Behaviours, motivations, and values: Validity, reliability, and utility of novice motorcyclists' self-report in road safety research

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This thesis is submitted to The University of Sydney in fulfilment of the requirement for the degree of Doctor of Philosophy.

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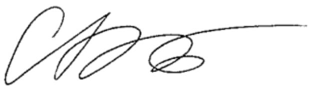
Declaration

The work presented in this thesis is, to the best of my knowledge, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Signature:  Date: 31/08/2013

Dedication

To my parents, *Chisato* and *Eiichi* – for instilling in me the value of hard work, persistence, and education.

To my partner, *Soames* – my inspiration and rock in life, for providing me with the confidence that I needed to keep pushing forward.

To my close friends, *Jordarna*, *Jodie*, *Peter*, *Kris*, and *Maria* – for keeping me grounded and being there for me especially in the challenging period of my life.

To my sister, *Lisa* and brother, *Hiroki* – for motivating me to grow into a better person.

To *Manly beach*, my home and my energy source – for always being there to nourish my soul, clear my mind and help me regain focus.

This thesis would not have been possible without the support, encouragement, and faith from all these individuals (and beautiful Manly) throughout my journey.

Eiichi Sakashita

21/1/1950 – 2/3/2011

I dedicate this work especially to my father who brought me into this life, of which I have learnt to make the most with all the resources that I have been granted.

Acknowledgements

Throughout my PhD journey I received support and guidance from numerous individuals to whom I am eternally grateful.

My primary supervisor, Professor Rebecca Ivers has provided me with the opportunities I needed to develop professionally. Rebecca is the chief investigator of the overall contract project with VicRoads from which the present thesis was derived. She played a key role in establishing relationships with the funders and collaborators and designing the randomised control trial. Rebecca's wealth of experience as well as her cheerful positive nature has allowed me to get through various challenges during my PhD journey. In addition to being a PhD candidate, I am the Project Manager for this contract project and my original PhD topic was based on the outcome and process evaluation of the project which had been intended to be completed in two years. However, with significant delays in the commencement of the project and in recruitment, which were outside my control, I would have had to wait for at least five to six years to complete my PhD as originally planned. Therefore I had to change my topic and start a new set of work half way through my PhD candidature. Rebecca's reassurance and confidence in me have been important facilitators to my completion of this thesis.

Associate Professor Teresa Senserrick is also an investigator of the overall project and played a critical role as my associate supervisor. Teresa's great expertise in road safety research as well as attention to detail has been integral to my PhD thesis. Teresa has allowed me to keep improving all the work that I produced. I have learnt a great deal from her, especially in terms of road safety research and effective writing.

I have been blessed with and am grateful for the generous help from Dr Serigne Lo and Associate Professor Stephen Jan at the George Institute for Global Health. Serigne has given me the practical and expert statistical advice that I needed to improve the quality of my work. Without Serigne's approachableness and willingness to help, my PhD training would not have been as valuable as it has been. Steve has given me his time to provide me with his technical expertise in Health Economics. He has been an integral part of the team to achieve in particular the fourth manuscript presented in this thesis. With Steve's easy going nature and generosity in sharing his expertise, it has been a pleasure and honour for me to work with him.

I am also grateful to the number of collaborators who contributed to the overall contract project from which this thesis was derived. Christine Mulvihill at the Monash University Accident Research Centre was instrumental in achieving the challenging recruitment of the study participants and delivery of the *VicRide* training program. Sonja Ronald at Honda Australia Rider Training was also critical to collect the *VicRide* program delivery data and ensure its integrity. Many thanks go to the Honda Australia Rider Training coaches who delivered the program to the participant riders and contributed to the program delivery data, and Mark Collins for overseeing this process.

The professional interviewers at the Survey Research Centre, Edith Cowan University were trained in the surveys designed for this study and conducted the telephone interviews. Special thanks go to Vicki Graham and Theresa Wilkes who ensured the integrity of the interviews conducted and the survey data collection. Dr Soufiane Boufous, also an investigator on this project, provided statistical guidance and assisted in the development of the overall methodology of the project. Dr Liz de Rome and Dr Jane Elkington who were at the George Institute at the inception of this contract project have also been critical in establishing the overall project and developing the surveys. I am also grateful for the generous administrative support provided by Dr Maria Ali and Rebecca Strath.

Last but not least, I am particularly grateful to VicRoads who have allowed me to utilise the project data for my thesis. The thesis arose from the data collected for a project with VicRoads which was supported by the former Victorian Motorcycle Advisory Council and funded by the Motorcycle Safety Levy in Victoria, Australia. Special and warm thanks go to VicRoads staff, Nicola Fotheringham, Linda Ivett, Catherine Scott, and Juliet Bartels for cooperating with me on my PhD timeline in the approval of the manuscripts for publication and on the provision of relevant information to the study. Without the incredible support, professionalism, and work ethics of all the above mentioned collaborators the entire project would not have been possible.

The thesis has been completed at the George Institute for Global Health, which has been my post-graduate educational and professional training ground. Specifically I have worked in the Injury Division with supportive team members. My working environment at the George Institute, consisting of many driven professionals and students, has been conducive to my PhD output. Both the George Institute and the University of Sydney have provided me with many opportunities and financial support for my educational and professional development. These opportunities have indeed complemented my academic training and I am truly grateful for them.

I have also been financially supported by The University of Sydney Postgraduate Award (UPA). I am extremely grateful for this scholarship, which has provided me with the financial security that I needed to undertake and complete this thesis. I truly hope that I have made valuable contributions to the scientific field along the way on my PhD journey, and that I will continue to through this thesis and in my future work.

Aside from my PhD, I have experienced major personal challenges during my PhD candidature that I started in April 2010. My father in Japan was in June 2010 diagnosed with cancer, which turned out to be progressive, and had to leave this life in March 2011. I was in Japan for my father’s funeral in March 2011, which also happened to coincide with the major earthquake and tsunami disaster in Japan. The whole of Japan was in shock and the mourning for my father was all the more intensified for my family including myself. I am grateful for Professor Rebecca Ivers for allowing me to work from Japan during February and March 2011 so I could be with my family. It took me months to regain myself after these events but I am truly grateful for my close friends who were there for me to get through this extremely challenging period of my life.

Last but not least, I thank my partner Soames for always having faith in me and in my potential, and inspiring me to advance myself, professionally and personally. Without his love, care, and support my journey would not have been as rich as it has been.

Abstract

The continuing use of self-report methods demands consideration of the validity, reliability, and utility of self-report data used in road safety research. This thesis assesses those self-report issues with respect to four key constructs in motorcycle safety research—exposure, on-road behaviour, riding motivations, and perceived value. A large-scale randomised control trial to evaluate a motorcycle rider training program provided an ideal opportunity to achieve that. The present sample consisted of Australian novice riders who participated in this trial between June 2010 and December 2011. The evaluation involved participants' police-recorded data on crashes and traffic offences as well as self-report surveys including riding exposure questions, previously developed *Motorcycle Rider Behaviour Questionnaire* (MRBQ) and the *Motorcycle Rider Motivation Questionnaire* (MRMQ), and a willingness to pay question in a contingent valuation (CV) survey. Four studies are presented in this thesis to provide a picture of the contributing elements to best practice motorcycle safety research. In ***Study 1*** a comprehensive set of statistical analyses was performed to test the validity and reliability of various forms of self-report riding exposure measures. Practical recommendations for best practice design of self-report riding exposure questions were provided based on the present findings. In ***Study 2*** and ***Study 3*** a comprehensive psychometric assessment of the MRBQ and MRMQ was achieved. Specifically, previously untested psychometric properties of stability, content validity, and predictive validity in terms of police-recorded offences and crashes as well as previously assessed factor structure, internal consistency, and predictive validity in terms of self-reported crashes were examined. These two studies were the first to examine the applicability of MRBQ and MRMQ amongst novice riders, and indicated that the measures are premature as they currently stand, at least amongst Australian novice riders. Further work is required before their wider use and recommendations for the re-design and use of the MRBQ and MRMQ are provided. In ***Study 4*** I demonstrated the utility of CV in measuring, understanding, and therefore addressing the perceived value of rider training amongst novice riders. ***Study 4*** is the first study to empirically quantify the perceived value of rider training and analyse the determinants through a well-designed CV survey. The four studies highlight that the appropriateness of self-report is dependent on not only the nature of the phenomenon under study but also the extent to which the factors that contribute to measurement reliability are taken into account in the design of self-report measures. Empirically informed question design ensures self-report is a valuable tool in motorcycle safety research. This thesis demonstrates the value of assessing the validity, reliability, and utility of self-report measures in providing results that contribute to best practice motorcycle safety research, policy and practice.

List of publications

This thesis contains a collection of published and submitted manuscripts as listed below. The journal confirmations for manuscripts in press and submitted are shown in Appendix 7. Signed authorship statements are included in Appendix 8.

Chapter	Status	Details
2	Published	Sakashita C, Jan S, Ivers R. The application of contingent valuation surveys to obtain willingness to pay data in road safety research: methodological review and recommendations. Australasian Road Safety Research Policing and Education Conference; 2012 4–6 October 2012; Wellington, New Zealand. Availabe from http://trid.trb.org/view.aspx?id=1250827
3	In press	Sakashita C, Senserrick T, Boufous S, de Rome L, Elkington J, Ivers R. The use of self-report exposure measures amongst novice motorcyclists: appropriateness and implications. Traffic Injury Prevention. 2013.
4	Under review	Sakashita C, Senserrick T, Lo S, Boufous S, De Rome L, Ivers R. The Motorcycle Rider Behavior Questionnaire: Psychometric properties and application amongst novice riders in Australia. Transportation Research Part F: Traffic Psychology and Behaviour. Under review.
5	Under review	Sakashita C, Senserrick T, Boufous S, De Rome L, Ivers R. The Motorcycle Rider Motivational Questionnaire: Psychometric properties and application for newly licensed riders in Australia. Transportation Research Part F: Traffic Psychology and Behaviour. Under review.
6	Published	Sakashita C, Jan S, Senserrick T, Lo S, Ivers R. Perceived value of a motorcycle training program: the influence of crash history and experience of the training. Traffic Injury Prevention. 2013. DOI: 10.1080/15389588.2013.828346. Available from http://www.tandfonline.com/eprint/Sr8FntbsA2x5I3MYDAHq/full

Additional publications, reports, and presentations by the author of the present thesis during the PhD candidature, but not forming part of the thesis, are listed below.

- Contract project report for Motor Accident Authority 2011

de Rome L., Gibson T., Haworth N., Ivers R.Q., **Sakashita C.**, and Varnsverry, P. (2012) "Improving consumer information about motorcycle protective clothing products." A report prepared for the Motor Accidents Authority of NSW (MAA), under the auspices of the Australian Heads of CTP.

- Book chapter 2012

R.F.S. Job, Graham, A.K., **Sakashita, C**. & Hatfield, J. (2012). "Fatigue and Road Safety: Identifying crash involvement and addressing the problem within a safe systems approach" (pp. 349-363). Matthews, G., Desmond, P.A., Neubauer, C., & Hancock, P.A. (Eds.), *The Handbook of Operator Fatigue*. Farnham, Surrey, UK: Ashgate Publishing. ISBN: **978-0-7546-7537-2**.

- Invited presentation for *Australasian College for Road Safety*, Adelaide 2012

Sakashita C. (2012). "Measurement of exposure in road safety research" Invited talk to the Australasian College of Road Safety Seminar, Adelaide, 27th March 2012.

- Conference presentation for *Australasian Road Safety Research Policing and Education Conference*, Wellington, 2012

Sakashita C, Jan S, Ivers RQ. (2012). "The application of contingent valuation surveys to obtain willingness to pay data in road safety research: methodological review and recommendations." Paper in Proceedings of the *Australasian Road Safety Research Policing and Education Conference*, Wellington, 4-6 October 2012.

- Conference presentation for *Australasian Road Safety Research Policing and Education Conference*, Wellington, 2012

Job R.F.S. and **Sakashita C**. (2012). "Combining safe system principles and road safety education in schools: An opportunity for improved demand on road system operators and a broader understanding of risk and safety." Paper presented to the *Australasian Road Safety Research Policing and Education Conference*, Wellington, 4-6 October 2012.

- Conference presentation for *Directions for road safety*, Brisbane 2012

Sakashita C. (2012). "Validity and reliability of the *Motorcycle Rider Behaviour Questionnaire* amongst the newly licensed rider population" Invited talk to the Directions in Road Safety Forum, Brisbane, 18-19th June 2012.

- Conference presentation *International Conference on Driver Behaviour and Training*, Paris 2011

Sakashita C, Senserrick T, Ivers RQ, Boufous S. (2011). "Process evaluation of a motorcycle rider training program" Paper accepted to be presented to the 5th International Conference on Driver Behaviour and Training, Paris, 29 -30 November 2011.

- Conference presentation for *Directions for road safety*, Adelaide 2011

Mulvihill C. and **Sakashita C**. (2011). "A large-scale trial of the VicRide On-Road Coaching Program in Victoria: development, delivery, and evaluation" Invited talk to the Directions in Road Safety Forum, Adelaide, 12-13th May 2011.

- Poster presentation for *Transportation Research Board*, Washington DC 2012

Job RFS, **Sakashita C**, Grzebieta R, Mooren L. Community Perceptions and Beliefs Regarding Low-Level Speeding and Suggested Solutions. Transportation Research Board Annual Meeting; January; Washington DC2013.

