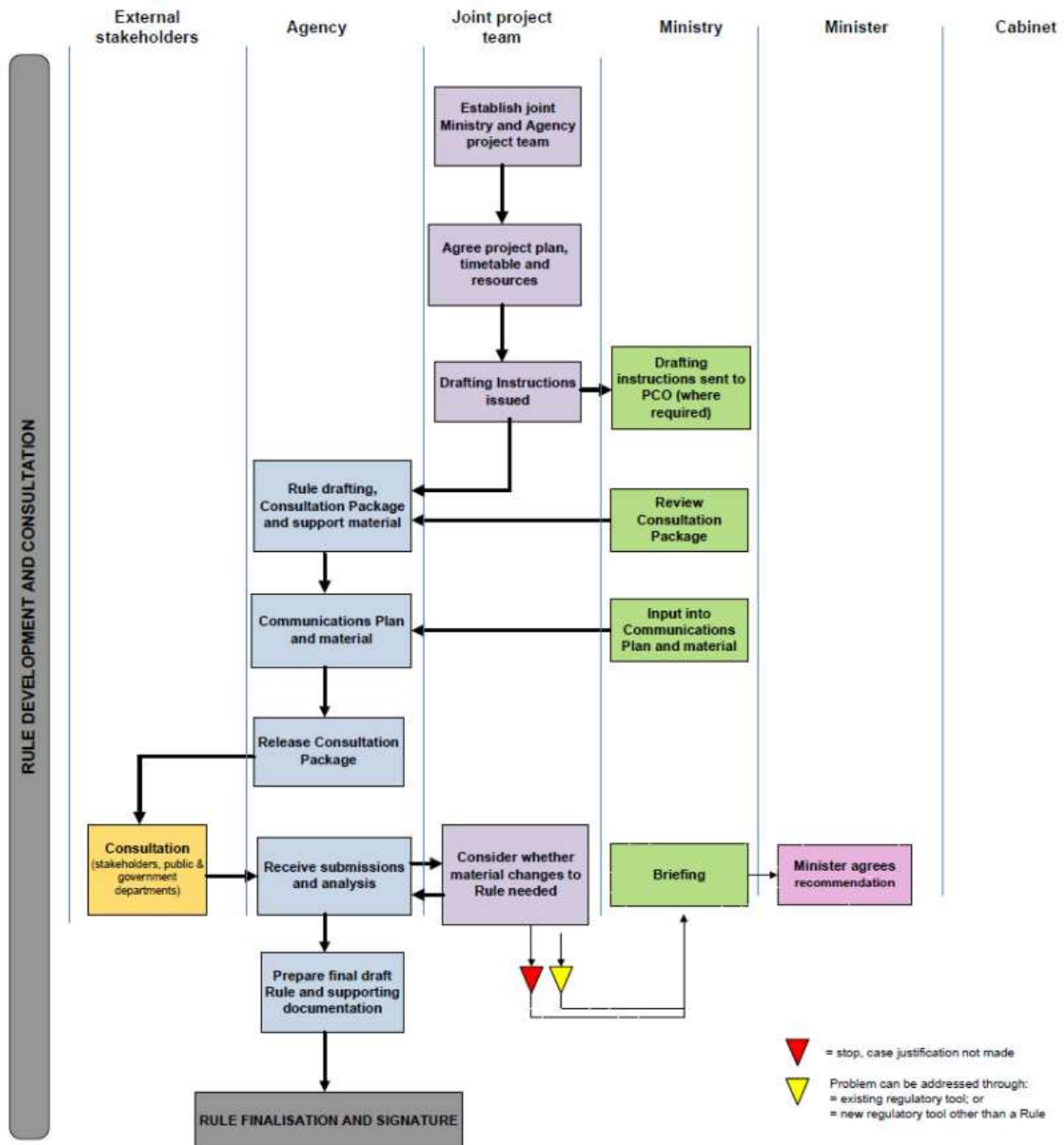


Figure 4.5 Process overview of the Rule Development and Consultation phase (Transport Agency, 2016b)

4.5.1.2 Public education

Any rule change would need to be well publicised at inception to comply with the requirements of the rule making process, which would include an educational or awareness raising campaign component. Regarding ongoing public education, the impact of the rule in this case is a contingent impact, given there is already an existing level of public education regarding drivers giving cyclists room, such as “Share the road” initiatives. Therefore, public education would be a cost associated with such a rule only if the ongoing cost of public education with a rule exceeded the cost of public education without the rule. So any incremental expenditure associated would need to be taken into account in looking at the rule’s costs and benefits.

Except in the much aggregated parcels presented in the Transport Agency’s public documents (e.g., English & Hide, 2009), details of expenditure on public education by the Transport Agency are not available for this report as they are commercially sensitive. According to the Transport Agency, the total spend on road safety advertising each year is around \$13 million dollars.

4.5.1.3 Road policing

Road policing costs would need to be considered on an incremental basis as there are existing road policing resources provided for cycling safety. These incremental costs would be:

- Any possible extra patrol hours associated with the rule.
- Any capital equipment costs associated with the rule.
- Any non-patrol time associated with the rule. This might include the setting of standards for, and calibration of, any equipment used to measure the distance of motorists from bicycles for road policing purposes, if indeed such equipment is in fact used for evidential purposes. Such equipment has only been used to issue warnings in a handful of jurisdictions so far (mainly in the US alongside some cases in Canada and Europe). Thus it has not required any special calibration to special standards of measurement to meet justice sector requirements. This can be an expensive and frustrating process as evidenced by past experience with speed measuring and alcohol measuring devices. An option in New Zealand that would avoid these costs would be to use equipment in a similar way to the American jurisdictions to advise Police when some sort of a warning, or just ‘friendly advice’ might be appropriate. Equipment could be used in this sort of way with or without a rule. Alternatively, more traditional ‘observational’ methods can be used where police officers make a judgement call regarding passing distances and follow-up with the motorists with a similar said warning and/or infringement (as is the procedure in Queensland, Australia; (Schramm et al., 2016).
- Any costs associated with the processing of infringements, though, it is assumed here that any offences against any rule would be infringements rather than the more expensive court offences.

Spending under the National Land Transport Programme, which finances road policing, is limited in its government spending and extra resources, and therefore parameters will need to be put in place to optimise funding in an effort to avoid depletion of other existing safety expenditure.

4.5.1.4 Road user delay costs

It is possible that compliance with a rule may impose delay costs on other road users. There is no evidence at present that such costs are incurred to any significant extent, but they are a cost. Equally, any crash savings could be considered, at least in part to other road users who might otherwise be involved in the crash. Currently, there is no available data regarding the possible delays and how they vary according to type of roads, road widths, and traffic volumes; making a cost calculation difficult to perform. However, under the premise that, in an urban environment on narrower local roads, compliance of a MOG law may lead to a speed reduction – creating a safety benefit by reducing crash risk. Moreover, this benefit may well be equivalent to any additional vehicle operating cost or travel delay cost caused by the MOG law – making the total effects neutral. For other higher volume roads and open road state highways, the standard vehicle lane is generally 3.5m, and for such roads shoulders are the norm. Thus, it would only be if a cycle is not using the shoulder that a car would have to cross

the centre line in order to pass. This would be a relatively infrequent scenario, and as such the delays associated with this will be ignored for the purposes of this report.

4.5.1.5 Opportunity costs

Unless the government allocates new funds to the implementation and continuance of a new rule, funds needed to support the new rule will need to be diverted from other uses in the transport sector. Were this to be the case, the marginal benefits of the new rule should be shown to outweigh any disbenefits in the transport area from which the funds were taken. This reallocation of resources is very important with safety measures as, under a safe system approach to road safety, it is imperative to use scarce road safety funds as effectively as possible. Further discussion of this is out of scope for this document, but it is a factor of which policy makers should be mindful.

4.5.2 Benefits

The main potential benefits of a MOG law (with a complementary education campaign) include:

- Increased cyclist safety
- Increased cycling, through making the roads appear more hospitable to cyclists thereby accruing health benefits. This benefit would be subject to some mitigation owing to the extra cyclists being subject to greater risk than if they were using other modes, with the exception of motorcycling, which has greater risk (Ministry of Transport, 2015c). However, any associated costs through increased risk are unlikely to outweigh the equivalent health benefits.
- Reduced vehicle emissions due to a possible mode shift towards cycling.

It is known from the literature review that, at best, there is scant evidence to show that any of these impacts have ensued overseas where such rule changes have been made. This does not mean that such impacts do not exist, nor does it mean that they do exist but rather that the research evidence is currently inadequate for the production of confident predictions.

Also, as previously mentioned, the impact of any rule would be a contingent and incremental impact, given an existing level of public education and road policing regarding drivers giving cyclists space.

4.5.2.1 Social cost of relevant cycle crashes

As agreed by Opus and the steering group, the number of relevant cycle crashes involving injury in the period 2006-2015 inclusive is 2196²⁴. Therefore, the average per year is 219.6. According to official Ministry of Transport figures for 2015 (Ministry of Transport, 2016a), (see Table 4.20) the social cost associated with an injury crash is \$371,000. Therefore, the average social cost of these crashes per year may be estimated to be a total of \$81.4 million. Therefore, if a MOG law would result in an increase in cycling safety, it would have the potential to produce savings through a reduction in cycling injuries and fatalities.

Table 4.20 Social cost per crash - 2015 update

Crash severity	June 2015 prices (\$)		
	All	Open roads	Urban roads
Fatal	4,709,000	4,840,000	4,337,000
Serious	900,000	955,000	850,000
Minor	95,000	102,000	91,000
Serious and minor	247,000	303,000	213,000
Fatal and serious	1,400,000	1,689,000	1,095,000
Fatal, serious and minor	371,000	539,000	262,000

²⁴ See the statistical analysis in section 4.1.

4.5.2.2 The health benefits of cycling

The health benefits of cycling are documented in (Genter, Donovan, & Petrenas, 2008). Table 4.21 below provides per kilometre estimates of these benefits as they relate to other active modes. The authors recommend using the medium level benefits in work of this kind.

Table 4.21 Per kilometre benefits of active transport modes

Scenario	Annual benefit	Per km walking	Per km cycling
Low	\$3,112	\$3.53	\$1.77
Medium	\$3,765	\$4.27	\$2.14
High	\$4,417	\$5.01	\$2.51

The information in Table 4.21 combined with travel survey data now allows the calculation of the total health benefits of a year of New Zealand cycling. Annual cycling kilometres from the New Zealand Household Travel Survey related to the period 2011-2014 inclusive are available from the Ministry of Transport web site (Ministry of Transport, 2014a). The relevant table from the website report is shown in Table 4.22.

Table 4.22 Mode share of time, distance and trip legs

Travel mode	Trip legs in sample	Million hours per year	Million km per year	Million trip legs per year
Car/van driver	95,557	820	30,374	3,093
Car/van passenger	47,718	430	17,104	1,513
Pedestrian	29,874	205	807	987
Cyclist	2,797	25	313	71
PT (bus/train/ferry)	4,309	66	1,521	163
Motorcyclist	594	6	250	19
Other household travel	1,196	35	See note ²	38
Total	182,045	1,586	50,897	5,885

Note: ¹ Distances unavailable for ferry trips.

² Some distances not available.

Totals may not add exactly due to rounding.

Using the figures in from Table 4.21 and Table 4.22 the average health benefits of a year's cycling, by all cyclists in New Zealand, at 2008 prices may be calculated as the product of the 313 million kilometres per year and the medium level benefits of \$2.14 per kilometre from Genter et al., (2008). This comes to \$670 million. The cost of road crashes are indexed to the average hourly earnings to express the value in current dollars. Expanding the 2008 health benefits figures by this index gives a 2015 figure of \$760 million for the average health benefits of a year's New Zealand cycling. Appendix A20 of the Transport Agency's Economic Evaluation Manual (EEM; Transport Agency, 2016a) uses a lower value of \$1.45 per cycle kilometre generated by new facilities. This report, for the sake of completeness uses both values.

4.5.2.3 Emissions saved

Table 4.23 from Victoria Transport Policy Institute (2015) features year 2000 air pollution costs by vehicles by urban, interurban and petrol/diesel. Table 4.24 gives the percentage of road travel in major urban areas (Ministry of Transport, 2014b).

Table 4.23 Air pollution cost (year 2000 Euro-cents/vehicle kilometre)

	Passenger Car	Heavy Duty Vehicle
Urban, petrol	0.17 (0.17 - 0.24)	
Urban, diesel	1.53 (1.53 - 2.65)	10.6 (10.6 - 23.4)
Interurban, petrol	0.09 (0.09 - 0.15)	
Interurban, diesel	0.89 (0.89 - 1.80)	8.5 (8.5 - 21.4)

Table 4.24 Percentage of road travel in major urban areas

	2007	2008	2009	2010	2011	2012
Road travel (millions of km)	22,036	21,914	22,269	21,818	20,358	21,408
Percentage of road travel	46%	45%	44%	45%	49%	47%

Table 4.24 shows that the urban and rural vehicle kilometres of travel are approximately the same. Thus, using the approximation that all vehicles are petrol driven (based on the relatively small proportion of diesel vehicles in the fleet; Ministry of Transport, 2015a), and ignoring heavy vehicles, the average pollution costs per vehicle km are around $(0.17+0.09)/2$ Euro cents in year 2000 prices. This comes to 13 Euro cents in year 2000 prices or about 25 New Zealand cents.

4.5.2.4 Benefits that might accrue from a 1% cycling increase

Given the lack of research evidence, the following section of the report makes a number of assumptions that are presented as an illustrative exercise to exemplify the potential benefits of an increased cycling mode share.

Were an assumption made that a MOG law could increase cycling by a one-off, sustained step change of 1%, then the future health benefits would be \$7.6 million per year and the cycle related crash disbenefits from the increase in cycling would be \$0.81 million assuming the extra cycling would be at a similar crash rate per kilometre as existing cycling. If an additional assumption was made that there would be a decrease in cycle crashes related to the new rule of 1% this would approximately wipe out the increases related to the increase in cycling, leaving essentially a nil impact on crashes.

However, if one assumes that these new cyclists previously used cars (they may be ex-walkers or public transport passengers but for the purposes of this document, this will be ignored) then their 3.13 million additional kilometres travelled would be at the expense of car travel. Assuming vehicle occupancy of 1.5 people (Ministry of Transport, 2015d)²⁵, this would equate to approximately 2.1 million fewer vehicle kilometres travelled each year.

The Ministry of Transport figures indicate that there were 23 injury crashes per 100 million vehicle km in 2015 (Ministry of Transport, 2016b). Applying this figure (which is for all vehicles) as an approximation to that for cars, 2.1 million fewer vehicle km corresponds to an average saving of half a crash per year or \$0.185 million. Therefore, ignoring emissions for now, the total benefits of a 1% increase in cycling mode share can be calculated by the following:

- Additional \$7.6 million (health benefits)
- Minus \$0.81 million (crash disbenefits related to increased cycling)
- Additional \$0.81 million (crash benefits related to the new rule)
- Additional 0.18 million (crash benefits from reduced car travel)
- A total of \$7.8 million.

To allow for emissions saved, it can be noted that emission costs avoided by reducing vehicle kilometres of travel by 2.1 million vehicle km are the product of 25 cents/km and 2.1 million vehicle km. This would yield a result of

²⁵ Discounted a little to provide an approximate figure of 1.5.

\$520,000, though it would be subject to inflation in prices as the emission cost per kilometre is based on year 2000 prices and also decreases in per vehicle emissions due to vehicle fleet changes. As these are unknown, it is not proposed to adjust the number to current values. Allowing for this reduction in emission costs makes a total benefit of \$7.8 million can be gained, with an additional \$0.5 million totalling \$8.3 million annually. If the lower figure for cycling health benefits used in the EEM is substituted, then the total benefits are \$6.1 million.

4.5.2.5 The impact of cycling changes by amounts different from 1%

Owing to the lack of evidence available from the literature, any changes in cycling that might ensue from such a rule change are still uncertain. However, if cycling were to change by a different amount than 1% or not at all, then the figures would change proportionately. It would be exceptionally difficult to detect if such a rule did impact on the amount of cycling as other influences on cycling would be happening at the same time as the rule was introduced. However, it is also very difficult to consider that any negative impact on cycling would ensue. Therefore, this report assumes either a zero or positive impact on cycling. Table 4.25 looks at the impact for a number of percentage change scenarios. Costs and benefits are in thousands of dollars.N

Table 4.25 Cost and benefit scenarios related to various levels of increased cycling (\$1000)

Percentage change in cycling	Change in cycling crash costs ²⁶	Change in motor vehicle crash costs	Health benefits	Emission related benefits	Net benefits
0	-810 ²⁷	0	0	0	810
0.25	-608	45	1900	130	1467
0.5	-406	90	3800	260	3744
0.75	204	135	5700	390	6429
1	0	180	7600	520	8300
2	810	360	15,200	1040	17,410
5	3240	900	38,000	2600	44,740

These figures indicate that the benefits are dominated by the health benefits of cycling, which in turn depend heavily on achieving, as a result of the change, an increase of cycling. This would be the same whatever the increase in cycling assumed, as crash costs also depend linearly on the amount of cycling.

As an example, using the assumptions involved in deriving Table 4.25, the net benefits of the law would be around \$8 million per year were cycling to increase by 1%.

The Transport Agency's economic efficiency assessment criteria considers a new initiative to have high economic efficiency if it has a benefit to cost ratio of four or more (see Table 4.26; Transport Agency, 2012). The total Transport Agency advertising budget is \$13 million per year (which, of course, does not include any road policing costs).

²⁶ Assuming the increased crash costs from more cycling are offset by decreases in cycle crashes related to the new rule. The increments as the column is read downwards originate from the assumed increases. The total crash cost change is zero in the 1% change row as for a 1% increase in cycling the crash benefits from the law are assumed to be equal to the crash disbenefits from the increase of cycling.

²⁷ This figure represents the crash costs associated with the crash movements agreed as relevant by Opus and the steering group.

Table 4.26 The Transport Agency's economic efficiency assessment criteria

Activity type	Economic efficiency assessment criteria			
	High	Medium	Low	No rating
Improvements and new initiatives	Benefit-cost ratio greater than or equal to 4	Benefit-cost ratio greater than or equal to 2 and below 4	Benefit-cost ratio greater than or equal to 1 and below 2 Non-monetised benefits that are not included in the benefit-cost ratio may be considered by the NZTA Board in support of the benefit-cost ratio	When no assessment has been made
Maintenance operations and existing services	Cost-effectiveness shows above-average efficiency through benchmarking	Cost-effectiveness shows average efficiency through benchmarking	Cost-effectiveness shows below-average efficiency through benchmarking	When no assessment has been made

For illustrative purposes, the assumption may then be made that the threshold for instituting a rule is high economic efficiency measured by a benefit cost ratio of four or greater. Then using the health benefit figures from Genter et al., (2008) yearly expenditure of up to about \$2 million, or 15% of the existing advertising budget might be justified. This expenditure could include both promotion and Police enforcement costs. Such expenditure would only be taken in the absence of competitive projects, which show a greater cost effectiveness. Were the lower values for health benefits of cycling from the Economic Evaluation Manual (EEM) used, then an expenditure of up to about \$1.5 million or 11.5% of the existing advertising budget would be justified.

Were a rule to have no impact on cycling mode share, but an associated 1% impact on crashes, the health benefits would equate to zero, the emission benefits would also be zero and the residual would be crash benefits of \$0.76 million. For a threshold benefit cost ratio of four to be achieved would require extra yearly expenditure to be restricted to around \$200,000 or 1.5% of the existing advertising budget per annum.

However, as stated before, the amount of cycling, if any, such a rule might generate is very difficult to gauge as the literature has little to offer in hard information, un-confounded by other work being carried out simultaneously, with broadly similar deliverables.

4.5.3 Discussion

Government has a policy to regulate only when there is a demonstrable need. This policy demands that any rule change be preceded by a high level of justification that the incremental benefits of the change, over and above the benefits of a non-regulatory solution, are substantial.

This research project has shown that the benefits of amending the Land Transport Users Rule (2004) to require passing a bicycle with a specific distance (e.g., less than one-metre clearance) are unclear from the evidence available from overseas jurisdictions that have instituted such a rule change. The benefits also remain unclear after the results of this research project are taken into account. While it is intuitive that cycling could increase, as there is subjective evidence that perceived safety, a key barrier to cycling uptake, increases following a MOG law, there is simply no clear information available showing evidence of an increase from previous experience overseas or from this research project at this time.

The costs are specific to the situation in New Zealand and include among others direct public expenditures on police hours and equipment and Transport Agency public education. These costs would vary greatly depending on the policies adopted were there a decision to go ahead with a policy to develop a rule. There would also be the marginal costs on top of any existing costs incurred in this area. A detailed assessment of the costs would also require disclosure of the Transport Agency advertising costs, which while the overall amount is available, the detailed breakdown is commercially sensitive information that would not be appropriate for disclosure in a publicly available document of this kind.

When a number of scenarios related to possible increases in cycling are looked at, the benefits are dominated by cycling related health benefits. Therefore, the efficacy of a rule change would depend, in the main, on how much extra cycling would accrue to the rule in addition to that which would occur if non-regulatory measures were used

instead. Table 4.27 summarises the maximum ongoing yearly expenditures permissible on such a rule given a threshold benefit to cost ratio of four (high economic efficiency) for the values of cycling health benefits from Genter et al., (2008) and the EEM. The table has two sections. The first assumes a 1% increase in cycling and a 1% decrease in cycle crashes and the second no change in cycling and a 1% decrease in cycle crashes.