Author’s contribution

The work presented in this thesis was carried out by the PhD candidate under the primary supervision of Professor Rebecca Ivers and associate supervision of Associate Professor Teresa Senserrick. The candidate was solely responsible for conceiving this thesis and the included studies, the statistical analyses, the first drafts of the manuscripts, revisions and finalising of the manuscripts for submission, and responding to reviewers’ comments.

Written statements of contributions from each of the co-authors of the publications presented in this thesis are shown in Appendix 8.

Ethical clearance

All empirical research presented in this thesis has been approved by a Human Research Ethics Committee. Ethics approvals are shown in Appendix 6.

Table of Contents

List of tables

The tables included in each chapter are listed below in the order that they appear in the thesis with page numbers indicated on the right. The table numbers in square brackets in the middle column refer to those in the published or submitted manuscripts.

List of figures

The figures included in each chapter are listed below in the order that they appear in the thesis with page numbers indicated on the right. The figure numbers in square brackets in the middle column refer to those in the published or submitted manuscripts.

List of abbreviations

CATI	Computer Assisted Telephone Interview
CFA	Confirmatory Factor Analysis
CV	Contingent Valuation
DBQ	Driver Behaviour Questionnaire
FARS	Fatality Analysis Reporting System
GLS	Graduated Licensing System
GPS	Global Positioning System
LAMS	Learner Approved Motorcycle Scheme
MRBQ	Motorcycle Rider Behaviour Questionnaire
MRMQ	Motorcycle Rider Motivation Questionnaire
NHTS	National Household Travel Survey
NPTS	Nationwide Personal Transportation Survey
NSW	New South Wales
PAF	Principle Axis Factoring
PCA	Principal Component Analysis
UK	United Kingdom
USA	United States of America
WTP	Willingness To Pay

Glossary

Abbreviation	Label	Definition
CATI	Computer Assisted Telephone Interview	A system that allows phone interviewers to follow a computerised script and enter responses directly into a secure database.
CV method	Contingent Valuation method	A survey-based approach in which individuals of a representative sample of the population at risk are directly asked to value in monetary terms (willingness to pay) a hypothetical reduction in their own and possibly other people's risk resulting from an intervention.
DBQ	Driver Behaviour Questionnaire	A self-report questionnaire (Reason *et al.* 1990) that measures risky on-road driver behaviours such as errors and violations, originally developed by Reason et al (1990).
ex ante		A term used in the willingness to pay context where monetary valuations are made from individuals prior to consuming the product.
ex post		A term used in the willingness to pay context where monetary valuations are made from individuals after consuming the product.
FARS	Fatality Analysis Reporting System	A national census of all traffic crashes on public roads (death within 30 days of the crash) in the USA.
GES	General Estimates System	Police-recorded crashes on public roads in the USA.
GLS	Graduated Licensing System	A driver or rider licensing system that includes learner and provisional stages before full licensing, providing beginners with the opportunity to first gain experience and acquire critical skills under conditions of reduced risk.
LAMS	Learner Approved Motorcycle Scheme	A scheme introduced in some Australian jurisdictions to restrict novice riders to the use of a range of motorcycles that excludes high power-to-weight models.

MRBQ	Motorcycle Rider Behaviour Questionnaire	A self-report questionnaire (Elliott *et al.* 2007) that measures risky on-road motorcycle rider behaviours such as errors and violations, originally developed by Elliot et al (2007).
MRMQ	Motorcycle Rider Motivation Questionnaire	A self-report questionnaire (Sexton *et al.* 2004)that measures reasons for riding a motorcycle, originally developed by Sexton et al (2004).
NHTS	National Household Travel Survey	The authoritative source of national data on the travel behaviour of the American public.
NPTS	Nationwide Personal Transportation Survey	Older version of NHTS.
PAF	Principle Axis Factoring	A form of exploratory factor analysis.
PCA	Principal Component Analysis	A data reduction analysis method.
Vision Zero		A philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system.
WTP	Willingness To Pay	A concept used in economic evaluation that represents the monetary value people are willing to pay for the product being valued.

Chapter 1: Introduction

1.1 Preamble

This chapter provides the rationale for the thesis and discusses the use of self-report methods in motorcycle safety research. It illustrates the advantages and risks of self-report methods. The concepts of validity and reliability are introduced and the ways in which they can be measured are described. This chapter also highlights the importance of the focus on motorcycle safety research and its key constructs. It then describes the overall study context from which the studies presented in this thesis were derived. Finally, the aims and objectives of the present thesis and the structure the thesis follows are summarised.

1.2 Background

Self-report is commonly used in epidemiological and psychological research, including road safety research (e.g. 1-7). The continuing prevalence of self-report methods demands consideration of the relevance, reliability, and validity of self-report data used in road safety research. Self-report methods are commonly used to understand motorcyclists and evaluate motorcycle safety interventions (e.g. 4, 8-11). Assessing and ensuring the validity, reliability, and relevance of self-report measures used in motorcycle safety research is fundamental to understand motorcyclists' behaviours, attitudes, and motivations, and evaluate motorcycle safety interventions.

1.3 Uses of self-report in road safety research

Road safety measures are generally aimed at reducing or eliminating crashes, injuries, and/or fatalities, and therefore the primary objective of road safety evaluations must be with respect to those outcomes. However, measurement of other constructs such as attitudes, beliefs, and on-road behaviours is also required to allow understanding of the underlying causes of behavioural change intended by the intervention being evaluated. Self-report is widely used for such purposes in road safety research (12).

In the context of road safety research, the advantages of self-report have been repeatedly demonstrated with respect to constructs of attitudes, beliefs, and on-road behaviours. Self-report is widely used to report on and understand driving behaviours that lead to crashes (e.g. 13, 14). Self-report surveys have contributed to the understanding of the factors that contribute to the effectiveness of enforcement for drink-driving (12, 15), speeding (16), and seatbelt use (17, 18). Self-report surveys have also informed the development of effective interventions for drink-driving (19, 20). The cost-effectiveness of self-report methods in providing exposure data has also been reported (21), and self-report has been shown to provide supplementary or complementary data to routinely collected state or national records of crashes (22, 23). Self-report motorcycle crash data can be particularly valuable when routinely collected data on motorcycle crashes can be limited to fatal and severe crashes, hiding the prevalence of less severe crashes and injuries (24).

1.4 Self-report methods

1.4.1 Advantages of self-report

Self-report is a research method that asks the person directly for information (25). It mainly takes the form of interviews and questionnaires. Research participants may be directly asked to report on their demographics and personal characteristics, attitudes, behaviours, values and motivations. The advantage of self-report is that it provides the person's own perspectives on information or constructs that generally cannot be obtained in any other objective way (25). These can include some constructs that are by definition perceptual (and therefore subjective in nature) and not directly observable such as values, attitudes, beliefs, and motivations. Self-report has the practical advantage of measuring behavioural constructs in situations where other behavioural measurement methods such as direct observation are not possible (e.g. for studying events that have already past or that occur in private settings). Self-report is also useful in the context of evaluation studies of interventions when aggregated national or state records of crashes or traffic offences are not sufficient (unless data linkage is possible) and individual self-report data are necessary. Self-report can also be useful when objective measures of technology are not affordable for the available research budget (e.g. GPS technology to measure exposure).

1.4.2 Risks of self-report

It is critical to note that not all self-report data are biased but they cannot always be taken at face value (25). As with other methods of collecting data, self-report may suffer from potential validity and reliability problems. In order to prevent the detrimental effects the methodology can have on research findings, it is vital to understand methodological risks and their sources.

Two main risks of self-report are repeatedly identified. First, people can lie to present themselves more favourably to others than truthfully, or provide honest self-descriptions but that are positively biased, commonly referred to as social desirability bias (26). For example, some people may not wish to admit to having been involved in a crash. Second, people can fail to recall events and details (27, 28). Research on self-reported crashes and near crashes show that respondents forget them over time (29, 30), and recall of details of crashes and near crashes is poor and biased, particularly in relation to fault attribution of the crashes (30, 31).

However, these biases and errors in self-report may not be common and are a greater risk in some contexts than others. They tend to arise from the interaction between factors such as the nature of the construct, the approach to its assessment (private versus public setting; poor question design leading to poor understanding of the question by the respondent) and the characteristics of the respondent, rather than solely being inherent in a particular method (32, 33). It can be speculated that people are more likely to honestly report that they have a cold than impotence, and people are more likely to honestly report that they have impotence in an anonymous setting than a non-anonymous setting. Self-report is also less likely to be valid and reliable if the questionnaires are too long thereby inducing respondent boredom and fatigue (34). On the other hand, there is also research evidence to show that self-reported attitudes to speeding are valid as shown by their consistency with physiological measures (35). Self-report should therefore be neither simply trusted nor never trusted.

It is possible to manage the risks of self-report in road safety research through various measures including the following:

- Minimal reliance on self-report details of crashes such as fault assignment which is likely to induce biased responding;
- Compare self-report and police-records of crashes and use both in evaluation;
- Ask questions in timeframes appropriate for recall of behaviours and events;
- Keep interview time short enough to avoid respondent fatigue and boredom;
- Use validated self-report measures, or check self-report against objective or previously validated measures;

- Use balanced response scales such as Likert scales ranging from strongly agree, agree, disagree, to strongly disagree;
- Use multiple questions to measure the same construct that is intended to be measured to ensure consistency in responses;
- Conduct structured interviews to control for respondents' ability to preview, review, and skip questions, and change responses, and to ensure that all questions are presented to all respondents consistently.

These issues raise the need to evaluate the validity and reliability of self-report data. The present thesis therefore addresses validity and reliability issues of key constructs in motorcycle safety evaluation.

1.4.3 Validity and reliability of self-report

All measurement methods have limits, and if self-report measures can be designed in ways that provide valid and reliable data, then it is a valuable method of data collection with the aforementioned advantages. The appropriateness of self-report can be assessed by firstly testing the validity and reliability of the self-report instruments within the target audience.

Validity refers to the extent to which an instrument measures what it purports to measure. It is a multi-faceted concept determined by relations with other variables (36, 37), including construct validity, content validity, and predictive validity. Construct validity refers to the survey items being representative of the underlying conceptual structure (38). Content validity refers to the measure covering a representative sample of the domain to be measured (36). Predictive validity refers to the ability of the measure to predict other relevant and important constructs (36). In road safety evaluation research, crashes, injuries, and fatalities are central outcomes of interest. If self-report does not provide such information and if self-report of related constructs (e.g. risky attitudes) does not reliably predict those central outcomes in a valid manner then the self-report data lack relevance and value.

Reliability refers to the overall consistency of a measure such that any score changes measured by a completely reliable instrument would be a reflection of true change in the construct that is being measured (36). Reliability is partly influenced by the level of control applied in the question formats and administration of the surveys. There are two main types of reliability—internal consistency and test-retest reliability. Internal consistency of a scale is only relevant for multi-item scales and refers to the consistency in responses to the questions of the same underlying construct i.e. the constituent items are measuring the same construct. Internal consistency of a scale is determined in a single administration of the scale. Test-retest reliability of a scale refers to the stability in measurement of the underlying construct across two measurement points. Test-retest reliability is determined by repeated administration of the measure (36). The stability of a self-report measure is especially critical when its use is intended for road safety evaluation research where the change over time due to the intervention, versus the natural change over time, versus the lack of reliability to measure change can be distinguished.

1.4.4 Statistical assessment of validity and reliability of self-report

Certain statistical tests are available to ensure acceptable validity and reliability of self-report measures. Self-report measurement of a construct is developed beginning with exploratory factor analysis and established through confirmatory factor analysis (39, 40). When there is no *a priori* assumption about the construct, exploratory factor analysis is firstly used (41). Confirmatory factor analysis can then be used to test specific hypothesis about the factor structure (41). Multiple items are developed to measure a construct and responses to those items that are believed to represent a single shared attribute are usually summed to form a composite scale. A composite scale consisting of multiple items is generally more reliable than each of the items alone (42). These attributes are referred to as latent variables or common factors within the jargon of factor analysis.

Content validity is demonstrated by the statistical consistency shown with other measures of the same domain (36). Predictive validity is demonstrated by the statistical relationship with measures of the predicted construct (36). These statistical tests of relationships include correlations and regression analysis, and statistically significant coefficients are considered to reflect validity. Internal consistency is tested by calculating Cronbach's alpha coefficient (43). Test-retest reliability can be tested by calculating the correlations of scores obtained from repeated tests. Generally a minimum Cronbach's alpha and correlation coefficients of 0.7 is recommended (42). Timing of measurements and practice effects are also important considerations in the interpretation of test-retest reliability coefficients.

1.4.5 Validity and reliability aims of the present thesis

The present thesis aims to examine these validity and reliability concepts in relation to self-report measures used in motorcycle safety research. Based on the findings it aims to provide best practice recommendations to maximise the theoretical and practical values of findings derived from self-report. In particular, the appropriateness of self-report in studying novice riders is not yet known and it is fundamental to test the validity and reliability of self-report surveys used in novice rider safety research before their wider use. The importance of the focus on novice riders is described in the next section.