Table 4.27 Summary table of maximum ongoing yearly expenditures if a MOG law had a benefit cost ratio of 4

For a cycling increase of 1% related to a minimum passing gap rule, assuming the rule decreases cycle crashes by 1%				
	Value of health benefits /km	Total benefits with 1% increase in cycling	Maximum yearly cost for benefit cost ratio of four or high economic efficiency	Percentage of existing Transport Agency advertising budget
From Genter et al., (2008)	\$2.14	\$8 million	\$2 million	15%
From EEM	\$1.45	\$6 million	\$1.5 million	11.5%
For a zero % change in cycling related to a minimum passing gap rule, assuming the rule decreases cycle crashes by 1%				
	Value of health benefits /km	Total benefits with zero % increase in cycling	Maximum yearly cost for benefit cost ratio of four or high economic efficiency	Percentage of existing Transport Agency advertising budget
From Genter et al., (2008)	\$2.14	\$0.76 million	\$0.2 million	1.5%
From EEM	\$1.45	\$0.76 million	\$0.2 million	1.5%

4.5.4 Conclusions

There is a lack of clear information and/or research regarding the benefits of a MOG law. Therefore, there may be some doubt regarding the extent that the supporting evidence would be sufficient to fulfil the evidential requirements of the Government's purposefully stringent legislative process. The potential benefits of such a rule are dominated by health benefits associated with any increase in cycling caused by the law, over and above any increase associated with other initiatives.

The total Transport Agency advertising budget is \$13 million per year. This of course does not include any road policing costs nor costs associated with local campaigns conducted independently by Territorial Local Authorities and Regions. The net benefits of the rule would be around \$8 million per year were cycling to increase by 1%. Thus, if a benefit cost ratio of four was the threshold for instituting a rule, then, given such an increase, and using cycling health benefit figures, a yearly expenditure of about \$1.5-\$2.0 million would be justified (in the absence of competitive projects that showed a greater cost effectiveness), which is about 12-15% of the existing Transport Agency advertising budget. Were a rule to have no impact on cycling, but an associated 1% impact on crashes (following the same process and caveats) a yearly expenditure of \$200,000 would be justified.

Were a rule not proceeded with, the Police could still use instrumentation as a screening tool to help them decide whom to offer advice or sanction to regarding their behaviour in the vicinity of cyclists. This could involve charges under existing law in more serious cases, verbal or written warnings, or the driver could be sent an official police behaviour modification letter, similar to those sent to a proportion of people reported by *555 callers.

5 Discussion

This research project aimed to assist the Transport Agency in evaluating the feasibility and practicality of introducing a MOG law in New Zealand while also assessing the effectiveness of any complementary/alternative education campaigns. To this end, the research conducted a multi-pronged investigation, beginning with a comprehensive acquisition of existing research and knowledge in this space that then informed the subsequent quantitative and qualitative data collection phases. A final discussion on the costs and benefits associated with such law was then performed under a range of scenarios, enabling researchers to methodically determine the viability of the MOG rule, informing the formulation of final recommendations.

Overall, the findings provide answers to two key questions. Firstly, the CAS and on road field results give an indication of the current situation in New Zealand. Following this, the qualitative results from stakeholder workshop and interviews identify the future potential of cycling safety in New Zealand by giving evidence to the feasibility and practicality of introducing a MOG rule. The following sections address each of these in turn and go on to identify key findings as well as areas that warrant further investigation.

5.1 Current situation: What is a safe distance and how often are cyclists given such a distance in New Zealand?

A thorough review of the existing literature on minimum overtaking distance laws in overseas jurisdictions (including academic research and correspondence with overseas experts, alongside other formal documentation) revealed a general lack of conclusive evidence supporting the two main assumptions of a MOG law. The first assumption is premised on the claim that the selected distance (usually 1 metre or 3 feet) is an adequately safe or comfortable distance for a majority of riders (an assumption that has been critiqued by leading experts in the field of cycling and motorist interaction research; Brown et al., 2010; Haworth et al., 2014). Following on from this, the second assumption is premised on the claim that the selected distance is not provided by overtaking motorists at a considerable frequency, and thus warranting initiatives for behaviour change. Adding further complexity to the picture, a number of studies have suggested that such passing behaviours have a high level of variation depending on rider, motorist and environmental factors (putting into question the required complexity of any law for it to be successful).

To better understand the existing situation, the current investigation involved a series of bespoke on-road field trials that produced critical empirical evidence, comprising the most comprehensive data-set of cyclist-motorist interactions, including objective and subjective success measures, reported internationally.

5.1.1 What is a safe distance?

To provide clarification around what distance would be perceived as a 'safe gap' by cyclists on New Zealand roads, field data was collected that examined the relationship between rider discomfort and the overtaking distance of passing motorists in a sample of over 6,000 motorist-cyclist interactions. Riders pushed an event button on their handle-bars to indicate a sense of discomfort or high-perceived risk in their interactions with motorists. Discomfort or perceived-risk is arguably a key "near miss" indicator for actual cyclist safety (e.g. Aldred & Crossweller, 2015), and is perhaps more importantly a critical influencing factor for cycling uptake as it relates to acceptability by new or less experienced riders (e.g. Sanders, 2015).

The first key finding that emerged from the field analyses indicated that over 90% of motorist-cyclist overtaking interactions occurred at a distance of 1.5m, which was deemed comfortable. Further, in an urban environment under 60km/h speeds, over 90% of interactions were deemed comfortable at a distance of 1.0m or more. These findings align with the recent legislation implemented in a number of Australian states, and recent perception

studies from Queensland, Australia, where research showed that 80% of cyclists and non-cyclists agreed that motorists should provide at minimum 1.0m when overtaking cyclists at 60km speeds or below (and 1.5m at greater speeds; Schramm et al., 2016). It should be noted, however, that the distances in their study were estimates based on general self-report data (i.e., they were not directly matched with actual field data measurements).

Comparative findings were collected in a similar field investigation in Europe (with one cycling participant) that assessed the relationship between passing distances, speeds, vehicle size and the perceived comfort of the rider (by conducting a short interview after each trial; Llorca et al., 2014). This study revealed more conservative findings, suggesting that a minimum passing distance of 1.5m for 50km/h speed zones and 2.7m for 120km/h speed zones was required to fall within an 'acceptable level of risk' as perceived by their rider (Carlos Llorca et al., 2014). This disparity in findings could relate to a range of factors, including differences in the riding environment (cycling infrastructure, road width, shoulder width) or rider related factors (such as perceived risk or experience). In terms of rider factors, in the current study, even when just looking at beginner riders (who have the lowest cumulative threshold around comfort), the 1.0m distance is comfortable for 87% of interactions in urban environments, and a distance of 1.5m is comfortable for 93% of interactions in rural environments.

While motorist comfort was not directly measured, there is also evidence that a graduated overtaking gap law (i.e., different distances depending on the road speeds) would fit intuitively with their concept of a safe distance. A road speed hierarchy rule (i.e., greater distances at higher speeds) already aligns with how motorists naturally adapt to different road environments, as motorists already provide wider gaps when overtaking cyclists on higher speed major arterial and rural road environments (about 0.2m more space).

5.1.2 What is the extent of the problem?

Though motorist-cyclist space-related crashes make up only a small portion of overall crashes, these interactions were most strongly related to rider discomfort (or perceived safety) in the current study. For example, interactions relating to overtaking and lane changes represented 87% of rider discomfort, but these only represented 22% of actual crashes from the event-types noted by riders (and about 7% of actual crashes overall, including all crash codes). Thus, the relative benefit of a MOG law would relate more strongly to rider perceived safety than actual safety – a finding that is likely related to the regular frequency of overtaking events. However, when these low frequency events do occur (such as lane changes and rear ending crashes) they do represent higher severity events (with greater likelihood of fatality). Overall, consideration needs to be given to the trade-off between increased rider comfort (which will increase cycling uptake), a potential increase in safety from increased gaps (reducing some low frequency, high severity events), and any practical barriers and flow-on safety effects (like shifting the risk to an oncoming motorist) in increasing the gap. To better understand this trade-off, having knowledge of the exposure to different gaps is important.

With respect to the exposure to different overtaking gap distances, the majority of riders were given more than a 2m gap when being overtaken by motorists. Only 1.6% of motorists were within 1m of a cyclist and about 14% of motorists were within 1.5m of a cyclist. Putting this into context, if the current guidance of 1.5m (for all on-road environments) was enforced, then approximately nine out of ten of the existing overtaking interactions (86%) would already be compliant. If a MOG law existed that followed two broad road hierarchies (i.e., 1.0m slow speed zone and 1.5m fast speed zone), then for existing interactions 97% would already be compliant.

Regarding exposure and discomfort, about 97% of interactions were comfortable and this increased to 97.5% when focusing on motorist overtaking interactions. In other words, based on the current data, about 1 in 40 overtaking interactions would be perceived as uncomfortable (see

Table 5.1). This is meaningful to cyclists and potential cyclists in terms of growth of this mode choice as this would equate to about one uncomfortable event for every 22 minutes of riding (based on the exposure rate of 102 interactions with motorists per hour of riding). Beginner riders in this sample were exposed to fewer vehicle interactions per riding hour (which perhaps relates to behavioural adaptation to limit their exposure to interactions

with motorists). Therefore, while they were less comfortable with overtaking interactions (with about 1 in 37 overtaking interactions being perceived as uncomfortable), beginners experienced one uncomfortable event for every 31 minutes of riding due to lower exposure.

Table 5.1. Discomfort rates from motorist overtaking events by overall and beginner riders

Rider type	Discomfort rate from motorist overtaking interactions	Cyclist ride time (per Discomfort event)
Overall riders	1 in 40	22 mins
Beginner riders	1 in 37	31 mins

5.2 Future potential: What is the feasibility and practicality of introducing a MOG rule in New Zealand?

It is unfortunately the case that, due to the lack of previously collected evidence in support of the selected distance, as well as the lack of baseline measures of motorists overtaking behaviours, there are few evaluations to date that have assessed the effectiveness of currently operating MOG laws in overseas jurisdictions in their ability to produce concrete behavioural changes.

Despite these caveats, the CARRS-Q report, alongside the comprehensive report on 3-foot legislation in the US (Brown et al., 2010) and correspondence with international experts, provide invaluable insights into the perceptive change of such a law as well as the practicalities associated with its implementation and operation. Such insights were applied to better understand the feasibility of introducing a potential MOG law in New Zealand. Additionally, the qualitative data collection included in this investigation, as well as a cost-benefit ratio discussion, builds on such insights to develop a clearer understanding around the potential benefits, costs and practicalities that a MOG law and accompanying education campaign could produce in the New Zealand context.

5.2.1 Would a MOG law work?

In assessing the effectiveness of an introduced MOG law in Queensland, Australia, CARRS-Q conducted a comprehensive investigation into the effects of a two-year trial of such a law in their jurisdiction. Though their field data was unsuitable for behavioural measurements, self-reported behavioural changes (drawn from police interviews and large-scale surveys) revealed that there was a perceived shift in safety. Motorists, cyclists and police officers all agreed to an extent that some increase in passing distance (and consequently cycling safety) had been observed since the laws introduction (though to varying degrees depending on the participant's demographic). It is important to emphasise however that, while perceptual changes are significant in their own right, it is still currently unknown to what extent such laws are able to produce concrete behavioural changes as no field data were available to corroborate the self-reported changes.

5.2.2 Three main challenges associated with MOG law of enforcement, education and practical ability to follow the law.

While a perceptual shift in safety is encouraging, the results from the CARRS-Q report (alongside Brown et al., (2010) and correspondents) also identified two main challenges (which, if addressed adequately could be used as enablers) associated with a MOG law. An additional third challenge of 'ability to uphold the law' emerged from the qualitative components of this investigation, which raised a perception around New Zealand's topography.

5.2.2.1 Enforcement

Consistent and effective enforcement of a MOG law was frequently mentioned as a considerable challenge to its implementation and success due to the difficulty in acquiring robust evidence to support infringements of that law. Considerable advances are being made in the instrumented bicycle technology space, where police officers are now able to measure exact passing distances from passing motorists, as is the case in Texas (Healey, 2015) and Canada (Turner, 2016). However, the implementation of such technology is, at present, still largely impractical – as it requires a considerable amount of resources, and hence, in most cases would require a police officer to detect and defend close overtaking manoeuvres from a vehicle at a distance (weakening the strength of the evidence and making it difficult to hold motorists legally accountable in court). Similar issues of acquiring sufficient evidence were noted in the CARRS-Q report where most of the police officers felt uncomfortable in making judgement calls regarding the MOG law, and as such generally issued infringements either when a crash occurred, or with the presence of some kind of video evidence. As an alternative, some transport authorities and experts alike propose the use of a MOG law as primarily an educational or awareness-raising tool where it is used to issue warnings to motorists exhibiting unsafe passing manoeuvres, providing them with information about the law and the vulnerability of cyclists.

Corroborating with these perspectives, results from the qualitative data collected in this investigation (including on-on-one-interviews, a stakeholder workshop and a police focus group) identified enforcement as a key issue for the reasons mentioned above – a view that was expressed by cyclists, motorists and roading authorities. Some disparity emerged regarding the enforcement potential of a MOG law. A few of the stakeholders and police officers felt that, although enforcement would be difficult, it would bring the topic of cycling safety into public discourse and would be a cultural step towards legitimising cyclists as road users with rights and vulnerabilities. Something that was reflected independently in submissions to an inquiry into the law change in Victoria, Australia:

“...introduction of this law would highlight the vulnerability of cyclists, their legitimacy as road users and the need to be careful around them.” (p. 20, Parliament of Victoria, 2016)

In regional settings with a similar culture (Australia), there is evidence that as many as two in three “other drivers” do not consider cyclists to be legitimate road users (Johnson & Le, 2012). Indeed, these points of view saw benefits in the ‘light’ enforcement of the law, where it is used as an educational tool or as an additional tool for police officers in building infringement cases.

Contrasting with this perspective, a larger proportion of the participants felt that enforcement was essential for the success of the MOG law the reasons for which are twofold. The first reason relates to the idea that the perception (with some corroboration from the field data), that only a small minority of passes are currently unsafe and that this minority group would not be sufficiently motivated by educational efforts/warnings – implying that strict enforcement is necessary for their behaviour change. The second reason mentioned relates to the fact that the introduction of the law would be with an expectation that it would be enforced, and consequently, public backlash, followed by despondence, may ensue if such expectations are not met. Moreover, such sentiments are likely to be directed at the efforts or attitudes of the police authorities, rather than the practicalities of the legislation itself. The CARRS-Q research presents some evidence in support of such a reaction, given that, of the 22 police officers, only three had issued infringements during the two-year trial of the law, and 80% of cyclists and 50% of motorists felt that the law was seldom enforced (if at all; Schramm et al., 2016). More recently, in Queensland, it was shown that 87 motorists had been issued with minimum passing distance infringements (from April 2014 to January 2016), but it was unknown how many of these were also crashes (such that the infringement has just superseded existing dangerous driving laws; Parliament of Victoria, 2016).

In light of these findings, careful consideration should be made regarding the regulation of a MOG law for motorists overtaking cyclists given the difficulties and potential consequences of scarce enforcement. A “lack of meaningful police enforcement” and reluctance to enforce has led to the suggestion to increase the priority of this

rule in enforcement agencies in Australia (p. 78, Parliament of Victoria, 2016). This included the suggestion that further training be provided that helps officers feel more engaged with the law change as well as better understand what evidence is sufficient to issue an infringement.

Pucher and Buehler (2008) highlight that in cycling friendly cultures (such as Germany, Denmark and the Netherlands), part of their success is attributed to the strict enforcement of all relevant road rules, including ones that focus on cyclist behaviours (e.g., running of red lights) alongside the ones that apply to motorists (which, in their cases, are usually vulnerable user laws). This approach, the authors argue, creates a sense of equality and fairness in that all users are expected to take responsibility for ensuring the safety of their roads while also acknowledging the differential vulnerability of different road users (i.e., large vehicles, cars, cyclists, pedestrians). However, it should be noted that enforcement agency priorities will target those behaviours and road users in an effort to best reduce serious and fatal injuries, following a hierarchical, as opposed to equality-based approach.

Overall, if consistent enforcement is not enough of a priority, such that there is “scarce” enforcement, it may be worthwhile to consider viable alternatives to a law, such as using a warning approach using instrumented bike technology and comprehensive education campaigns. There are several practical challenges to enforcement such as measurement of distance, and understanding the conditions required for infringement notices. However, these barriers could be overcome if there was sufficient evidence to deem this law a high priority for enforcement.

5.2.2.2 Education/awareness raising initiatives

Across all sources of information, one of the most consistent findings was the perception that effective, comprehensive and consistent education and/or awareness raising initiatives are vital for successful behaviour change with respect to the overtaking cyclists by motorists (whether there is a law passed or not). On the more superficial level, such perceptions are fairly unsurprising given that an integral part of any legislative change (especially one that effects large scale behaviours) is the provision of adequate education and promotion. These would include awareness raising initiatives (i.e., media messages, advertisements) as well as more directed information aimed at providing instruction for behaviour change and the reason behind its importance (i.e., training efforts, evaluation of behaviours, continuous messaging of appropriate behaviours). This rationale emerged consistently in various discussions with stakeholders, where it was frequently mentioned that a well-designed education campaign was required, not only to inform people of the law in a consistent way, but to also raise awareness of the need for such a law by highlighting the extent of the issue.

Alongside this reasoning however, a more in-depth discussion emerged around the importance of education in addressing ‘the larger cultural problem’ – within which unsafe overtaking behaviours are situated. In the interviews, workshop and focus group; discussions were had around the current road and transport culture in New Zealand, which, at present, functions under an unequal hierarchy of road users. The premise of this being that larger vehicles are seen to dominate the roads, and that such a hierarchy subsequently favours cars, followed by cyclists and lastly pedestrians. The manifestation of this culture is one where the needs of the larger vehicle in any interaction are perceived as being of a higher priority and thus any action (whether that be of the individual users or by government) should be put in place to satisfy those needs first (and any compromise of those needs are deemed as less acceptable).

Contextualising this within a motorist-cyclist interaction, it was expressed by several participants (including motorists, cyclists and police officers) that cyclists are required to ride ‘defensively’ where the onus is put on them to ride cautiously, be clearly visible to other motorists and stay alert to risks. Likewise, there is a perception that, although most motorists endeavour to pass cyclists safely, that this be done only if it does not result in undue inconvenience or delays to motorists. Put together, this hierarchical cultural norm of road use results in a situation where cyclists are often portrayed as delegitimized road users – a perception that is held both by motorists (who may therefore be less attentive or engage in unsafe behaviours) as well as actual and potential cyclists (who are fearful and perhaps even resentful of the behaviour of motorists). As no data currently exists to corroborate these perceptions with a representative sample (i.e., surveys that assess attitudes and beliefs around cyclists as road users), these sentiments are largely speculative. Nevertheless, discussions of this kind highlighted the need for

longer-term behaviour change initiatives and education campaigns that incorporate and consider these wider social norms and perceptions.

In light of the importance of education campaigns, specific attention was paid to identifying what features and processes an effective education campaign would contain. Unfortunately, few official evaluations have been conducted to compare the effectiveness of education campaigns (MOG related or 'share the road' campaigns more generally both overseas and in the NZ context) due to a lack of clear objectives, success indicators and baseline measures. Despite this knowledge-gap, discussions from the workshop and interviews, as well as understandings drawn from Baglo et al., (2013) and the 2013 Seattle Bicycle Master Plan, reveal key insights to help guide the development of any future education campaigns aimed at addressing the aforementioned issues. This can build on the existing guidance principles, such as those outlined in New Zealand's 'share the road' campaign guide (Cambridge & Francis, 2006a).

Firstly, the campaign should employ scientific principles if it is to yield measurable results that can be evaluated. Thus, the campaign should set clear objectives that need to be met and identify success indicators that can be monitored over time. Accordingly, baseline measures of said indicators should be collected to enable for before and after evaluations of any actions (law or otherwise). In the instance of a MOG law, the baseline measures collected in this investigation can be used as a means of assessing the effectiveness of any future actions by evaluating behavioural changes over time. This however should be supplemented with survey methods to assess any perceptual shifts (or lack thereof) regarding safe overtaking behaviours.

Secondly, the campaign should consider the social context of the desired behaviour and should target specific audiences accordingly. Previous findings suggest that where a minority group exhibits unsafe passing behaviours, efforts should be made to portray the campaign in multiple ways, each of which attract the attention of and are relatable to the specific audience. It may prove more effective to engage the majority who are already motivated to pass cyclists safely by providing clearer instruction of the desirable behaviours and highlighting the fallibility of human attention, thereby acting as an 'encouragement' tool. For the unsafe minority however, more serious messages are perhaps warranted that highlight the vulnerability of cyclists and the consequences of unsafe passing manoeuvres (both for the cyclist as well as for the motorist in the case of a MOG law infringement or other legal action). In both instances, the desirable behaviours, especially in the instance of a specific desirable MOG, should be clarified using comparative approaches so that the viewers develop a context-broad understanding of what that behaviour looks like in a variety of conditions. The actors in such campaigns should be 'relatable' real people that the audience identifies with. In reaching all target audiences, and encouraging behaviour change for the long-term, the campaign should distribute messaging across all channels to ensure that information is disseminated broadly (including relevant non-road users such as road engineers and designers) and over a sustained period of time. Consideration should also be given to the construction of MOG specific road signs (whether relating to a law or guidance) to give credence and support to any initiatives.

The campaign should also consider the wider culture currently circulating around road use and the relationship between cyclists and motorists, and should even be extended to interactions with pedestrians (given the influx of shared-paths and the lack of clarity around their use). This could have the appearance for example of a vulnerable road user law, or social code of conduct for all road users. Such an approach would emphasize the desirable behaviours for all road users, taking into account their difference capabilities, restrictions and vulnerabilities. Responsibility would then lie equally with all the different road users to 'drive social', which would include adopting safe passing behaviours when overtaking cyclists, pedestrians crossing roads in appropriate places and times and cyclists complying with the road laws.

More specifically, key elements can be drawn from the discussions presented here to help inform campaign development. For example, the hierarchy of vehicles (and unfavourable views between different road users) could be addressed by providing information on the functionality and needs of all parties (i.e., the vulnerability of cyclists and the functionality of their bicycles as well as the limitations of motorist visibility and manoeuvrability). Highlighting the vulnerability of cyclists would emphasise that a MOG rule stipulates a minimum passing gap for a

reason, and would therefore also encourage motorists to give more than that if possible (circumventing the potential eventuality of motorists providing less space than they currently do). However, these perceptions are speculations drawn from a relatively small sample size and therefore a campaign of this nature would greatly benefit from a wider collection of perspectives (by means of surveys) to develop a clearer understanding of the current road user culture in New Zealand.