1.5 Brief review of trends in motorcycle use, crashes, and novice riders as a focus of research

In Australia, according to the 2012 Motor Vehicle Census, motorcycle registrations showed the largest average annual growth over the five years between 2007 and 2012 at 7.0% compared to the average annual growth of 2.6% for all motor vehicles (44). Increasing numbers of motorcycle licence holders and registrations in the face of increasingly crowded road systems will lead to increases in motorcycle crashes (45). In fact over the nine years from 2000-01 to 2008-09 in Australia, those injured as motorcyclists recorded the highest rates of increase with average annual rates of increase of 6.9% amongst all road user groups (46). Consistent with this national trend, increasing trends of motorcycle licences and registrations are evident in the state of Victoria in Australia (Figure 1.1), which is the context for the present research. Following these trends, motorcycle safety research is a growing field internationally, and the development and use of valid and reliable methods used in rider safety research are fundamental processes (47, 48).

Amongst all road user groups in Australia in 2008-09, motorcyclists had the highest serious injury rate per 100,000 registered vehicles, which was ten times the corresponding rate for car occupants (50). Motorcycling is understood to carry more risk of crash and injury than driving a car because of the inherent instability of, and lack of protection afforded by, the vehicle (51). These factors may account for the differential risks between motorcycle riders and car drivers, but it is also possible that differences in other factors such as behaviours, motivations, and attitudes between motorcycle riders and car drivers also contribute to their differential risks. This highlights the need to measure those factors for better understanding of motorcycle crash risks.

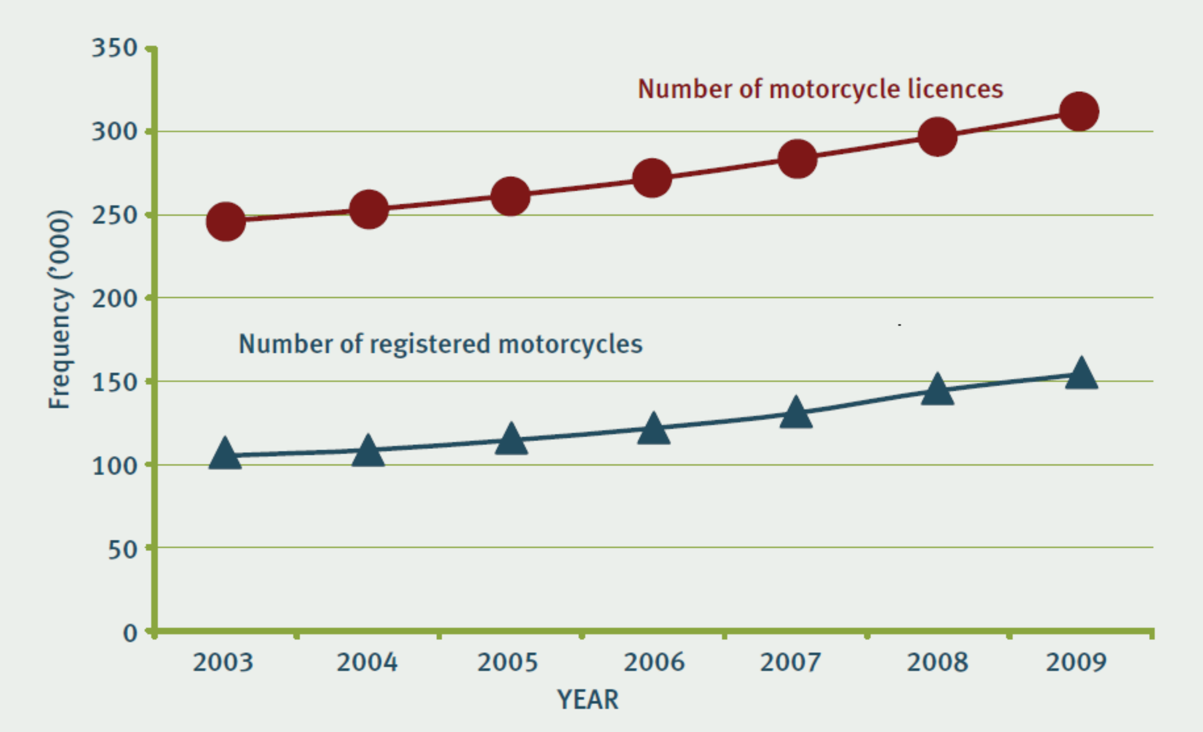


Figure 1.1 Increasing trend in motorcycle licences and registrations in Victoria, Australia. *Source:* VicRoads (2010) Graduated Licensing for Motorcyclists A Discussion Paper.

Amongst motorcyclists, those in their early years of riding are involved in more crashes than riders with more years of riding experience (49, 52). For example, the substantial decline in the number of motorcycle crashes with licensing years in Victoria is shown in Figure 1.2 (49). In Victoria novice riders represent almost one third of all motorcycle fatalities and serious injuries (49). The current thesis therefore focused on the application of self-report methods amongst this particularly high risk group: novice riders.

In addition it cannot be assumed that all populations would provide equally reliable and valid self-report data. It is plausible that experienced drivers may find it more difficult to recall details of highly automatized tasks of driving, that is, the reliability and validity of self-report may depend on driving experience. Similarly, relatively inexperienced novice riders whose riding is still a novel event may be able to recall recent riding events better than experienced riders whose riding have become frequent mundane events. To the knowledge of the present author, no research has addressed the reliability and validity of self-report specifically amongst novice riders.

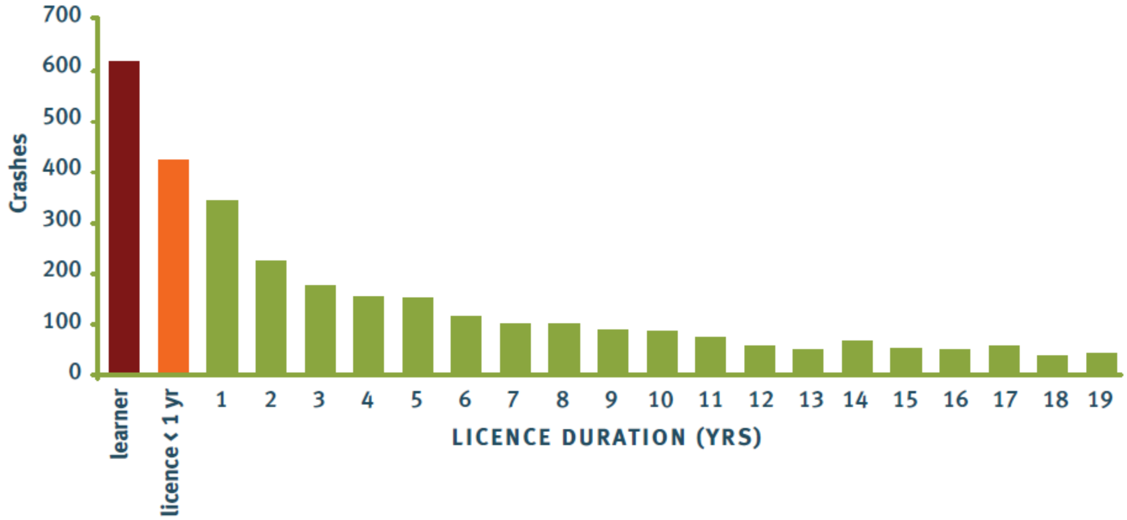


Figure 1.2 Number of motorcycle crashes (fatal and serious injury) by licence duration based on Victorian crash data 2003–2007.
Source: VicRoads (2010) Graduated Licensing for Motorcyclists A Discussion Paper.

1.6 Key constructs in motorcycle safety research

Road safety policy development and implementation are a product of the interplay of community beliefs and values, politics, resources, management processes, and scientific evidence on reductions in crashes, injuries and fatalities. The success of motorcycle safety interventions such as rider training depends on not only that they modify motorcyclists' behaviours, attitudes, and/or motivations in a desirable manner, and thereby crash risks, but also that they are valued by the target audience and/or the wider community. Generally it is when the interventions meet those features that they attract funding and prioritisation by governments. As a consequence, motorcycle safety research must integrate multiple constructs to facilitate successful delivery of policies and subsequent potential positive impact on safety.

In this context, riding exposure, on-road riding behaviours, motivations to ride a motorcycle, and motorcyclists' perceived value are all key constructs in motorcycle safety research. Data on riding exposure and riding behaviours can be useful for not only outcome evaluation of interventions but also crash and injury risk factor identification. Riding motivations and motorcyclists' perceived values of rider interventions can inform intervention contents and implementation strategies. Any given measure, self-report or other objective measures, of these four constructs will have its limitations, but the development of valid and reliable self-report measures of those constructs will provide researchers with extra tools that may complement or supplement other data sources.

This thesis will explore four important motorcycle safety constructs—exposure, on-road behaviour, riding motivations, and perceived value—and their validity and reliability. In the following section, each is described and the justification for the use of self-report to measure those constructs are provided in turn.

1.6.1 Riding exposure

Exposure, generally defined as some form of the amount of travel (53, 54), is one of the most fundamental concepts in road safety research because it indicates the road users' exposure to the risk of death or injury. Whilst number of motorcycle licence holders and motorcycle registrations are commonly used as a proxy measure of riding exposure, they can misrepresent real riding exposure especially for motorcyclists, for reasons discussed in detail in Chapter 2. Hence, riding exposure measured in terms of the amount of actual riding, such as distance and time travelled and number of riding trips, is more appropriate than licences and registrations. Installation of technology on motorcycles to collect such riding exposure data is likely to produce the most objective valid data. However, in the context of large-scale research or limited budget, alternative methods such as self-report might be used. Standardised self-report measures of riding exposure do not yet exist in motorcycle safety research. Therefore, in the context of escalating riding and injury, there is an urgent need for the development and evaluation of valid and reliable self-report riding exposure measures. The present thesis therefore critically reviews the literature to identify the current status of self-report measurement of riding exposure, and incorporates validity checks and reliability tests of various forms of self-report riding exposure measures so that best practice self-report riding exposure measures can be recommended.

1.6.2 On-road riding behaviours

Risky on-road behaviours have been historically dichotomised broadly into errors and violations (14). The *Motorcycle Rider Behaviour Questionnaire* (MRBQ), was specifically developed for motorcyclists to measure errors and violations as well as the use of motorcycle safety equipment (10). Accordingly, on-road riding behaviours refer to those behavioural domains in this thesis. Police records of traffic offences are useful to understand risky on-road behaviours. However, they do not necessarily capture all errors and violations due to the variability in enforcement (people do not always get caught for breaking road rules). Furthermore, they do not necessarily capture all non-use of safety equipment because in most jurisdictions and countries the use of safety equipment is not legally mandated except for helmets. It can also be impractical to observe on-road behaviours in natural driving environments which are complex, especially for large-scale research. For these reasons the development and evaluation of a self-report measure of on-road riding behaviours can be useful for motorcycle safety research and practice. The present thesis therefore critically evaluates the literature on the MRBQ as well as the *Driver Behaviour Questionnaire*, on which the development of the MRBQ was based, in order to identify the current status of self-report measurement of on-road behaviours. It also examines the psychometric properties of the MRBQ to assess the applicability of the MRBQ amongst novice riders, a population to whom the MRBQ has not been applied to date.

1.6.3 Riding motivations

It has been suggested that people are attracted to motorcycling for a variety of reasons including image, the feeling of freedom, to feel at risk, to impress others and practical motives such as convenience and economy (55). The *Motorcycle Rider Motivation Questionnaire* (MRMQ; 11) is the first structured questionnaire that was developed to systematically assess the reasons for riding. Accordingly, riding motivations refer to riders' reasons for choosing to ride a motorcycle in this thesis. Certain interventions may not work unless the underlying motives are addressed, and measurement of riding motivations can help to address riding behaviours in ways that are sensitive to the different needs amongst motorcyclists. Given riding motivations are about subjective reasons for riding and not directly observable by another individual or apparatus, direct self-report can be the most useful method to understand riding motivations. The present thesis therefore critically evaluates the literature on the self-report measurement of riding motivations including the MRMQ in order to identify its current status. It also examines the psychometric properties of the MRMQ to assess its applicability amongst novice riders, a population to whom the MRMQ has not been applied to date.

1.6.4 Rider perceived value of rider training

Public and private support for safety programs and thus funding are critical to implementation of effective evidence-based programs. While the decision to fund and implement road safety programs should be based on their actual effectiveness in reducing crashes and related injuries and fatalities, the community's perceived value can create a political will to provide and even mandate programs even if no sound evidence exists to demonstrate their effectiveness. This may also happen in the opposite direction where the lack of value placed by the community can be a significant barrier to implementing road safety measures with sound evidence for effectiveness. For instance, this is observed in relation to speed camera and bicycle helmet legislation (56-58). Measuring, understanding and therefore addressing perceived value of interventions is useful to manage this mismatch and enable resource allocation to the most effective interventions. One of the ways in which community or users' value of road safety interventions can be systematically measured is the contingent valuation (CV) method. The CV method is a survey-based approach in which individuals of a representative sample of the population at risk are directly asked to value in monetary terms (willingness to pay) a hypothetical reduction in risks of their own and possibly other people's resulting from an intervention (59, 60). Self-report is appropriate to measure such subjective valuation which is not necessarily directly observable by another individual or apparatus. The present thesis therefore critically evaluates the CV literature in order to identify the current status of self-report measurement of perceived values of rider interventions and to inform the development of the CV survey for this thesis. It also assesses the perceived value of a rider training and the determinants of the perceived value via the CV survey.

1.7 Study context—evaluation of a motorcycle rider training program

A large-scale study to evaluate a motorcycle rider training program provided an ideal opportunity to assess the self-report measures of the abovementioned key constructs. This study, aimed at evaluating the effectiveness of the program via a randomised control trial, is a contract project with VicRoads, the state authority for roads in Victoria in Australia, and supported by the former Victorian Motorcycle Advisory Council and funded by the Motorcycle Safety Levy in Victoria, Australia.