5.2.2.3 Ability to uphold the law

An additional challenge that was not frequently mentioned in overseas examples, but that was a consistent point of discussion in the interviews, workshops and focus group, was the practical ability of motorists to uphold a MOG law in the New Zealand context. These discussions were centred on the practical difficulty in following a MOG law in specific situations. Examples included steep, narrow and/or winding hills (of which there are many) where a motorist choosing to abide by a MOG law may technically have to wait before a safe passing opportunity would present itself.

Space on New Zealand roads

Better infrastructure was frequently mentioned or endorsed as something that would support safer overtaking behaviour and enable such a law to function more easily. However, depending on the nature of infrastructure solutions, these also have practical implementation challenges. Improvements are ongoing in terms of recent policy shift and investment in better cycleways in New Zealand, but there will always be challenges around space provision and conflict between different road users when they share spaces. With improved spatial data (like that collected in this study), prioritising key locations for targeted improvements is becoming easier.

However, while the ability to follow a law is more challenging under infrastructure space constraints relating to factors like road dimensions, these challenges are faced everywhere. There is no evidence that New Zealand roads would provide any unique issues in the implementation of a MOG law, when compared with overseas jurisdictions. In terms of road dimensions, in particular road width, there is evidence of some similarities between countries like Australia and New Zealand (perhaps due to the fact that the Austroads road design standards have been shared by engineers across both countries since 1989). For example, looking at comparisons of road widths between the space provision offered in Queensland (where the law has been implemented) and New Zealand, common urban cycling routes were slightly narrower (by about 1m on average) in Queensland, and there was little difference (about 0.1m on average) between common rural cycling routes between locations (see Appendix F). This indicates that, while there are likely to be challenges in the topography of the road, these challenges are not unique to New Zealand.

Space and rider discomfort

The field data in the results also indicated that discomfort is over-represented in certain temporal conditions that limit space, such as in the presence of heavy vehicles (where button presses were about three times as likely). When looking at discomfort in relation to more permanent conditions related to space (such as where there was either no shoulder, a tight shoulder or a full shoulder), there was a higher likelihood of discomfort in the no shoulder condition. However, there also appeared to be an expectation effect, where riders with no shoulder were also more tolerant of closer distances before they pushed the discomfort button. It is hypothesised that this was because riders adjusted their expectations of what constitutes a reasonable distance based on the space available. Subtle differences like this mean that the relationship between discomfort and road dimensions may not always be linear. This points to the fact that riders and drivers do recognise changes in their environment and adapt their expectations and behaviour accordingly. If supported by education and signage around higher risk situations, this could reduce discomfort and enhance safety.

Provisions and complementary laws

Finally, several provisions and complementary laws were suggested in the qualitative discussions to circumvent the aforementioned practical issues, such as the use of crossing of yellow lines (or painted medians) to safely overtake, or establishing a 'cycle friendliness' route system to give guidance to cyclists as to which roads are

more suitable for them. Similarly, education aimed at encouraging cyclists to pull over and let faster travelling vehicles pass on road sections without adequate passing opportunities (similar to other slow moving vehicles) could be put in place. Some recommendations have also been made for signage interventions, first, to encourage grouped riders to keep left and ride in single file along particularly narrow or tortuous roads, and second, signage to encourage drivers to overtake with care (Parliament of Victoria, 2016). For example, a 'slow to pass' provision could be included as an 'out clause' where motorists are required to reduce their speed in situations where the roads are too narrow to provide the specified distance (such as reducing from 80kph to 50kph to allow a smaller overtaking gap). A key point here is that drivers already intuitively take many of these adaptations and cyclists, as the majority of drivers at present overtake at the recommended 1.5m or more. Thus, formalising and communicating some of these provisions may help with rider and driver comfort.

5.3 Conclusions

Drawing from the findings across all aspects of this investigation, it can be said that improving cycling safety by changing motorist overtaking behaviours is a worthy cause that warrants the attention and effort of roading authorities, as well as the New Zealand public. As a potential avenue in achieving such a goal, the findings show that the introduction of a MOG law is a complex solution that holds both promise and uncertainty regarding its feasibility for improving overtaking behaviours (and cycling safety more broadly).

5.3.1 What we do know

Through a variety of approaches and methods, the current investigation has substantially enhanced our understanding of the feasibility of introducing a MOG law in the New Zealand context. Firstly, results from field trials revealed that, if a MOG law were to be introduced, there is now empirical evidence to support a speed graduated law. More specifically, results show that a 1.0m distance should be suitable for roads with speeds of 60km/h or less (i.e., urban roads) and a 1.5m distance should be suitable for roads with speeds over 60km/h (i.e., major arterials and rural roads). As these were the threshold distances where most riders were comfortable (including novice riders), the relative improvement in comfort beyond these distances was minor. These distances intuitively align with existing motorist behaviour, will focus improvement on the higher risk behaviour, and have been applied in overseas standards. It is important to note, however, that such a law should be sensitive to the fact that different riders feel comfortable at different distances and in different situations, and so, while the minimum is required, motorists should be encouraged (perhaps via means of an education campaign) to provide more space where possible. Complementing the field-data, discussions from the stakeholder interviews revealed that a graduated MOG law would be more suitable as it would be sensitive to the differential needs of cyclists at different speeds, particularly for less confident riders.

Secondly, the field results have given us a much clearer understanding of the extent of the problem in New Zealand. Findings show that, on the one hand, a relatively small proportion of passes were perceived as unsafe, giving credence to the perception that it is a minority of interactions that should be targeted for behaviour change (whether that be by MOG with education campaign or with education campaign alone). On the other hand, however, though low in frequency, the few passes that were perceived as unsafe were substantially distressing, and thus, could be deterring people from cycling on New Zealand roads (particularly new cyclists and tourists who are unaccustomed to close passes). This is a noteworthy finding given that the discussion on the costs and benefits showed that the benefits of introducing a MOG law would very likely out-weigh the costs if the law resulted in a 0.5% increase in cycling mode share. Put simply, the fact that these findings focus on 'perceived' safety does not detract from their importance as it is the perceived lack of safety that acts as a considerable deterrent from greater cycling uptake.

Finally, the gathered information regarding the effectiveness of a potential MOG law revealed that, if it is introduced with special consideration around its enforcement, education and practicality, it has the potential to improve the overtaking behaviours of motorists, and thereby greatly enhance the safety of cyclists on the road by

legitimising cyclists as road users as well as bringing cycling safety discussions into the public discourse. What is more, the law could be used as an educational tool to give immediate information to motorists exhibiting close passing gaps by police officers; while also giving authorities an additional piece of legislative evidence to support any crashes that may occur being a cyclist and a motorist. Well-executed, a MOG law has the potential to help shift the current culture of road use and could bring substantial health, social and economic gains to New Zealand through an increase in cycling mode share.

5.3.2 What is still uncertain

There are still considerable gaps in our knowledge regarding the extent of a MOG law's effectiveness and wider impacts, requiring further investigation. Firstly, a lack of behavioural baseline measures overseas means that, at present, there are scant evaluations of MOG laws effectiveness in improving overtaking behaviours. Although perceptual changes were observed in the investigation conducted by CARRS-Q, it is unknown whether such perceived changes would be matched with observable behavioural improvements, or any overall crash reduction. Lastly, similar uncertainties remain around the effectiveness of education campaigns (as standalone or complementary to law initiatives) due to the lack of evaluations, and as such, they too warrant additional research and consideration.

With respect to the 'feasibility' of a MOG law, there are numerous variables that would determine its effectiveness, including its enforceability, its practicality (in terms how easy it is to follow), levels of compliance and the response of the public to these factors, as well as the law itself. While informed estimates can be made, it is still relatively uncertain how such factors would manifest in the New Zealand context without additional information. Consequently, it is difficult to produce accurate estimates of the costs that would be involved in the introduction of such a law (and accompanying education programme). Moreover, due to the uncertainty of its effect on cycling mode share (i.e., we do not know whether it would in fact lead to a 0.5% increase), it is also unknown whether such costs would be out-weighed by the benefits (both social and economic).

Finally, the research is still scarce regarding the ability of motorists and cyclists to judge lateral distances while operating their respective vehicles. Research of this kind could be of substantial value, as it could have significant ramifications for the expected behaviour changes (of cyclists and motorists). A situation could transpire where motorists overcompensate due to uncertainty around the passing distance, resulting in unnecessary delays or movements into oncoming traffic. Conversely, over-reporting of close passing manoeuvres may occur on behalf of cyclists due to an inaccuracy in lateral distance judgements. Further investigations could help better anticipate such situations and could be incorporated into education campaigns and enforcement methods to help educate the public and authorities of the realistic abilities of road users in this respect.

6 Recommendations

Based on the findings and insights of this investigation, we propose the following for consideration:

- 1 **Graduated MOG law.** If a MOG law is to be introduced, it is recommended that consideration be given to the two distances based on road hierarchy and speed zone (namely, 1.0m at 60km/h or less and 1.5m at over 60km/h) – an option that has been under consideration by the Cycle Safety Panel (New Zealand Cycling Safety Panel, 2014) . However, drivers should be encouraged to give this as a minimum, as there is some variation regarding levels of perceived comfort given specific MOGs.
- 2 **Comprehensive education campaign.** Regardless of the introduction of an MOG law, it is recommended that, building on existing share the road cycle campaigns, an additional education campaign be taken to address the needs of cyclists with particular emphasis on space given when being overtaken by motorists. Such a campaign should have clear objectives and measurable success indicators, should target specific audiences in appropriate ways, use all channels of messaging, address difficulties in current mobility culture while also building on its strengths. If such a campaign were to be accompanied by a MOG law, the campaign should include comparative methods to illustrate how such a law would function in different contexts/situations. This could include how it might function within the context of other laws (such as the ability for slow passes on yellow no passing lines or painted medians), as these situations are not well communicated or understood. For monitoring and improvement purposes, it is also recommended that before-and after evaluations of the campaign be conducted, noting any behavioural or perceptive changes.
- 3 **Wider mobility culture.** Irrespective of the introduction of a MOG law, it is recommended that the broader mobility culture be given careful consideration and potential investigation (by means of attitudinal surveys). Developing a clear understanding of the current mobility culture in New Zealand will enable for a) before and after evaluations of perceptions and social norms, b) more informed education campaigns that will increase the likelihood of more consistent, longer term results, c) application to a wider range of issues and potentialities, giving relevant authorities a high-level view of not only behavioural but perceptual patterns of mobility in New Zealand (identifying areas that overlap, and ways of optimizing initiatives and resources).
- 4 **Wider legal context.** If a MOG law is to be introduced, it is recommended that an assessment be made of how it would fit within the wider set of laws relating to cyclists (including shared paths/pedestrians). More specifically, if wider culture surveys were to go ahead, it is recommended that questions be included regarding other cycling related laws in an effort to create an integrated approach (a method vital for successful behaviour change and optimising cost-effectivity). This should also take into account stricter enforcement of cycling related laws (e.g., running red lights), which could help to create an overall culture change and build on New Zealand's existing cultural values of fairness and equality.
- 5 **A trial period.** It is recommended that either a MOG law (with education) or the aforementioned comprehensive education campaign alone be trialled (similar to how a MOG law was introduced in Queensland, Australia). This would enable for before and after assessments of behaviour change, user comfort and comparison of injury and crash statistics over time. Moreover, this would give authorities an opportunity to trial enforcement and communication approaches, identify strengths and improve on weaknesses. The advantage of this approach is that it would provide the evidence base to either permanently introduce the law or to discount it. To increase the likelihood of the trials success, as well as to acquire the needed evidence, the following steps should be considered:
 - a **Evaluating success.** It is recommended that real-time measures of road user discomfort be used to inform and monitor future enforcement or education interventions in conjunction with any behaviour change monitoring, with the main goal of reducing the small number of overtaking interactions that are perceived as being considerably distressing. Perceived risk is a key barrier to greater cycling uptake, which is the main benefit of any action around overtaking behaviour (MOG law or otherwise).

- b **Integrated MOG implementation approach.** It is recommended that if a specific MOG is made mandatory, that special consideration be put into the practicalities of enforcement and the ability of motorists to comply with the law (and how this will be communicated to the public in such a way to give them realistic/positive expectations while also avoiding potential public backlash). To achieve this, all the factors presented in this report regarding enforcement, education and followability should be presented to relevant transport authorities (e.g., road design and maintenance, police) and detailed approaches be composed regarding enforcement and compliance of the law. This should be an integrated initiative to ensure that a consistent approach be conducted and consistent messaging be delivered to the wider public.
 - c **Understandings and perceptions of MOG law.** It is recommended that a MOG perception study be conducted in advance of any MOG law (if introduced), to mitigate uncertainties around the public understanding and response to a MOG law (in regards to attitudes, expectations and behaviours). This will greatly inform the decision-making process, enabling anticipation and mitigation of negative public responses, and provide a benchmark to monitor the success around education. It would also improve the process around education, especially for targeted groups who may hold specific views, and testing how to communicate around problem space locations (like narrow rural roads).
 - d **Lateral distance judgement.** It is recommended that, in light of the knowledge-gap regarding motorists' and cyclists' abilities to judge lateral distances (particularly when in motion), investigations be conducted to assess levels of accuracy as well as ways of improving judgements. Such information could greatly inform education campaigns (knowing how to illustrate to people what a specific distance looks like and how to achieve it). It would also enable police authorities to anticipate the potential behaviours of road users (and perhaps times/situations/areas where judgements are likely to be less accurate).
- 6 **Signage.** Signage could be used to encourage cyclist groups to ride in single file at difficult (e.g. narrow) locations. Irrespective of the introduction of a MOG law, it is recommended that specific 'share-the-road' signage be more consistently distributed across New Zealand. Given the passing of a MOG law, this would raise awareness of its introduction while also acting as legitimisation tool. Without a law, such signage would represent cyclists as legitimate road users who warrant care and attention.
- 7 **Targeted infrastructure improvements.** It is recommended that consideration be given towards opportunities for targeted infrastructure improvements that would allow a MOG law (or behaviour change more generally) to function effectively. The data collected in this investigation (and/or its methodology) could be used to identify pinch-points or areas where problematic passing behaviours occur at greater frequencies, and use this information to help inform any infrastructure upgrades or changes.

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8 Appendices

Appendix A: International MOG laws

Country/State	MOG metric	Year passed	Details and provisions
USA & Canada			
Wisconsin	3 feet	1973	The first minimum passing distance law to be passed.
Minnesota	3 feet	1995	Cyclist not required to stay in bike lane or bike path.
Arizona	3 feet	2000	Law does not apply on roads with bike lanes.
Utah	3 feet	2005	Motorist allowed within 3ft if they provide a 'safe and reasonable' distance.
Florida	3 feet	2006	Law applies to other non-motorised vehicles.
Oklahoma	3 feet	2006	-
Virginia	2 feet	2006	-
Arkansas	3 feet	2007	-
Illinois	3 feet	2007	-
Maine	3 feet	2007	Allows motorists to cross double-yellow line when overtaking cyclist.
Tennessee	3 feet	2007	
Connecticut	3 feet	2008	-
New Hampshire	3 feet at 30m/h	2008	An additional 1ft of space must be given for every 10mph speed increment above 30m/h.
Colorado	3 feet	2009	Driver will not pass in an imprudent or careless manner.
District of Columbia	3 feet	2009	-
Louisiana	3 feet	2009	Anti-harassment provision that protects cyclists from having objects thrown at them.
Maryland	3 feet	2010	Law doesn't apply if 1) cyclist not to right of roadway, 2) cyclist not keeping steady course 3) highway does not permit it.
Mississippi	3 feet	2010	Allows motorists to cross non-passing zone when overtaking cyclist.
Delaware	3 feet	2011	Reduce the speed of the vehicle to a safe speed.
Georgia	3 feet	2011	Law only applies 'when it is feasible.'
Kansas	3 feet	2011	Accompanying speed increase of 5m/h (8.1km/h)
Nevada	3 feet	2011	Forbids motorists from interfering with movement of cyclists.
Pennsylvania	4 feet	2012	Must pass with a careful and prudent speed.
Nebraska	3 feet	2013	Also applies to electric assistive mobility devices
Alabama	3 feet	2014	Does not apply if cyclist is more than 2ft from right shoulder of the roadway, on high speed roads (i.e., over 45m/h) or on no passing zones.
Nova Scotia	1 metre	2014	Motorist permitted to cross a line to pass the bicycle if can be done so safely.
California	3 feet	2014	If unable to provide said space, have to slow to speed that is reasonable and prudent and only pass when it will not endanger the cyclist (taking various environmental conditions into account).
South Dakota	3 feet at 35m/h	2015	6 feet on roads that exceed 35m/h. Motorists permitted to cross no-passing zone if it is safe to do so.

Country/State	MOG metric	Year passed	Details and provisions
West Virginia	3 feet	2015	Must pass with careful and reduced speed.
Wyoming	3 feet	2015	Only applicable 'when space allows.'
North Carolina	4 feet	2016	Motorists are permitted to pass cyclist in no passing zones if they provide 4 feet and if the cyclist is not making a left turn.
Australia			
Queensland	1m at 60km/h	2014	1.5 metres on roads over 60km/h. Motorists are exempt from other relevant road rules (e.g., yellow lines) if it is safe to do so.
Southern Australia	1m at 60km/h	2015	1.5 metres on roads over 60km/h. Motorists are exempt from other relevant road rules (e.g., yellow lines) if it is safe to do so.
Australian Capital Territory	1 metre at 60km/h (trial period)	2016	1.5 metres on roads over 60km/h. Motorists are exempt from other relevant road rules (e.g., yellow lines) if it is safe to do so.
New South Wales	1 metre at 60km/h (trial period)	2016	1.5 metres on roads over 60km/h. Motorists are exempt from other relevant road rules (e.g., yellow lines) if it is safe to do so.
Western Australia	1 metre at 60km/h (trial period).	2016	1.5 metres on roads over 60km/h. Motorists are exempt from other relevant road rules (e.g., yellow lines) if it is safe to do so.
Europe			
Netherlands	1 metre		
Belgium	1 metre	1975	Approach at a moderate speed
France	1 metre	2003	1.5 metres outside of urban areas. Motorist should not overtake if it will disturb the cyclists flow into traffic.
Spain	1.5 metres	2003	Motorists must slow down.
Portugal	1.5 metres	2014	Driver should assess that the road way has sufficient length and breadth to manoeuvre safely.

Appendix B: Stakeholder discussion prompts

Initial discussions

- 1 How would a mandatory passing distance law affect cyclist safety and comfort?
 - a ...When the law is enforced routinely (and cars are frequently pulled up for near-miss events).
 - b ...When the law is enforced retrospectively (after there has been a crash/incident involving a cyclist and a motorist).
 - c Under what conditions would the law be effective in enhancing cyclist safety and comfort?
 - d Under what conditions would the law be ineffective for enhancing cyclist safety and comfort?
 - e Would the law have any 'secondary' effects that could benefit cyclist safety in some way (i.e., the law brings cycling safety into the public sphere, raising the awareness of cyclists).
 - f Could the law have any possible negative influences on cyclist safety/comfort? (Tense motorists-cyclist interactions).

- 2 What impact would a mandatory passing distance law have on other road users and the network efficiency?
 - a Other than making motorists provide more space, what other changes may occur with the implementation of a MOG law on other road users?
 - b How would the law impact other road users if the law was only seldom enforced (e.g., like driving on the restricted licence)?
 - c How would the law impact other road users if it was strictly enforced?
 - d How do you think road users may feel about the law? Why?
 - e How do you think the law would impact the relationship between cyclists and motorists from the motorists point of view?
 - f In what situations do you see the law causing undue delays/traffic?
 - g How would motorists feel about the law if cyclists were held more consistently accountable for the laws that apply to them (e.g., running red lights) etc.

- 3 What are conditions/places/times that such a law would be difficult to implement and what provisions would need to be put in place to overcome them?
 - a In what physical conditions (e.g., narrow roads, up hills) would it be difficult to legally follow the law for motorists? Why?
 - b In what locations (e.g., specific NZ places) would it be difficult to follow the law? Why?
 - c In what situations (e.g., high traffic) do you think that people would be less likely to follow the law? Why?
 - d Assuming that the law is implemented, what else could be done to enable people to be able to provide cyclists with enough space? (e.g., some countries have giving exceptions to some other laws such as crossing yellow lines – in order to be able to pass cyclists safely).
 - e Is there anything that could be done by the cyclists to enable motorists to abide by such a law (while still maintaining their own safety?). Behaviour changes etc.

Post information discussions

- 1 What should the minimum overtaking distance be?
 - a What evidence supports/opposes what you think the minimum taking distance should be (that would apply to the NZ context)? Do you think distances that have been used in other places around the world would apply to the New Zealand context?
 - b How much space do you think motorists currently give to cyclists when overtaking in New Zealand? Is this sufficient? Is this occurring frequently enough?
 - c What are the pros and cons of different passing distances, e.g., what are the pros and cons of having 1m passing distance in all places? What are the pros and cons of having speed specific passing distances (1m 60 < 1.5m above 60km). What would the ideal overtaking manoeuvre look like? Does it involve other factors other than how much distance there is between the cyclist and the motorist?
- 2 What is the extent of the problem (i.e., of motorists overtaking cyclists in an unsafe way).
 - a Do you think that the evidence (anecdotal or otherwise) suggests that there is an issue with passing distance of cyclists?
 - b What do you think supports the idea that there is an issue with unsafe passes of cyclists by motorists in New Zealand?
 - c Are there situations where you think that is more of an issue? (e.g., particular physical situations, locations, traffic situations).
 - d If there is insufficient evidence, what do you think would count as evidence? What wouldn't? Can we use the evidence from other countries to tell what the situation is like here in NZ?
 - e IF you're not a cyclist, would you feel safe cycling on-road in NZ? IF you are cyclist, do you feel safe? If so, would you recommend novices to go out cycling? If you have children, how comfortable would you feel with them riding on NZ roads?
- 3 Would such a law work in NZ?
 - a In what ways would the law work? In what ways would it be effective?
 - i Would it improve actual driving behaviours?
 - ii Would it make cyclists feel safer on the roads?
 - iii Would it encourage a greater number of people to cycle?
 - b In what ways would it be ineffective?
 - i Why would motorist's behaviour not change?
 - ii Why would cyclists not feel safer on the roads?
 - iii What are the challenges to success?
 - iv How might such challenges be overcome?