The motorcycle rider training program, marketed as *VicRide*, is currently under trial in an initiative by VicRoads for consideration for its inclusion in the graduated licensing system. Graduated licensing is a system that delays full licensing, providing beginners with the opportunity to first gain experience and acquire critical skills under conditions of reduced risk. As novices gain maturity and experience, restrictions are gradually lifted and novices are granted the opportunity to experience and master new, more complex traffic conditions and scenarios. The system begins with the learner's permit stage and progresses through to two probationary (also known as restricted, provisional, or intermediate in other jurisdictions) stages and ends with the full privilege licence stage. A diagrammatic depiction of the graduated motorcycle licensing system in Victoria is presented in Figure 1.3, including the learner (L), two probationary (red P1, green P2) and full licence (F) stages.

The *VicRide* program aims to lower the risk of on-road crashes amongst novice riders who have advanced from a learner's permit to a probationary licence because they are shown to have a higher risk of crash than more experienced riders (49, 52). Formal rider training is often promoted as an intervention to teach vehicle users skills, attitudes and motivations relevant for the safe on-road operation of the vehicle, thereby reducing the risk of motorcycle crashes and injuries (61-65). It is based on the assumption that it is a lack of skills gained by experience that contributes to the higher involvements in crashes of novice riders (55, 66-69). The *VicRide* program is not a basic motorcycle control skills training but a higher cognitive skills training to develop safe riding attitudes and behaviours. Safety concepts may not be readily embraced or internalised until novice riders acquired some riding experience (70). Thus *VicRide* is targeted at those riders who have been exposed to riding on-road. Therefore the present sample consisted of riders who were either on the red P1 or green P2, hereafter referred to as novice riders.

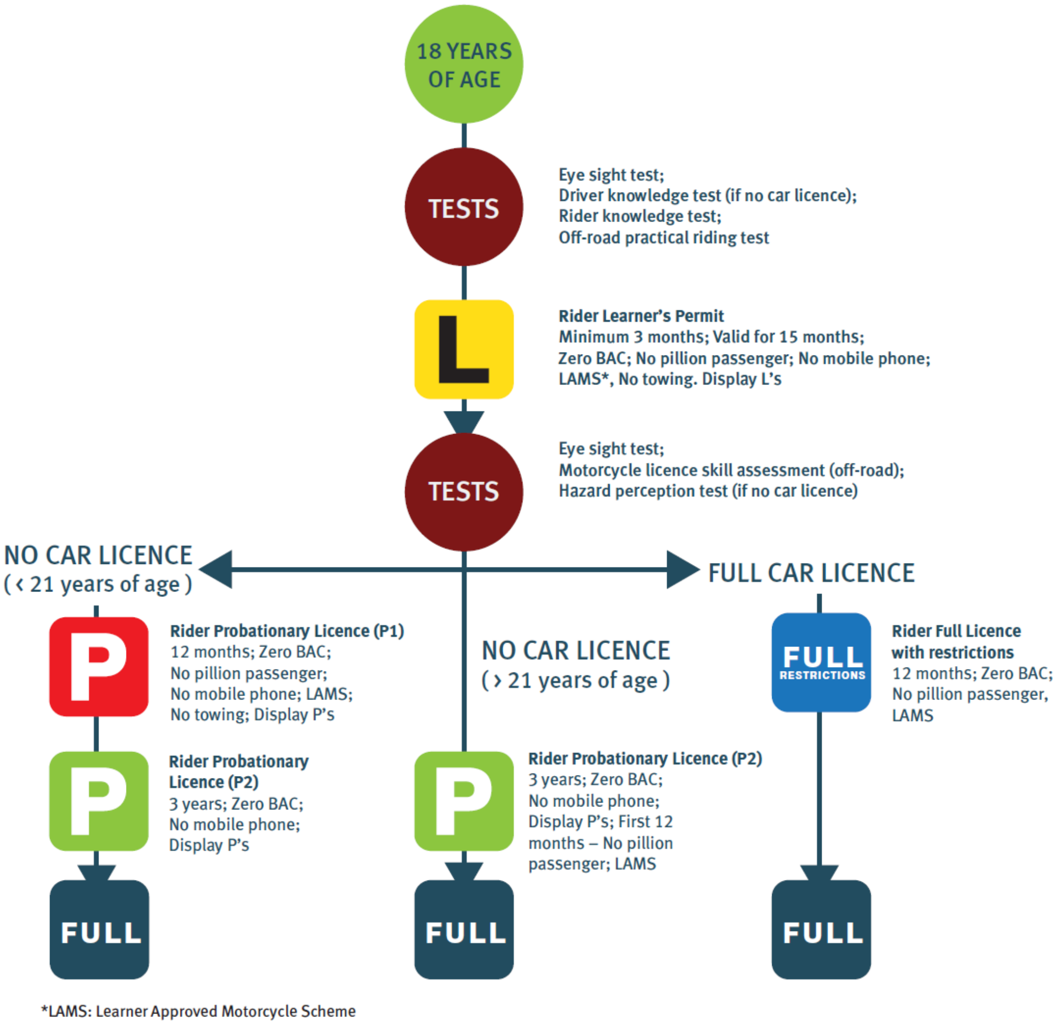


Figure 1.3 Diagram of the Graduated Licensing Scheme for motorcycle licensing in Victoria, Australia.
Source: VicRoads (2010) Graduated Licensing for Motorcyclists A Discussion Paper.

The *VicRide* program involved a four-hour on-road ride session in both metro and rural settings followed by post-ride group discussions in a group of two to three novice riders facilitated by a professional motorcycle coach. For the purpose of the randomised control trial, VicRoads sent letters of invitation to motorcycle riders who had recently advanced from a learner's permit to a probationary motorcycle licence. The study candidates could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The eligibility criteria required by the *VicRide* program included 1) potential participants owned a motorcycle (not a scooter or moped); 2) their motorcycle had an engine capacity of 125cc or greater and was compliant with the VicRoads' Learner Approved Motorcycle Scheme (which includes motorcycles with an engine capacity up to and including 660cc but do not exceed a power-to-weight ratio of 150 kilowatts per tonne); 3) they had ridden at least 500km over at least 12 separate trips on public roads since obtaining their learner's permit; 4) they had been on a Victorian probationary motorcycle licence for one year or less. If the candidates met all the eligibility criteria they were asked to provide informed consent to participate in the study and for their police-recorded offence and crash data to be accessed as part of the study participation.

A scooter refers to a vehicle with or without a seat that has two or three wheels and a footboard between the front and back wheels in Victoria. Mopeds are defined in the Australian Design Rules as powered vehicles with two or three wheels, an engine cylinder capacity not exceeding 50 ml and a speed not exceeding 50 km/h. Scooter and moped riders were excluded from this evaluation trial to control for factors such as locations, reasons, and amount of riding and maximise the statistical power to detect intervention efficacy, if any. Potential differences between motorcycle types may contribute to different effects of the program being evaluated and the sample size required for stratified statistical analysis was not pragmatic for the present research context. The Learner Approved Motorcycle Schemes (LAMS) have been introduced in some Australian jurisdictions to provide access to a range of motorcycles that excludes high power-to-weight models. VicRoads requires all Victorian learner and probationary riders to only ride LAMS approved motorcycles. Criterion 3 also ensured that those riders who have been exposed to riding on-road were recruited.

The evaluation of *VicRide* involved the use of self-report surveys and police-recorded crash and traffic offence data of the study participants. The self-report surveys were designed specifically for this study based on previous research. Specifically, the surveys included riding exposure questions, previously developed questionnaires on riding behaviours and riding motivations, namely the *Motorcycle Rider Behaviour Questionnaire* (10) and the *Motorcycle Rider Motivation Questionnaire* (11) respectively, questions on willingness to pay for *VicRide* as well as questions on socio-demographics. This evaluation study therefore provided an ideal opportunity to assess the validity, reliability, and relevance of self-report measures used in motorcycle safety research amongst novice riders. The present sample consisted of novice riders who participated in this randomised control trial.

1.8 Contributions by the present author

As the author of this thesis, I had significant input in the development of the overall methods to implement the randomised control trial for this contract project with VicRoads including the development of the randomisation algorithm, recruitment and interview procedures, and data collation. I was involved in the design of the evaluation surveys with the investigative team. I also designed the majority of the phone recruitment method including the development of the phone recruitment interview script for the overall trial and the entire contingent valuation survey presented in Chapter 6. I was the Project Manager for the overall contract project managing all aspects of the project including obtaining ethics approval, stakeholder relationship management (especially to ensure timely recruitment and program delivery), data management, risk management, and responding to all study participant queries with respect to the evaluation. I was fully responsible for the conduct of the literature review presented in Chapter 2, and the conceptualisation of each of the four studies presented in Chapters 3-6 and the conduct of all the associated statistical analyses. I prepared the first drafts of the manuscripts presented in Chapters 3-6 and of response to reviewers' comments, and was responsible for finalising all the manuscripts for submission for publication.

1.9 Aims and objectives

The broad aim of this thesis is to explore the appropriateness and relevance of self-report in measuring four key constructs in motorcycle safety research, namely, riding exposure, on-road riding behaviours, riding motivations, and rider perceived value of rider training amongst novice riders.

The specific objectives of this thesis are:

1. To provide a critical review of the literature on the self-report measurement of riding exposure, on-road riding behaviours, riding motivations, and rider perceived value of rider training (***Chapter 2***).
2. To examine and identify best practice self-report measures of riding exposure amongst novice riders (***Chapter 3***).
3. To examine the applicability of a self-report measure of riding behaviours amongst novice riders; specifically the *Motorcycle Rider Behaviour Questionnaire* that was developed amongst experienced riders based on the widely used *Driver Behaviour Questionnaire* (***Chapter 4***).

4. To examine the applicability of a self-report measure of riding motivations amongst novice riders; specifically the *Motorcycle Rider Motivation Questionnaire* that was developed amongst experienced riders (***Chapter 5***)
5. To develop and conduct a contingent valuation survey and examine the perceived value of a motorcycle rider training program and its determinants amongst novice riders (***Chapter 6***)
6. To provide a summary of principal results presented in Chapters 3–6, main limitations of the studies, an assessment of the appropriateness and relevance of self-report in motorcycle safety research, and recommendations and conclusions highlighting the original contribution of this thesis (***Chapter 7***).

1.10 Structure of thesis

This thesis is submitted as a hybrid thesis under The University of Sydney, School of Public Heath guidelines. This thesis is a collection of two published (Chapters 2, 6), one in press (Chapter 3), and two submitted manuscripts under review (Chapters 4, 5), each presenting original research concerning the self-report measures used in motorcycle safety research. Each manuscript included in this thesis provides a detailed description of the methodology and therefore a separate methodology chapter is not included. Overall the research presented in this thesis provides recommendations for improving self-report methodology used in novice rider safety research as well as related recommendations for motorcycle safety and broader road safety research, policy and practice.

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Chapter 2: Literature Review

2.1 Preamble

Chapter 2 provides a critical review of the literature to identify the knowledge gaps and the significance of the aims of the four studies that comprise the present thesis. This addresses the four key constructs in turn – riding exposure (2.2), on-road riding behaviours (2.3), riding motivations (2.4), and rider perceived value of training (2.5).

2.2 Self-report measurement of riding exposure

2.2.1 Background

In road safety, exposure, generally defined as some measurement of the amount of travel (1, 2), is one of the most fundamental concepts. With respect to road safety evaluations, comparisons of the number of crashes only can be misleading if exposure is not taken into account. For example, the number of motorcycle crashes may reduce from pre to post intervention but that may be due to an already existing decreasing trend of number of motorcyclists on the road or amount of riding and not due to the intervention. When comparing relative risks between different road user groups, crash risks that do not take into account exposure can be misleading (3, 4). In 2011 Australia had 201 motorcyclist deaths, much fewer than the 579 car driver deaths (5). This was mainly due to fewer motorcyclists on the road than car drivers. Once exposure is taken into account the death rates are 2.96 per 10,000 registrations for motorcyclists and 0.55 for car drivers (5), shedding light on the significance of the motorcycle safety issue.

Valid and reliable measurement of exposure is crucial to understand factors that contribute to increased or decreased risk of a crash. While the importance of the exposure concept is generally understood in road safety, the best way to measure it is less known, especially for motorcyclists. The issues of riding exposure measurement are explored next.

2.2.2 Operationalisation of riding exposure

In order to understand the best way to measure riding exposure, a clear operational definition must be considered first. Exposure could be measured as number of vehicle registrations, licence holders, on-road trips, distance travelled (km, miles) or time duration (hours, minutes) of travelling on road. Whilst the appropriateness of each of these exposure measures would depend on the research or policy question, they respectively bear limitations and may misrepresent the real risk. For example, the calculation of motorcycle crash rates in terms of licence holders and registration can underestimate the size of the motorcycle problem because those units may not reflect the real exposure of motorcyclists on road. This is because having a motorcycle licence does not necessarily mean that all licence holders actually ride on road. Similarly, having a motorcycle registration does not necessarily mean that all registered people actually ride the registered vehicles on road. Some riders may keep their motorcycle licence for historical reasons but not necessarily own and ride a registered motorcycle. In many Australian states (e.g. Victoria, NSW and Queensland), though separate licences, motorcycle and car licences are linked to a single identification number. In addition, a single fee renews a car licence as well as a motorcycle licence automatically even if the licence holder may no longer be riding. Retired riders can also return to riding without this being reflected in the licensing figures. The ratio of licence holders to registered motorcycles has been reported to be greater than two to one in Victoria and almost five to one in NSW (6). Others may be dual owners of a car and a motorcycle or multiple motorcycles but rarely ride a certain vehicle, making vehicle registration an inaccurate representation of their riding exposure. For example, only 47% of motorcycle licence holders aged over 30 in Victoria were found to be active riders (7).