Scenarios and problem solving

- 1 A single mandatory minimum overtaking distance law vs a graduated (different distances in different situations) minimum passing distance law.
 - a Possible prompts to think about are:
 - i how to determine what is a safe distance

- ii how to teach the law to motorists and cyclists
 - iii how to signpost the law
 - iv how to enforce the law.
- 2 Behaviour change initiative with NO mandatory requirements (i.e., the law) vs a behaviour change initiative supported by a mandatory requirement.
- a Possible prompts to think about are:
 - i What would a good behaviour change initiative look like?
 - ii What would a bad behaviour change initiative look like?
 - iii If one was done with the law, would the law be a component of the behaviour change or the behaviour change be a way of supporting the new law (what would take the lead)?
 - iv Under what conditions would a law help an education campaign?
 - v Under what conditions would it be unhelpful for an education campaign?
- 3 Mechanisms for introducing and enforcing any legislated minimum overtaking distance (e.g., 1m at speeds below 60km/hr and 1.5m for speeds above 60km/hr).
- a Possible mechanisms (then look at pros and cons of each):
 - i Education campaign (more general cycling safety or focused on law).
 - ii Advertising campaign of law change
 - iii Introducing law into driving tests
 - iv Retrospectively enforcing law after crashes
 - v Developing a method for catching people (e.g., instrumented cop bike)
 - vi Getting people to send in their own videos.
 - vii Any other technical apps that would aid in this process?

Appendix C: Instrumentation Detail

Instrumented Bike Development

The Opus instrumentation team further developed their existing instrumented bike technology (which had previously been used in the Waipa rural roads cycle trial; Trotter et al., 2015) to produce two instrumented bicycle units that were able to capture the following variables (see Figure 8.1).



Figure 8.1. A detailed illustration of the instrumented bike technology.

Motorist overtaking distance and speed and vehicle type (LiDAR units)

Using two LiDAR units fixed on the seat post and handlebar stem, 950mm apart, the unit was able to accurately capture vehicle passing distances and passing speeds. Both units independently measured the gap between cyclist and vehicle to at least 0.03m accuracy, at a rate of 800 measurements per second. The time taken for a vehicle to travel between the two units provides an accurate measurement of speed. Motor vehicle length was also measured, which can be used to derive vehicle type based on the Transport Agency's vehicle classifications.

Bicycle speed (speedometer)

A wheel mounted speedometer (similar to that used by bicycle trip computers) provided an accurate measure of rider speed. The speedometer was calibrated against the diameter of the wheel and enabled precise measurement of the time taken for the wheel to travel a set distance. This data was necessary to calculate vehicle passing speed, since captures were made by recording vehicles from a moving platform.

Location on the road network (GPS)

To assess how particular roads or road layouts may affect overtaking behaviours (for example a comparison between narrow roads that are common in hilly suburbs and wider central city streets), a GPS device was used to locate the position of each vehicle passing movement along with a bearing to show direction of travel.

Subjective rider discomfort (push button)

A measure of cyclist perceived safety was captured during each field trial ride using an 'event' button mounted on the handlebars that riders pressed to flag moments during their trip where they felt moderate or severe discomfort as a result of a vehicle interaction (short button press for moderate discomfort, long button press of two seconds

or more for severe discomfort)²⁸. All the flagged moments were time stamped and compared with recorded data during the same period.

Qualitative assessment of interactions (video capture)

The duration of a ride is recorded on a front facing wide angle video camera. The wide angle video captures the passing movement, any obstructions in the cyclist's path, and provides a qualitative assessment of the road environment. The recorded video is tagged for review when a passing movement is detected by the LiDAR's, or when the cyclist presses the event button to indicate a vehicle interaction causing discomfort. This video provided valuable insights into the events flagged by the riders that went beyond measured distances and speeds. The data integration process allowed the tagged events to be synchronised directly to the other sensor data. The constant capture from the camera provided significant additional insight into the wider experience of the cyclist, in particular around the context of uncomfortable events, beyond passing distance and speed.

Meaningful data representation

In addition to the data collection, the instrumentation technology was able to produce visual representations of the collected data and consequently provide objective evidence of a safe (or unsafe) network.

Data validation

As the LiDAR equipment was mounted on a moving platform, various algorithms were developed to validate if the information received was a passing movement. The challenges around accurate capture are excessive bicycle pitch and tilt, varying vertical offset between bicycle and vehicle, vehicles with variable shapes and structures (i.e. trucks), road geometry (i.e. camber), and spurious interference such as bollards. Vehicles present a reasonably unique signature and therefore the following algorithms were implemented to achieve the very high capture success rate.

- A 'lock on' algorithm recognises an object that presents in front of the rear LiDAR and then observes measurements on the front LiDAR to detect an object in a similar range. This helps to prevent false triggering and allows the bicycle to maintain a very fast detection rate by constantly discarding irrelevant measurements.
- Detection sensing was implemented to help remove vehicles in the oncoming lane and stationary objects that appear to be moving towards the bicycle, from triggering a measurement. This helped to remove some spurious interference such as bollards.
- Pattern matching was used across both LiDARs to validate that the object was an overtaking vehicle. An example of the pattern matching algorithm is that the front LiDAR must see the same measurement, with a time differential, while the rear LiDAR maintains the 'locked on' measurement. This helps to eliminate features of the surrounding environment from registering measurements (i.e. bollards, shop fronts, side streets).
- Timing constraints were applied to the pattern matching algorithm to remove surrounding features that present a similar measurement pattern to a vehicle. An example is the bicycle leaning into a corner and measuring the road, or a road with a high crown. This also helps to quickly reject irrelevant measurements quickly.

²⁸ Participants were told that a long button press is for interactions that made them feel very uncomfortable, unsafe, unhappy, and anxious, as opposed to the short button press being for interactions that were unpleasant, not great, too close for comfort, but not horrendous. While there were a handful of repeat button presses captured within the data, it could not be determined whether these related to increased severity or simply from the rider choosing to repeat the press to ensure the event was recorded.

- A comparison algorithm compares the measurement results between both front and rear LiDARS to detect any significant measurement difference. For example, the time the vehicle is present in front of each LiDAR is accurately measured. This helps to eliminate measurements that may have come from two separate objects that have matched the pattern of an overtaking vehicle. An example is two vehicles passing the cycle simultaneously but at differing speeds in different lanes.
- Drop counting was used to help detect vehicles that have open frame structures and/or trailers. Drop counting is used to count the number of miss-hits that occur during a correctly pattern matched measurement and is compared with the measured vehicle length. For example a large truck with a trailer will measure approximately 25 metres in length and have a drop count that is similar between both LiDARs. This helps to detect if an overtaking vehicle was a single vehicle, potentially with a trailer, or two separate vehicles. Furthermore, a constantly increasing drop count signifies the end of a successful vehicle measurement and allows quick re-arm of the bicycle algorithms.
- Sanity checks are carried out on the resulting measurement. This means that we can compare the final result to ensure that it falls within valid ranges for vehicle length, speed etc. These checks are carried out against a number of variables detected during the process to ensure accuracy. For example, a vehicle that presented as five metres long travelling at 200kmph, but was present in front of the bicycle for one second would be rejected as that result is unfeasible.
- All rejected captures are stored in a separate dataset tagged with a reason for rejection. This allows access to data that would have otherwise been discarded.

Appendix D. Study Area Detail

Wellington metropolitan area

Wellington is located at the southern tip of New Zealand's North Island and contains the New Zealand capital city (see Figure 8.2). This area is particularly well suited for urban testing due to it being a metropolitan area with a wide variety of road types, traffic volume, peak and off-peak variation, infrastructure features and a variety of terrains all being interacted with, to a greater or lesser extent by cyclists on a daily basis (including narrow, windy roads, steep hills, one-way streets, multi-lane streets and cycle lanes). The presence of the Wellington University campuses and central Wellington Port also created great opportunities to capture interactions between bicycles and the full range of other vehicles of all sizes, from scooters to camper vans, freight vehicles to oversized logging trucks.

Moreover, the State Highway connections between Wellington City and the surrounding suburbs enabled the capture of overtaking behaviours in different speed environments, traffic volumes and on sections with and without shoulders. The State Highway connections also enhanced the likelihood of capturing high rates of vehicle interactions given that these are the primary entrances for commuters heading in and out of the city from the major suburbs to the East (e.g., Lower Hutt, Upper Hutt using SH2), and the North (Johnsonville, Tawa, using SH1). Lastly, the Wellington region (particularly during the test period of June-July) experiences a changeable climate, meaning that any tests were likely to include a range of weather conditions (including wind, cloud and rain). On the other hand, the mode share of cycling is higher in the Wellington area (especially Wellington city) than the national average. In Wellington, 9% of people ride to work, at least fairly regularly while the 2013 national census average was 2.9% (NZ Transport Agency, 2015; Statistics New Zealand, 2014).

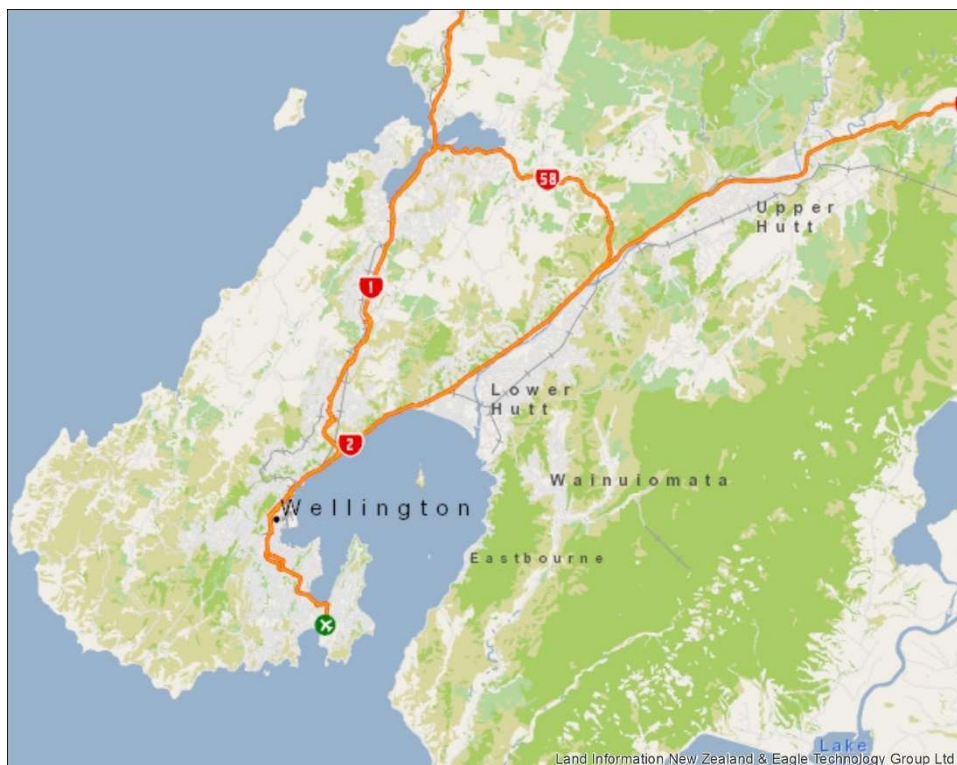


Figure 8.2. The Wellington Region (Basemap credit: Land Information New Zealand & Eagle Technology Group Ltd).