For these drawbacks of licence and registration data as riding exposure measures, a more suitable operational definition of riding exposure would be the amount of actual riding, which can be quantified in terms of distance and time duration travelled, and number of riding trips. A review of the literature indicated that few exposure studies either conducted in Australia or internationally have included motorcyclists (e.g. 8, 9) and only one published peer-reviewed study was identified that focused on motorcyclists in Australia (10). Most exposure studies involve drivers only, and there is dire need to develop and improve measurement of riding exposure.

2.2.3 Self-report methods of exposure measurement

The literature review identified that self-report surveys are frequently used to measure driving and riding exposure. A summary of these studies is provided in Table 2.1, identifying the study population, self-report methods and units of exposure measurement. Self-report surveys can be conducted via phone interviews (e.g. 3, 4, 11, 12), postal questionnaires (e.g. 9, 10, 13, 14), or computer questionnaires (e.g. 15). These surveys can be accompanied with travel diaries/logs (e.g. 8, 16) in which the study participants are required to record details about their trips and/or odometer readings for a certain time period in a designated vehicle for the study.

Common issues arise from these self-report exposure studies. First, often how the exposure question was asked was not reported (17-19), therefore it is difficult to assess and improve the validity and reliability of the exposure questions. Second, it is not clear what the optimum time period is about which exposure should be asked. Some studies extrapolate the weekly distance to derive annual distance (e.g. 20, 21) but it is not clear if the distance obtained for the week is representative of the distance in a year therefore potentially making this extrapolation inappropriate. No study has directly compared the exposure collected for a certain period (e.g. week) and for a longer period (e.g. year) from the same individual. Third, most studies do not provide evidence for the validity of the self-reported exposure in terms of unit (trips, time, distance) or source (travel diary, self-reported odometer, unaided question). Therefore, evidential consensus for the best unit of riding exposure is lacking. It is important to assess what unit produces the most valid and reliable measure of exposure in order to develop valid and reliable self-report exposure measures. The units of exposure measurement are explored in more detail in the next section.

2.2.4 Units of exposure measurement

The literature review identified that distance in kilometres or miles of travel is the most commonly used unit of exposure, but sometimes time in hours and/or minutes of travel, and number of trips are also used (see Table 2.1).

Driving exposure studies have shown mixed results in terms of risk patterns with varying units of exposure. One study showed that changing the unit from kilometres to hours did not change the finding that the very young and the very old drivers have higher crash risks (22). It also showed positive association between miles and minutes driven, except for 18-24 year olds who drove more minutes and trips to home, school, and work, but drove more miles to other social and recreational distances (22). However, another study showed that the number of trips did not correspond to the same patterns observed in the number of minutes or miles driven (15). When the average speed is similar, time and distance gave equivalent information about exposure, highlighting the need for exposure to consider both time and distance (23). Another study showed that while young male drivers remained at high risk for all types of exposure, older women had high crash rates when distance was included but men and women over 60 had very similar crash rates when time exposure was used (20). This study also highlighted that apparent differences in crash risk per kilometre is explained by differences in typical driving speed and environment (20). The optimal units of exposure are not clear in understanding crash risks amongst drivers, and much less clear amongst motorcyclists for which exposure studies are rare. Therefore the validity and reliability of self-report riding exposure measures of varying units were assessed in the present thesis.

TABLE BEGINS OVERPAGE.

Table 2.1 Review of self-report driving and riding exposure studies

Study	**Sample**	**Method of exposure measurement**	**Unit of exposure measurement**
(25) af Wåhlberg 2011 The accident-exposure association: Self-reported versus recorded collisions	N=157 bus drivers. Source/Location = Sweden 1999-2001.	How exposure data collected not reported except that the hours worked per year data were available for 1999-2001.	Number of hours worked as a bus driver.
(8) Beck *et al.* 2007 MV crash injury rates by mode of travel, United States: Using exposure-based methods to quantify differences	Source/Location = National Household Travel Survey (NHTS) 2001, USA.	Phone survey accompanied with travel diaries completed by all members of the household on a randomly assigned travel day.	Person-trips (one-way journey between two points).
(23) Chipman *et al.* 1992 Time vs. Distance as measures of exposure in driving surveys	N = 3686 drivers 16 years and over. Source/Location = urban, rural, and northern regions of the province of Ontario, Canada, 1988.	Mail survey accompanied with • 3-day diary – all drivers aged 60+ and half of drivers aged < 25 • 1-day diary – the remainder. Diary entries: • Odometer readings • Clock times. The arbitrary cut-off points used to exclude improbable data (the upper and lower 5% of the speed index distribution).	• km/day • hr/day.
(20) Chipman *et al.* 1993 The role of exposure in comparisons of crash risk among different drivers	N = 3686 drivers 16 years and over.	Mail survey accompanied with • 3-day diary – all drivers aged 60+ and half of drivers aged <	• Annual km • Driver days.

and driving environments	Source/Location = urban, rural, and northern regions of the province of Ontario, Canada, 1988.	25 • 1-day diary – the remainder. Diary entries: • Odometer readings • Clock times. Extrapolation: Mean daily distance and time spent driving were used to estimate the annual driver km and driver days.	
(16) Doherty *et al.* 1998 The situational risks of young drivers: The influence of passengers, time of day and day of week on accident rates	N=306,319 drivers 16-59 years involved in police reported crashes. Source/Location = Province of Ontario, Canada, 1988.	Mail survey accompanied with • 3-day diary – all drivers aged 60+ and half of drivers aged < 25 • 1-day diary – the remainder. Diary entries: • distance • day of week • time of day • roadway type • number of passengers.	Mean daily driver km by group and situation.
(15) Ehsani *et al.* 2011 Driving exposure by driver age in Michigan	N=14,315 households. Source/Location = Michigan Department of Transportation's state wide survey, USA.	Phone, mail or web survey accompanied with travel diary. Diary entries: Minutes and number of trips in a consecutive 48-hour travel period for every household member occurring on	• Minutes of driving • miles driven • number of trips.

		Mondays – Thursdays during the school year. Miles driven calculated by the authors using origin and destination coordinate data points projected onto a road network of Michigan using ArcGIS version 9.3.	
(17) Engström *et al.* 2008 Young drivers–Reduced crash risk with passengers in vehicle	N=124, 960 crashes N=38,186 million person km. Source/Location = National study of the driving habits of licensed drivers, Sweden, 1994-2000.	No information other than exposure data collected annually in a national study reported.	Annual km.
(10) Harrison and Christie 2005 Exposure survey of motorcyclists in NSW	N=794 people who had registered motorcycles. Source/Location = NSW, Australia.	Two mail surveys. Questions: • odometer reading • date of reading • self-estimates of riding distance in the preceding week, month and year. Extrapolation: Difference between the two odometer readings multiplied by 365 divided by days elapsed between the dates of readings.	Annual km.
(22) Kam 2003 A disaggregate approach to crash	N=21,580 households; 57,823 respondents;	Mail survey accompanied with a travel form completed by each member of	• Crash per km • crash per 10,000

rate analysis	224,203 travel stops. Source/Location = Pooled Victorian Activity and Travel Survey (VATS) data from 31 local government areas within the Melbourne Statistical Division, Australia, 1994 – 1997.	the household. Entries on the assigned travel day: • all travel stops • starting and arrival time • purpose • mode • addresses of the origin and destination (or nearest cross streets).	hours • Crash per million trip-km.
(14) Langford *et al.* 2006 Older drivers do not have a high crash risk−A replication of low mileage bias	N = 47,052 drivers. Source/Location = Annual surveys 1990-95 and biannual surveys 1997-2003 combined, Netherlands.	Bi/annual mail survey. Question not specified.	Annual km.
(13) Lourens *et al.* 1999 Annual mileage, driving violations, and accident involvement in relation to drivers' sex, age, and level of education	N = 35, 275 stratified sample of drivers from a representative Dutch population sample aged 15+. Source/Location = Dutch research institute's large-scale national survey.	Bi/annual mail survey. Question: Km driven in a car in the last year (exact as accurate as possible).	Annual km.
(24) Ouimet *et al.* 2010 Using the US NHTS to estimate the impact of passenger characteristics on young drivers' relative risk of fatal crash involvement	N=26,038 households with trips of one or two occupants. Source/Location = NHTS 2001 USA.	Mail survey. Questions: • trip distance in miles • trip purpose • number of vehicle occupants	• Annual vehicle trips (1=one-way travel from one address to another) • Vehicle miles travelled (VMT)

		• age and sex for household members.	expressed in 10millions.
(9) Segui-Gomez *et al.* 2011 Exposure to traffic and risk of hospitalization due to injuries	N = 12,369 road users in passenger cars, and/or mopeds/motorcycles. Source/Location = Spanish university graduates.	Mail questionnaire followed up two-yearly up to 8 years. Questions: • average travel in km per year in passenger cars (<1,000, 1,001–10,000, 10,001–20,000, 20,001–50,000, and ≥ 50,001) or on mopeds/motorcycles (never, <1,000, 1,001–5,000, 5,001–10,000, ≥ 10,001) at baseline • merged question and categories (<1,500, 1,501–5,000, 5,001–10,000, 10,001–20,000, and ≥ 20,001) at follow-up.	Annual km in one of the five-categories that summarise mid-point range average distances travelled (1,000, 3,250, 7,500, 15,000, or 25,000).

Note: Exposure studies including motorcyclists are in shaded cells.

TABLE ENDS HERE.

2.2.5 Testing the validity and reliability of self-report exposure measures

A review of the literature identified that whilst the validity and reliability of self-report exposure measures are not examined or reported in most driving exposure studies, they have been critiqued in some driving exposure studies. A summary of these validity studies is provided in Table 2.2, identifying the methods and units of exposure measurement, and the validation tests used and their results. It is apparent that these validity studies are also mostly for drivers, and validity studies on riding exposure are lacking.

It is not clear whether the errors detected in self-report exposure studies for drivers that do exist can be generalised to drivers in general, let alone riding populations. Several studies used in-vehicle electronic devices to refute the validity of self-reported exposure surveys (e.g. 26, 27). These studies only consisted of 61 drivers aged between 67 and 92, thus validity found may only apply to old drivers, whose recall can be expected to be poor in general (26, 27). Another study was based on teen drivers and it is not clear if their results can be generalized to motorcycle riders or novices who are less experienced but not necessarily young (28). Staplin et al (2008) found a discrepancy in the number of those who self-reported to drive less than 5000 miles per year in a survey and the number of drivers found in an Emission Exemption Database (EED) that contains information of vehicle owners who are exempt from emission testing because they drive less than 5000 miles per year. However, the EED contained only those who 'self-certified' to drive less than 5000 miles per year and there is a financial incentive for respondents to report they drive less than 5000 miles/year to be exempt from emission testing. Hence the data Staplin et al (2008) used to validate self-report is likely to suffer from self-selection bias.

A number of studies that have attempted to validate self-reported exposure measures also lack rigour in the analyses. Some validation studies used coarse analysis such as percentage difference between self-report and another measure of exposure (21, 29) and it is not clear at what percentage the error could be assessed as acceptable measurement. Other statistical analyses used to compare two exposure measures include paired t-test (26-28), calculation of coefficient of variation and measurement error (26, 27), or correlations (28, 30). Although more rigorous, they cannot solely provide sufficient evidence for the validity and reliability of the self-report exposure measures. For example, a non-significant result from a t-test between self-report and another (assumed to be valid) measure could mean that both over and underestimations existed to an equal extent rather than supporting the validity of self-report. Significant positive relationship between self-report and a standard measure could mean that both have a monotonically increasing relationship but not necessarily at equal values. Values of coefficient of variation indicate the spread of the distribution. However, equal variance between self-report and standard measure as indicated by equal coefficient of variation does not mean that the two measures have equal values. Hence a comprehensive set of analyses is required to provide sufficient confidence for the validity and reliability of the self-report exposure measures.

The Bland-Altman plot and coefficient of variation can complement the paired t-test and correlation. The Bland-Altman plot that graphs the difference between the two measures against the mean of the two measures with the mean difference and the limits of agreement identified (31) provides more insight into the paired t-test results and whether the level of agreement is related to the underlying value of the two measures. The limits of agreement calculated as the upper and lower 95% confidence intervals ($\mu \pm 1.96 \times SD$ where μ = mean difference between the two measures; SD = standard deviation of the mean difference) provides the range in which the two exposure estimates should lie across all levels of exposure if the two measures tend to agree. The coefficient of variation is particularly useful when examining the consistency between two measures of the same construct but in different units (e.g. kilometres versus hours of exposure). If the spread of the distributions of the two variables compared were similar as indicated by coefficients of variation of similar magnitude, then the two variables can be considered comparable. Hence the exposure study in the present thesis used a comprehensive set of analyses including the paired t-tests with the aid of the Bland-Altman plot, correlations, and the calculation of the coefficient of variation and measurement error, to perform validity checks and reliability tests.

Another study used quasi-induced exposure to test the validity of self-reported exposure (32). Quasi-induced exposure (QIE) method has been employed to circumvent the practical difficulties of collecting exposure information (e.g. 33-35). This method is convenient in that it relies solely on crash data to calculate rates. In a multiple vehicle crash one is determined to be entirely responsible for the crash and the other/s entirely not responsible. The 'not-at-fault crashes' is then used as a proxy exposure measure under a few assumptions. This method assumes that fault assignment is valid and reliable, and the not-at-fault drivers are involved in a crash randomly and passively and hence represent the entire driver population who are exposed to the crash risk condition. However, the QIE method in itself bears limitations and until they are resolved the validation of self-report exposure with QIE might be premature. First, the assignment of fault in crashes can be a problematic process, which may be biased by variables that are of interest to the study. For example, if the aim was to understand the crash risks of young riders in comparison to older riders, young riders may be more likely to be blamed for the crash (36-38) even though they may not have been really at fault. Second, assignment of fault neglects significant contributing factors to the crash that may not be easily identified or proven. As a hypothetical example, a rider with little riding experience may be less likely to respond to the errors of others and be involved in a crash with a rider who did not give way at the signed intersection. The low experience might have contributed to the crash but the fault might be entirely assigned to the latter rider. Third, the data on not-at-fault drivers is likely to be less reliable because the police might be less motivated to collect data on not-at-fault drivers. All these limitations could bias the results significantly.

All in all, it is not yet clear whether self-report exposure measures should be completely ruled out as a method for collecting riding exposure information. Overcoming the disadvantages of self-report exposure measures (i.e. questionable reliability and validity) with improved exposure question designs is possible. However, no exposure study has specifically provided practical recommendations for how to best ask the question to collect valid and reliable exposure information.

One way to validate a measure is to incorporate a variety of thematically related measures into the same investigation (39). Information can be gathered from the same individuals using several different measures of exposure. Hence, ***Study 1*** in the present thesis examined the relative validity and reliability of various self-report exposure questions amongst novice riders by comparing self-reported exposure estimates by the same individuals using alternative estimation procedures. This was to help identify the best unit of riding exposure and recommend the best practice self-report exposure questions, if feasible.

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Table 2.2 Review of validation studies on self-report driving exposure measures

Study	Sample	Method of exposure measurement	Unit of exposure measurement	Validation tests and results
(26) Blanchard *et al.* 2010 Correspondence between self-reported and objective measures of driving exposure and patterns in older drivers	N=61 older drivers aged between 67 and 92 from South-western Ontario, Canada who had a valid licence, drove at least once a week, the sole household driver or shared one vehicle.	Pre-formatted trip logs (driver name, no. and relation of passengers, no. of stops and weather of each trip) and daily activity diaries (departure/return times, destinations, modes of travel, estimated travel time). "Can you estimate the number of km you drove this past week? If so how many?" Those who hesitated prompted to try. If still hesitant, missing data. Only 53% gave self-estimates. "How long are most of your driving trips each way? - <15min; 15-30min; 30-60min; or >60min" for 34%. CarChip (for time of day, distance etc) and Otto Driving Mate, lightweight GPS device	Minutes, number of trips, km.	Time – CarChip vs diary: Driving time comparable when restricted to trips recorded by both the diary and CarChip. Trips – CarChip vs diary/log: CarChip recorded more trips than diary/log (agreement worse for log than diary). Distance – CarChip vs self-estimate: Non-significant difference but both under and overestimation and poorest agreement of all the units; Coefficient of variation = 44.5%; Measurement error = 77.5km.

		(for mapping roadways and manoeuvres).		
(27) Huebner *et al.* 2006 Validation of an electronic device for measuring driving exposure	Canadian drivers: 14 men aged 60-89 and 6 women aged 62-81 who held a valid driver's licence, had a 1996 or newer model vehicle, and were its sole driver.	CarChip plugged into the electronic (OBDII) system of vehicles 1996 or newer – trip information recorded each time the vehicle is started during the week study period. Questionnaire at the end of the study week including a question on how many km driven in the previous week.	Weekly km.	Paired t-test: Non-significant most likely due to both over and underestimation. Coefficient of variation = 33.6%. Measurement error = 110km.
(40) Joly *et al.* 1993 Exposure for different license categories through a phone survey: Validity and feasibility studies	Study 1: N=35 long distance truck drivers from a Canadian truck company. Study 2: N=40 Montreal bus drivers. Study 3: N=32 private car drivers.	Study 1: Self-reported via telephone interview versus mileage and time recorded in company logbooks. Study 2: Self-reported via structured face-to-face interview versus Transport Commission data. Study 3: Self-reported via telephone and face-to-face interviews versus self-filled logbooks at the time of travelling.	Distance, time	Study 1: Distance • Wilcoxon test – non-significant • r=.82 (significant) Time • Wilcoxon test – significant • r=.67 (significant). Study 2: Distance • Wilcoxon test – significant • Non-significant correlation Time • Mean difference = 0. Study 3:

				Distance • Wilcoxon test – non-significant • r=.90 (significant) Time • Wilcoxon test – non-significant • r=.81 (significant).
(21) Langford *et al.* 2008 In defence of the 'low mileage bias'	N=18,509 vehicle records with a known primary driver plus ratio of vehicle to drivers between 0.5 and 1.5, and those with self-report and odometer mileage were extracted from the NHTS 2001 USA.	NHTS 2001 question: "During the past 12 months about how many miles was the vehicle driven by all drivers?" Range responses assigned with the mid-point value. For vehicles owned for less than 12mths – "About how many miles has this vehicle been driven since you had it?" Extrapolation: 2 odometer readings at least 2 months apart (up to 4 months) extrapolated to 12 months controlling for seasonal difference in the travel volumes.	Annual km.	Percentage difference [(SR-odo)/SRx100]: Modest differences, little impact on any subsequent calculation of per-distance crash rates. Crash rates based on odo vs self-reported annual mileage: Low mileage drivers – crash rate substantially reduced Medium and high mileage drivers – crash rate altered slightly. The commonly found observation of heightened crash risk for low mileage drivers across age groups and particularly high for old low mileage drivers still existed albeit to a reduced extent.
(32) Lardelli-Claret *et al.* 2011	N=27,934 drivers aged 15-64 residing in Spain Nov	Spanish Household Survey on Alcohol and Drugs.	Annual km.	Both methods detected similar crash risk patterns (increased risk for the

Comparison of two methods to assess the effect of age and sex on the risk of car crashes	2005-April 2006.	For those who had driven a car during the previous year (n=17,053) - km driven in the previous year in eight range categories.	Quasi-induced exposure methodology (based solely on crash data to estimate exposure).	youngest and oldest compared to middle-age; for males compared to females in the youngest age group 18-20).
(28) Leaf *et al.* 2008 Driving miles estimates by teen drivers: how accurate are they?	N=118 teens participating in a longitudinal study of parent influences on teen driving; who obtained their Learner's in Connecticut, USA 2000-2001 and licensed <1 year.	Two interviews between Feb and Aug 2002, about 10 days apart. A daily trip log of each driving trip in the 7 days prior to the 2nd interview. Phone interviews: • Unaided overall estimate of miles and trips (a journey from one point to another) driven in the preceding week • Sum across the enumerated trips on each of the 7 days and miles for each trip. (1st week recall; 2nd week based on triplog) • Teens who drove their own vehicle (N=58) called for an odo reading prior to the first week and asked	Miles per week.	Non-shared vehicle drivers: Odo and aided mileage not significantly different but both significantly higher than unaided mileage; Week 1 correlations = 0.65 – 0.73 Week 2 correlations = 0.16 – 0.75. Shared vehicle drivers: Difference between aided and unaided decreased in week 2 after filling out daily trip logs.

		for odo in each interview.		
(29) Staplin *et al.* 2008 'Low mileage bias' and related policy implications–A cautionary note	N=331 drivers aged 75+ found in two datasets in the same timeframe – Emission Exemption Database (EED) and Maryland Pilot Older Driver Study (MaryPODS) USA. N=1868 who self-reported weekly and annual miles driven in MaryPODS. N=11,013 drivers whose ratio of no. of vehicles to no. of drivers for a given household was 0.5-1.5 in NHTS 2001 USA.	Emission Exemption Database (EED) containing individuals aged 70+ who self-reported to drive their vehicle <5000miles/year to qualify for emission testing exemption (N=90,136). MaryPODS , driving history questionnaire from Maryland Pilot Older Driver Study. Annual mileage based on odometer reading and based on self-report from NHTS 2001.	Weekly miles driven & annual miles driven in MaryPODS. Annual km from NHTS 2001.	Test 1 – EED vs MaryPODS: 30% in EED (by definition only drive <5000miles/year) self-reported to drive >5000 miles/year in the MaryPODS survey. Test 2 – % difference [(Weekly mileagex52)/Annual mileage] of 2 self-estimates within MaryPODS: 100% difference for 10%+ of sample, 50% difference for 40%+ of sample. Test 3 – Self-reported mileage vs miles recorded by in-vehicle GPS for the same trips: Overestimation by high mileage drivers; underestimation by low mileage drivers (i.e. frequent and short trips). Test 4 – Percentage difference [(SR-odo)/SRx100] of 2 estimates from NHTS 2011 plotted by low, medium, high mileage groups: Underestimation highest for low mileage drivers; slight overestimation by high mileage drivers.

(30) White 1976 On the use of annual vehicle miles of travel estimates from vehicle owners	N=911 automobile and station-wagon inspection receipts, North Carolina 1974.	Odometer readings on inspection stickers collected 11-13 months apart. 3month follow-up mail survey of the vehicle owners of the inspection receipts. Question: "How many miles was this vehicle driven during the past 12months?"	Annualized odometer derived miles. Self-reported annual miles.	r=0.67 (n=433). Symmetric distribution of differences centred near 0. Mean difference = 423 miles (SD=5363 miles). Regression model [Self-estimate =0.6x(odo)+ 4039] implied owners of low usage vehicles (<12,000miles) tended to overestimate annual VMT whereas owner of high usage vehicle tended to underestimate it.

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2.2.6 Summary of the literature review

The following text box summarises the key take away points from the literature shown in Tables 2.1 and 2.2.

KEY TAKE-AWAY POINTS FROM THE LITERATURE REVIEW TABLES 2.1 and 2.2:

- Most exposure studies are on drivers and motorcycle riding exposure studies are almost non-existent.
- Self-report is heavily used to measure driving exposure but the appropriateness of self-report to measure riding exposure is not clear.
- Many self-report exposure studies do not specify the method in detail as to how the exposure question was asked, or use questions that seek estimates only.
- Most road safety studies do not provide evidence for the validity of the self-reported exposure measure used in whatever unit (trips, time, distance) or source (unaided question, self-reported odometer).
- Self-report exposure validation studies that do exist lack a comprehensive set of statistical analyses to provide sufficient evidence for the validity and reliability.
- Best practice design of exposure questions is not well understood, specifically, the best unit of exposure in self-report exposure measures is not clear.

2.2.7 Research objectives arising from the exposure literature review

Overcoming the disadvantages of self-report exposure measures with improved exposure question designs is possible. ***Study 1*** in the present thesis therefore had the following objectives:

1. To examine various self-report riding exposure questions of different units (distance, time, number of trips), sources (self-estimates, self-report odometer), and timeframes (week, month, three months) in order to assess the appropriateness of self-report to measure riding exposure amongst novice riders;

2. To conduct validity checks and reliability tests of different self-report riding exposure measures via a comprehensive set of statistical analyses;

3. To analyse possible sources of differential reliability of self-report riding exposure measures;

4. To provide recommendations on best practice self-report riding exposure questions based on the present results.

2.3 Measurement of on-road rider behaviours

2.3.1 Background

Historically, risky on-road behaviours have been dichotomised broadly into errors and violations (41). Errors relate to cognitive processing problems and have been referred to as “the failure of planned actions to achieve their intended consequences” (p.1315) e.g. slips, lapses, and mistakes (41). Violations have been referred to as “deliberate deviations from those practices believed necessary to maintain safe operation” (p.1316) e.g. speeding (41). The *Driver Behaviour Questionnaire* (DBQ) has been widely used in studies of drivers to measure on-road risky behavioural errors and violations. A similar measure, namely the *Motorcycle Rider Behaviour Questionnaire* (MRBQ), has been developed specifically for motorcyclists based on the same theory as the DBQ to measure errors and violations via self-report (18). The MRBQ also measures the use of motorcycle safety equipment (18). Understanding motorcyclists’ on-road behaviour through valid and reliable measurement is critical for not only the development but also the evaluation of interventions specifically targeted for motorcyclists. In this thesis, self-report measurement of on-road riding behaviours is assessed with respect to the MRBQ.

2.3.2 Self-report measure of riding behaviours: MRBQ

The 43-item MRBQ was developed to identify behavioural factors influencing motorcyclists' crash risk (18). Respondents are asked to rate on a 6-point Likert scale from 'never' to 'nearly all the time' how often they display the behaviour described while riding. For all the scales, higher scores indicate more frequent display of the behaviour described. Two studies have so far examined the value of the MRBQ amongst experienced motorcyclists in the UK (18) and Turkey (19) showing, to some extent, consistent results.

Understanding, and thus measuring, novice riders' on-road riding behaviours in particular can be beneficial to address their overrepresentation in crashes (42, 43). However, self-report behavioural measures for novice riders with proven validity and reliability are lacking, and no published study has examined the applicability of the MRBQ amongst novice riders in Australia. Testing the validity and reliability of the MRBQ amongst novice riders is essential before its use in further research and practice, and is useful to examine the applicability of the already developed MRBQ to novice riders first before considering the development of a new measure altogether. Given the MRBQ is a relatively new measure and is based on the widely studied DBQ, both the DBQ and the MRBQ literature are reviewed to identify the gaps in understanding the psychometric properties of the MRBQ.