Wairarapa

The Wairarapa region is located on the South-Eastern corner of New Zealand's North Island and spans a wide geographic area covering the Tararua ranges (see Figure 8.3).

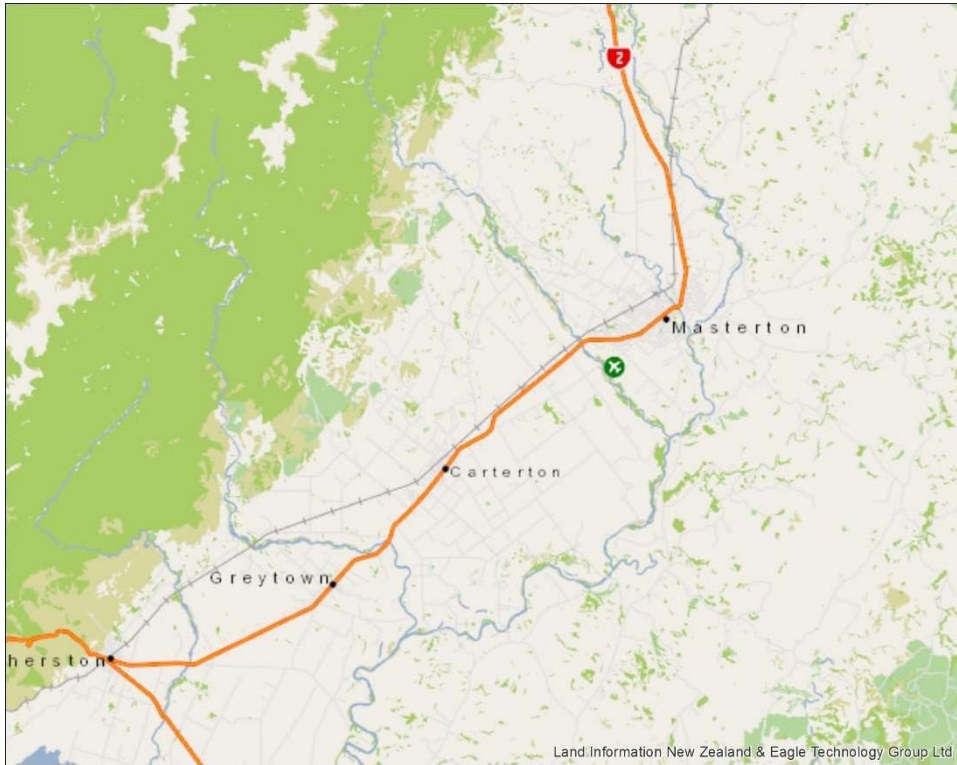


Figure 8.3. Wairarapa Region (Basemap credit: Land Information New Zealand & Eagle Technology Group Ltd).

The central townships of Masterton and Carterton were particularly suitable for running the rural testing given their connection to a network of rural roads as well as the main SH2 arterial route over the Rimutaka Hill to Wellington. Consequently, this region also provides a range of road types and widths, speeds, vehicle types, traffic volume and terrain. Similar to the Wellington region, the Wairarapa has a variable climate and so also increased the likelihood of capturing interactions occurring in a range of environmental as well as roading conditions.

Appendix E. Study Procedure

Participant recruitment detail

To capture urban cyclists, information about the trial was disseminated across the Wellington CBD and surrounding suburbs to the South (e.g. Miramar), North (e.g. Johnsonville) and the Eastern suburbs of Lower Hutt and Upper Hutt. To capture rural cyclists, information was disseminated in towns along SH2 in the Wairarapa area between Featherston and Masterton. Numerous advertising mediums were employed (e.g., trial posters and brochures), which were dispersed in public facilities (such as libraries), community leisure and medical centres, I-sites and swimming pools, as well as bike shops. Cyclists were also specifically targeted by ‘tagging’ bicycles parked at these public facilities and others (e.g., such as supermarkets, and other public bicycle racks) using a postcard attached to the handlebars with an elastic band. Information was also delivered opportunistically by hand to cyclists encountered or known to the research team and was advertised online through social media (e.g., Facebook).

Opportunistic snowballing techniques were employed where possible to gather momentum. This technique was particularly useful for recruiting less experienced riders, by taking opportunities to impress the importance of including the full range of cyclists in our trial, and encouraging keen cyclists to consider other less experienced cyclists within their social networks who might be interested in taking part.

To optimise the efficiency of this process, recruitment began as early as possible (during the inception and knowledge stocktake phase). Given the distance between the Opus office in Petone and the preferred site for our rural riding in Masterton, a custodian was sought in Masterton to manage the rural participants. The owner of Happy Valley Cycles in Masterton was approached and agreed to provide a custodian role for the trial. The cycle shop was the primary location for picking up and dropping off the instrumented bike, and the owner handled all the hand-overs and consenting for the rural participants. Table 8.1 shows the details of the incentives provided.

Table 8.1. Incentives offered to each participant

Time spent cycling	Incentive
1 st hour cycling	\$50
2 nd hour cycling	\$30
3 rd hour cycling	\$30
4 th hour cycling	\$30
10 min intervals	\$5 each
Bonus for completing all four hours	\$40
Refer a friend who registers interest	\$20
Maximum four hours trial cycling	\$200

On the final weekend of the trial, an eight-hour ‘Let’s Ride’ CBD cycling trial was organised in Wellington. Participation in this event was offered to all the Wellington-based individuals who had expressed an interest in the main on-road trial, but had been surplus to the requirements of the sample quotas.

Handover of the instrumented bicycle

Handover of the bicycles to the urban participants was undertaken by one of the research team, while handovers to the rural participants were undertaken the owner of the Happy Valley cycle shop. The handovers typically took between 10 and 15 minutes during which time participants were:

- Given a run through of the start-up and shut-down operation for the data capture equipment

- Asked to demonstrate the start-up and shut-down process
- Assisted to adjust the saddle height appropriately
- Given practical information such as; how to charge the data capture recorder, non-use during rain, care when mounting and dismounting so as to not knock the rear lidar, care not to cover the rear lidar with long clothing, keeping the bike secure, non-use by others, and what to do should something go amiss – either with the technology, the bike or the arrangements.
- Provided with the opportunity to ask questions
- Offered the use of safety gear and equipment
- Provided with a charging pack for the data recorder
- Asked to sign a consent form
- Provide details of their bank account for payment of the incentive
- Reminded to complete a post-ride survey after every ride.

Post-ride process

Participants were asked to complete a post-ride survey for each ride they undertook on the instrumented bicycle. These were defined by a period of data recorder shut-down between rides. Post-ride survey completion was monitored on a weekly basis, and compared with both the booking schedule and data capture times provided by the instrumentation team. This allowed follow-up reminders to be given to cyclists who had completed rides, as indicated by the ride data download files, but had not completed a post-ride survey for the associated ride.

The post-ride survey included:

- 1 Detailed description of their ride including:
 - a Origin, destination and route taken
 - b The different types of roads travelled on
 - c Level of familiarity with route
 - d Time of day, distance travelled in km and ride time from start to finish
- 2 Questions about clothing worn and equipment used during the ride
- 3 Questions about any environmental, road infrastructure features or interactions with motorists that presented a possible risk or impacted on their feelings of safety during the ride
- 4 Questions about the estimated closest and furthest passing distances that participants experienced when being passed by other road users during their rides (these questions were only included in the participant's final post-ride survey), and how they felt about these distances in terms of their proximity to the cyclist from a safety perspective.

Once the participants had completed their final ride, the post-ride survey and trial ride data for that participant were reviewed. The post-ride survey ride times were used as the basis for incentivisation payments, supported by the ride data-capture times. When there were significant discrepancies between the stated ride time and the data capture ride time, the ride data capture was looked at more closely. It became apparent that there were occasions where for one reason or another (participant failing to turn on the data recorder correctly, the rider knocking or covering the LiDAR, or the data capture equipment having an unexplained temporary 'absence') when data was not recorded for a period of the ride. To minimise data loss in the later trials, additional information was provided to the participants around how to ensure accurate LiDAR recording (by not knocking or covering the sensors), and ensuring the participants all completed a complete start-up and shut-down process for

the instrumentation during the handover, as well as the instrumentation team investigating causes of and solutions for the occasional 'absences' in the data recording.

Scheduled maintenance and data download

Throughout the eight-week trial period, the instrumented bicycles were returned to Opus Research once a week. This scheduled 'off-trial' time allowed the data to be downloaded and reviewed, the instrumentation functionality to be checked and updated where developments were available and general maintenance and servicing of the bicycles to ensure they were road worthy for the forthcoming week.

Appendix F: GIS survey of cycling routes

A GIS survey of 57 popular cycling roads in Queensland and 57 in New Zealand suggests little difference in mean road widths. The selection of sites was made based on route popularity (focussing on high demand cycling sites, using heatmaps from Strava data), and based on different road types (including urban and rural).

The urban roads popular for cycling that were measured, are on average slightly narrower in Queensland (M = 9.9m) compared with New Zealand (M = 10.9m; see Table 8.2). For rural roads there is very little difference between mean road widths in Queensland (M = 8.7m) and New Zealand (M = 8.8m; see Table 8.3). In both states, narrow, windy roads appear to attract sports cyclists in significant numbers. The similarity in road dimensions in Australia and New Zealand is largely attributable to the 'Austroads' road design standards, which engineers in both countries have shared since 1989.

Table 8.2. Road width by rural road type for New Zealand and Queensland.

Urban road type	Road width (m)	
	New Zealand	Queensland
Urban National	15	10
	11	10
	17	10
Urban arterial	12	10
	13	10
	14	10
	12	12
Urban collector	12	12
	7	11
	10	10
	10	9
	11	11
	9	8
	14	12
	12	8
	9	10
	13	9
	16	11
	14	9
	12	12
12	12	
Urban access	6	6
	8	10
	7	7
	5	9
	7	11
	7	8
Mean of urban undivided	10.9	9.9

Table 8.3. Road width by rural road type for New Zealand and Queensland.

Rural road type	Road width (m)	
	New Zealand	Queensland
Rural Hwy (undivided)	9	8
	11	8
	12	8
	10	15
	10	6
	10	10
	8	8
	8	11
	10	10
	10	9
12	10	
Rural Main Rd	11	7
	9	9
	8	9
	6	6
	10	8
Rural minor road	5	9
	7	7
	6	8
	8	13
	8	5
	5	6
	9	9
Mean of undivided rural	8.8	8.7