2.3.3 Psychometric properties of the DBQ

A summary of the literature on the psychometric properties of the DBQ is provided in Table 2.3. It identifies the study population, the methods used, and the results with respect to the DBQ factor structure, internal consistency, stability, predictive validity, content validity, and other related variables. It is apparent that although ample DBQ studies exist, they have rarely examined all those psychometric properties comprehensively. Only one study has examined all but the content validity of the DBQ (44), and only two studies (45, 46) have examined them all.

Variations in the DBQ factor structure, reliability and validity are also evident from the review of the DBQ literature. Although the errors versus violations distinction seems stable, different sampling strategies, different target populations, driving purposes (work versus leisure) and traffic cultures seem to influence the stability of the DBQ factor structure. The extracted DBQ factors have also been commonly found to be significantly related to gender, age, and experience. Men, young drivers, and those with more driving distance and longer driving hours tend to show more violations than women, older drivers, lower distance, and less hours (41, 44, 46-51). Females and those with more driving hours tend to show more errors and lapses (47, 48). Similar to the demographic and cross-cultural variations in the DBQ factor structures and DBQ-crash relationships (48, 49, 52-55), the MRBQ psychometric properties and MRBQ-crash relationships may vary within different target populations.

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Table 2.3 Studies on the psychometric properties of the Driver Behaviour Questionnaire (DBQ)

Reference	**Sample**	**Procedure and analysis**	**Results**
(50) Aberg and Rimmo 1998 Dimensions of aberrant driver behaviour	N=1429 drivers selected from the official register of Swedish car owners aged 18-70. Owners of cars older than 11 year excluded. Mean age = 42 (SD=16) 29% females Mean years of driver licence = 22 years (SD=14) Mean annual mileage = 21,000km/year (SD=7800km/yr).	Postal survey including new Swedish specific DBQ items. Principal component analysis with VARIMAX rotation.	Factor analysis: Four factors–violations; mistakes; inattention; inexperience errors. Internal consistency: NA. Stability: NA. Predictive validity: NA. Variables related to DBQ factors: Violations and mistakes related to age (-); violations and inexperience to annual mileage (+&- respectively); all but inattention to gender (males showed more violations and mistakes but females more inexperience errors).
(62) af Wahlberg *et al.* 2011 The Manchester Driver Behaviour Questionnaire as a predictor of road traffic accidents	Four samples from different studies: N=307 US drivers (mean age = 69.6) N=238 UK drivers (mean age = 46.7) N=141 Swedish drivers (mean age = 45.6) N=153 Canadian drivers (mean age = 42.6).	48-item DBQ for the US study 50-item DBQ for the UK study 32-item DBQ for the Swedish study 15-item DBQ for the Canadian study. Self-reported and recorded accidents.	Factor analysis: US – two, errors and violations UK – three Sweden – two Canada – one. Internal consistency: NA. Stability: NA.

		PCA with VARIMAX rotation. Correlation.	Predictive validity: US – none UK – none Sweden – errors significantly correlated with self-reported bus accidents Canada – none
(49) Blockey and Hartley 1995 Aberrant driving behaviour: Errors and violations	61 male and 74 female drivers recruited in places of employment and Murdoch University psychology students, Western Australia. 72% =<26 years 55% females 45% university students.	Questionnaires distributed for later collection. Self-reported questions: • convictions for speeding, • dangerous driving, • driving under the influence of alcohol, • other offences, • driving accident in lifetime. Principal component analysis with VARIMAX rotation. Multiple linear regression.	Factor analysis: Three factors–general errors; dangerous errors; dangerous violations. Internal consistency: NA. Stability: NA. Predictive validity: Speeding convictions positively related to violation Convictions other than speeding, dangerous driving or driving under the influence of alcohol positively related to general errors. Variables related to DBQ factors: Dangerous errors and violations with age (-), exposure (+), and gender (females reported more dangerous errors and less violations than males).
(60) Davey *et al.* 2007 An application of the Driver Behaviour Questionnaire in	N=443 Australian fleet drivers aged 18-68 in both urban and rural areas.	Postal survey of the reduced item DBQ and modified wording to suit the Australian	Factor analysis: Three factors–errors, highway code violations, aggressive violations.

an Australian organisational fleet setting	Mean age = 44 22% females Mean licence years = 26 Work driving exposure = 11-20 hours/week and 20-40K km/year. Self-reported crashes and offences in the last 12 months.	drivers. Principal axis factoring with OBLIMIN rotation. Cronbach's alpha. Correlation.	Internal consistency: Errors .77 Highway code violations .80 Aggressive violations .60. Stability: NA. Predictive validity: Errors significantly with offences (r=.13) Variables related to DBQ factors: All three factors with age (-), licensed years.
(48) de Winter and Dodou 2010 The Driver Behaviour Questionnaire as a predictor of accidents: A meta-analysis	N=142 studies. Published and unpublished studies in English that used the DBQ searched in Google Scholar, Web of Science, Scopus, and references of the reviewed documents. Inclusion criteria: Data on self-reported and/or recorded accidents, gender, age, and mileage were available. Exclusion criteria: Studies on children, pedestrians,	Meta-analysis. Zero-order and multivariate correlations.	Factor analysis: NA. Internal consistency: NA. Stability: NA. Predictive validity: Self-reported crashes errors (n=32; .10 and .06) violations (n=42; .13 and .07). Variables related to DBQ factors: Errors and violations with age (-), exposure (+), and gender (males reported fewer errors and more violations than females).

	and moped drivers AND that extracted neither violation nor errors factor.		
(45) Harrison 2009 Reliability of the Driver Behaviour Questionnaire in a sample of novice drivers	N=822 drivers licensed in the last 6 months from the Victorian (Australia) licensing database of probationary licence holders. Self-reported driving offences detected by Police or automated cameras, crashes and near misses in the last 6 months. 55.8% females Higher mean age for females (21.2) than males (20.3).	Online survey with a telephone survey as a supplementary method for follow-up surveys. Principal component analysis with VARIMAX rotation. Cronbach's alpha. Correlation. Loglinear analysis.	Factor analysis: Four factors− errors; ordinary violations (deliberate breaking of the law without aggressive motivation e.g. speeding); lapses; aggressive violations. Internal consistency (time1/time2): .77 & .79 errors .77 & .79 violations .65 & .66 lapses .69 & .73 aggressive violations. Stability (6 months): .65 errors .75 ordinary violations .72 lapses .72 aggressive violations. Predictive validity: Violations with offences and crashes; lapses with crashes.
(58) Lajunen *et al.* 2004 The Manchester Driver Behaviour Questionnaire: A cross-cultural study	N=831 British; N=1123 Finnish; N=703 Dutch driving licence holders drawn from Finnish register of car owners, UK electoral register, Dutch register	Postal survey of the extended DBQ. Principal axis factoring with OBLIMIN rotation to examine	Factor analysis: First-order four factors − aggressive violations, ordinary violations, errors, lapses Second-order two factors – mistakes,

	of telephone users. Range of the 3 samples: Mean age = 37.52-45.90 Mean annual mileage = 18612 – 24637 Mean driving years = 16.93 – 23.62 Male % = 45.9 – 70.4.	the first-order factors, and principal axis factoring with VARIMAX rotation second-order factors. Procrustes target rotation techniques and factorial agreement coefficients to examine cross-cultural stability of the factor structure. Cronbach's alpha.	violations. Internal consistency range across the three samples: aggressive violations .65 – .73 ordinary violations .75 – .80 errors .64 – .73 lapses .64 – .69. Stability: NA. Predictive validity: NA. Factorial stability: Congruent but not perfect.
(63) Mattsson 2012 Investigating the factorial invariance of the 28-item DBQ across genders and age groups: an Exploratory Structural Equation Modelling study	N=1017 Finnish car owners. Female = 53.5% Mean driving licence years = 17.1.	Postal survey of the extended DBQ. Structural equation model (SEM) and Exploratory Structural Equation Model (ESEM).	SEM – usual three-factor model not good fit ESEM – modification of the model good fit, but DBQ measures different underlying latent variables in the different subgroups.
(44) Mesken *et al.* 2002 Interpersonal violations, speeding violations and their relation to accident involvement in Finland	N=1126 drivers aged 18-79 car owners in Finnish Register. Mean age = 37.5 (SD=15.1) Mean licence years = 16.9 years (SD=12.9) Mean annual mileage = 20,510 km (SD=21,990)	Postal survey including self-reported active accidents (respondent hit another road user or an obstacle) and passive accidents (respondent was hit by another road user) and fines (speeding, parking and other) in the last 3 years.	Factor analysis: Four factors–errors; lapses; speeding violations; interpersonal violations. Internal consistency: .70 lapses .77 errors .75 interpersonal violations

	54.1% females.	Principal axis factoring with OBLIQUE rotation. Cronbach's alpha. Stepwise logistic regression.	.79 speeding violations. Stability: NA. Predictive validity: Errors predicted active accidents; violations predictive passive accidents. Content validity: Interpersonal violations and speeding violations positively related to speeding and parking tickets. Lapses and errors negatively related to speeding tickets and parking tickets respectively. Only interpersonal violations positively related to other traffic penalties.
(59) Özkan *et al.* 2006 Cross-cultural differences in driving behaviours: A comparison of six countries	N=242 driving licence holders from each: Finland, Great Britain, Greece, Iran, The Netherlands, Turkey, matched for age and sex. Range of the 6 samples: Mean age = 29.48-32.25 Mean annual mileage = 10.99-87.18 Mean driving years = 8.84-12.00 Male % = 45.9 – 70.4.	Postal survey of the extended and modified DBQ (slips and lapses scale and the drink-driving item were excluded). Self-reported number of active and passive accidents and offences (parking, speeding, and other) during the last 3 years. Confirmatory factor analysis, Procrustes target rotation	Factor analysis: Three factors– ordinary violations, errors, aggressive violations. Internal consistency range across the six samples: ordinary violations .73 – .85 errors .61 – .75 aggressive violations .59 – .74. Stability: NA. Predictive validity:

		techniques, and factorial agreement coefficients. Cronbach's alpha. Poisson and Poisson-gamma regression.	Aggressive violations significant in the Finnish and Iranian samples but none significant in the rest. Factorial stability: Ordinary violations fully congruent and errors fairly congruent across countries.
(47) Özkan *et al.* 2006 Driver Behaviour Questionnaire: A follow-up study	N=622 (55% response rate) Finnish register of car owners. Mean age = 43.5 (SD=15.2) Mean licence years = 22.2 (SD=13.2) Mean annual mileage = 18, 420 km (SD=20,408) 54.8% females.	Postal surveys 3 years apart. Principal axis factoring with OBLIMIN rotation. Cronbach's alpha. Procrustes target rotation techniques and factorial agreement coefficients to test the stability of factor solutions.	Factor analysis: Two factors–errors and lapses; violations. Internal consistency (two time points): errors (.84 & .83) violations (.85 & .83). Stability (3 years): errors (.50) violations (.76). Predictive validity: NA. Variables related to DBQ factors: Errors with gender (females more errors and lapses), violations with age (-) and gender (males more violations). High annual mileage showed the strongest two-factor time-across stability. Low mileage and 55+ had the least stable DBQ factors.

(46) Parker *et al.* 1995 Driving errors, driving violations and accident involvement	N=1656 drivers (licence holder and had driven during the last 6 months) aged 17-70 drawn from the data maintained by the Transport and Road Research Laboratory, Great Britain. Including supplementary data n=273 drivers involved in 2+ road traffic accidents.	Postal survey. Principal component analysis with VARIMAX rotation. Cronbach's alpha. Correlation. Hierarchical multiple regression.	Factor analysis: Three factors–violations; errors; lapses. Internal consistency: .72 lapses .84 errors .80 violations. Stability (7 months): .75 lapses .69 errors .81 violations. Predictive validity: Violations a significant predictor of crashes. Variables related to DBQ factors: Violations with age (-) and exposure (+) and all three factors with gender (females reported more lapses and males reported more violations and errors).
(57) Parker *et al.* 2000 Elderly drivers and their accidents: the Aging Driver Questionnaire	N=1989 UK drivers aged 50+ from a panel maintained by Age and Cognitive Performance Research Centre, University of Manchester (n=642); press release (n=1347).	Postal survey including self-reported accidents (occurred on public roads and only the vehicle was damaged and involved injury) in the past 5 years when they hit another car/object (active) or their car	Factor analysis: Five factors–error; lapse; violation 1; violation 2; factor 5. Internal consistency: NA. Stability: NA.

		had been hit by another vehicle (passive). Principal components analysis with OBLIMIN rotation. Poisson generalized linear modelling.	Predictive validity: error and lapse factors predictive of active accident; lapse factor passive accident.
(41) Reason *et al.* 1990 Errors and violations on the roads: A real distinction?	N=520 drivers aged 20-78 approached on the street or in supermarket car parks, UK. 41.2% females.	Postal survey. Principal component analysis with VARIMAX rotation.	Factor analysis: Three factors–violations; hazardous errors; non-hazardous errors. Internal consistency: NA. Stability: NA. Predictive validity: NA. Variables related to DBQ factors: Violations was related to age (-), exposure (+), and gender (men reported more violations than women), and non-hazardous errors to gender (females reported more errors than males).
(56) Rimmö 1999 Modelling self-reported aberrant driving behaviour	Four samples from different studies: N=2248 new drivers (mean age 19),	Swedish version of the DBQ. Confirmatory factor analysis.	Factor analysis: Four factor across varying age and gender – violations; mistakes; inattention; inexperience errors.

	N=1296 inexperienced drivers (mean age 21), N=744 young drivers (mean age 24.5), N=976 experienced drivers (mean age 49).		Internal consistency: NA. Stability: NA. Predictive validity: NA.
(61) Steg and Brussel 2009 Accidents, aberrant behaviours, and speeding of young moped riders	N=146 moped riders aged 16-24 from an insurance company database, Netherlands. mean age = 17.3 (SD=1.3) mean riding years = 18 months (SD=12) driving km/wk = 107 (SD=76) 60% female.	Mail questionnaire using DBQ adapted to moped riders including self-reported crashes in the past year. Confirmatory factor analysis. Cronbach's alpha. Logistic regression on a sub-sample (n=97) who have ridden a moped for 12 months+.	Factor analysis: Three factors−errors, lapses, violations. Internal consistency: Errors .80 Lapses .79 Violations .87. Stability: NA. Predictive validity: None predicted self-reported crashes.
(54) Xie and Parker 2002 A social psychological approach to driving violations in two Chinese cities	N=520 professional drivers aged 19-60. Mean age = 35.77 (SD=7.99) 18.4% females Mean mileage = 30,983 km (SD=29,320) Mean driving licence years = 8.3 (SD=7.18) Mean self-reported accidents in the last 3 years =.37 (SD=1.22;	Postal survey including new Chinese specific DBQ items. Principal axis factoring with OBLIMIN rotation. Cronbach's alpha. Logistic regression.	Factor analysis: Six factors but scales with alphas <.60 were not reported −Lapses and errors; Inattention errors; Aggressive violations; Maintaining progress violations. Internal consistency: Values not reported except that further analysis conducted only on scales with alpha >.60.

	18.4%).		Stability: NA. Predictive validity: Aggressive violation a significant predictor self-reported crashes controlling for age, gender, and annual mileage. Variables related to DBQ factors: Years of driving (-) for all four factors, age (-) for inattention errors, and gender for lapse and error, and inattention error (females reported more than males).

TABLE ENDS HERE.

2.3.4 Psychometric properties of the MRBQ

To date two published studies have examined the psychometric properties of the MRBQ to some extent (18, 19). These studies are summarised in Table 2.4. In both studies principal component analyses identified five components which were named traffic errors, control errors, speed violations, stunts, and safety equipment. These five sub-scales represented similar constructs and were shown to have good internal consistency. However, the item constituents of each scale were not exactly the same between the two studies. Although both studies showed the predictive validity of a few of the MRBQ scales in terms of self-reported crashes, they were not completely consistent results. The stunts factor was found to be predictive of self-reported crashes in the Turkish rider sample (19), whereas traffic errors were in the UK rider sample, and additionally control errors and speed violations when restricted to crashes the respondents took blame for (18). In the Turkish study, both speed violations and stunts were significant predictors of self-reported traffic offences (19).

The two MRBQ studies were conducted amongst European (UK and Turkey) experienced riders with an average of 11 years of riding (18) or over 60,000km of riding (19). Riding behaviours amongst novice riders who are in the formative years of riding may be distinct from those of more experienced riders who have established their behaviour on-road and made a decision to keep riding. Climatic and cultural differences between UK and Turkey versus Australia may also have implications for the MRBQ psychometric properties. The present study therefore firstly conducted confirmatory factor analysis to test the fit of the two factor models proposed by Elliot et al (2007) and Özkan et al (2012) within an Australian novice rider sample. When the two models were rejected, exploratory factor analysis was performed to respecify the factor model for the present MRBQ data.

As with the DBQ literature, neither of the MRBQ studies has examined the MRBQ psychometric properties comprehensively, including the factor structure, internal consistency, stability, content validity, and predictive validity. First, neither Elliot et al nor Özkan et al examined the content validity of the MRBQ. Converging evidence from different measures of the same construct such as state records of traffic offences or third person observer can minimise uncertainty about self-reports and provide confidence in the validity of the MRBQ (39). Therefore correlations between self-report use of safety equipment by riders participating in training and the use of protective gear as assessed by a coach during training as well as the relationships between the behaviours self-reported via the MRBQ and equivalent police-recorded offences were examined to test the content validity of the MRBQ.

Second, while both studies examined the predictive validity in relation to self-reported crashes and Ozkan et al examined the predictive validity in relation to self-reported traffic offences, neither study examined it in relation to police-recorded crashes and offences. The MRBQ factor and crash/offence relationships may vary depending on whether the crash and offence data were obtained via self-report or the police due to the possible differences in the nature of crashes and offences included. For example, self-reported crashes can include less severe crashes than police-recorded crashes (64, 65) and underreporting of motorcycle crash data in official state records is also possible (66). Moreover, examination of the validity in terms of self-report can be limited due to the possible consistency motif where an artificial positive relationship is created due to respondents' tendency to try to maintain consistency in their responses (62). When MRBQ, crashes, and offences are all collected via self-report, artificial relationship is possible due to all being self-report. Therefore in this study the relationships of the MRBQ with not only self-reported crashes and near crashes but also police-recorded crashes and offences were examined.

Third, neither study examined the stability of the MRBQ (18, 19). Stability of the MRBQ is critical to ensure its ability to measure behaviour consistently over time, especially if those behaviours can be expected to be stable over time in practice. The stability of the tool can also reflect the modifiability of motivations over time, which has implications for the development and evaluation of rider interventions. Therefore stability of the MRBQ was also examined in the present study.

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Table 2.4 Two published studies examining the factor structure, reliability and validity of the Motorcycle Rider Behaviour Questionnaire (MRBQ)

Country	**United Kingdom (18)**	**Turkey (19)**
Sampling and procedures	Postal survey of a random sample of 28,400 motorcyclists in the UK Driver Vehicle Licensing Agency database who were determined to be 'active' riders (i.e. registered bikes that had been road taxed within the past 12 months, excluding shops and business).	Anonymous online survey of mopeds and high performance motorcycles (800cc) invited through announcements on various websites.
N	8666	451
Mean age	43 (SD not reported)	33.94 (SD=8.59)
% of males	92%	100%
Mean riding experience	11 years *Note*. Riding on public roads for more than one year was counted as one.	Not reported, but the sample is indicated to have full riding licence.
% of self-reported crash in the last 12 months	11% (n=953)	NA
Mean number of self-reported crashes in the last 3 years	NA	Active: 0.8 Passive: 0.2
Mean number of self-reported traffic offences	NA	0.63 (SD=1.2)
Mean lifetime mileage	NA	62943.49km (SD not reported)
Annual mileage definition and mean	Approximate mileage ridden on public roads in the last 12 months; 4467miles (SD=7188.94km).	Not defined; 8960.71km (SD not reported).

Self-reported crash definition	Crash including minor spills while riding a motorbike.	Active accident "situations in which you hit a vehicle, pedestrian or an object" while riding a motorcycle. Passive accident "situations in which a vehicle or a pedestrian hit you" while riding a motorcycle.
Offence definition	NA	Self-reported traffic offences that have been penalized by the police for overtaking, parking, speeding, and other.
Components extracted from PCA with VARIMAX rotation	5 components: Traffic errors; speed violations; stunts; safety equipment use; control errors.	5 components: Speed violations; traffic errors; safety equipment use; stunts; control errors.
Internal consistency	Traffic errors .84 Speed violations .87 Stunts .81 Safety equipment use .70 Control errors .73	Speed violations .88 Traffic errors .85 Safety equipment use .80 Stunts .77 Control errors .62
Type of regression and significant predictors of self-reported crashes	Generalised Linear Modelling. All crashes: Traffic errors; safety equipment use; experience; annual mileage; age. Blame crashes: Traffic errors; control errors; speed violations; age; experience; annual mileage.	Hierarchical regression. Active crashes: Stunts; age; mileage. Passive crashes: Age; mileage.
Type of regression and significant predictors of self-reported offences	NA	Hierarchical regression Speed violations; stunts; mileage.

2.3.5 Summary of the literature review

The following text box summarises the key take away points from the literature shown in Tables 2.3 and 2.4.

KEY TAKE-AWAY POINTS FROM THE LITERATURE REVIEW TABLES 2.3 and 2.4:

- Variations in the DBQ factor structure, reliability and validity are evident.
- The *Motorcycle Rider Behaviour Questionnaire* (MRBQ) has been specifically developed for motorcyclists based on the same theory as the DBQ, but to date only two published studies exist on the MRBQ psychometric properties amongst European (UK and Turkey) experienced riders.
- Given the demographic and cross-cultural variations in the DBQ factor structures and DBQ-crash relationships, the generalisability of the MRBQ results amongst experienced European riders to novice riders in Australia is not clear.
- PCA with VARIMAX rotation identified five factors in both the MRBQ studies, namely traffic errors, control errors, speed violations, stunts, and safety equipment.
- Both of the MRBQ studies have examined the predictive validity in terms of self-reported crashes only, but neither in terms of police-recorded crashes.
- Neither of the two MRBQ studies has examined the stability of the MRBQ or the content validity with respect to police-recorded traffic offences.

2.3.6 Research objectives arising from the MRBQ literature review

Study 2 in the present thesis therefore had the following objectives:

1. To examine the previously examined psychometric properties of the MRBQ including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes (18, 19);
2. To examine the psychometric properties of the MRBQ not yet examined in previous studies including stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes;

3. To assess applicability of the MRBQ amongst novice riders in Australia, a population to whom the MRBQ has not been applied to date.

2.4 Measurement of riding motivations

2.4.1 Background

Research suggests that motorcycle riders are a heterogeneous group who can be characterised by different motivations for riding (67, 68), and that these underlying motivations for motorcycle use provide some explanation of why riders engage in different on-road risk behaviours (69, 70). As such, certain interventions may not work unless the underlying motives are addressed, and measurement of riding motivations can help to address riding behaviours in ways that are sensitive to the different needs amongst motorcyclists. However, well-developed measures of riding motivations and rigorous research in the relationship between riding motivations and riding behaviours are lacking (Elliot 2010).

2.4.2 Lack of rigorous measurement of riding motivations

It has been suggested that people are attracted to motorcycling for a variety of reasons including image, the feeling of freedom, to feel at risk, to impress others and practical motives such as convenience and economy (71). Various themes of riding motivations have been identified in previous studies. They are summarized in Table 2.5, identifying the study population and design, and the motivational themes. However, these studies (e.g. 67, 69, 72-74) are observational commentaries or qualitative research that does not demonstrate strict empirical methodology and lacks quantitative analyses.

The interview used by Reeder et al (1996) was not designed strictly based on measurement theory (e.g. Likert scale with multiple questions) but rather used a single question that asked respondents to choose as many reasons as they liked from the seven pre-categorised reasons. The representativeness of the sample used in the ethnographic research by Bellaby and Lawrenson (2001) is not known and the interviews that identified four themes of riding motivations were unstructured making the results vulnerable to unknown levels of method variance. That is, the variability in responses may be due to characteristics of the measuring instrument (in this case unstructured interview) rather than due to the underlying attribute that is intended to be measured by the instrument (75). Zamani-Alavijeh et al (2009) used open-ended questions and the transcripts were qualitatively coded to derive four categories of riding motivations (69). The success of the methodological control to avoid bias and ensure the validity and reliability of this qualitative approach is not clear. In Wilson et al's study (2009) the two riding motivations of thrill and sense of freedom were not based on empirical analysis. The three riding motivation themes of fun and excitement, transport and economic advantages, travel time saving and parking convenience, identified by Haworth (2012) were observational commentaries rather than an empirical study.

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Table 2.5 Review of the studies on riding motivations

Reference	Sample and design	Identified themes of reasons for riding a motorcycle
(74) Bellaby and Lawrenson 2001 Approaches to the risks of riding motorcycles: Reflections on the problem of reconciling statistical risk assessment and motorcyclists' own reasons for riding	Ethnographic research – authors talked to staff and riders at bike dealers/repairers, new riders at a training course.	Motorcycling as a life enhancing activity for various purposes: • Transport (cheap and convenient to avoid traffic jams and parking problems) • Intrinsic merits (enjoyable in itself) • Sensation of speed and acceleration • Independence and freedom.
(71) Broughton and Stradling 2005 Why ride powered two-wheelers?	Study 1: After riding the Edzell racing track in Scotland, N=69 riders asked to indicate on a map of the track at which parts they • felt most at risk, • felt the greatest enjoyment, • had to concentrate hardest. Study 2: N=96 riders asked to rate using a 5-point Likert scale 6 pictures of various road conditions for risk and enjoyment.	Study 1: Widespread responses – individual differences in what they found most risky, most enjoyable and requiring most concentration. Risk and concentration coincided well but the co-occurrence of risk and enjoyment rare. Study 2: Three types of rider risk profiles • risk averse (enjoyment decreases with increasing risk), • risk acceptors (accept risk at a cost to a certain point in order to ride for other purposes), • risk seekers (risk is not a cost and the enjoyment increases with increasing risk).
(72) Haworth 2012 Powered two wheelers in a changing world-challenges and opportunities	Observational commentary.	• Fun and excitement • Transport and economic advantages • Travel time savings and parking convenience.

(67) Reeder *et al.* 1996 Rider training, reasons for riding, and the social context of riding among young on-road motorcyclists in New Zealand	N=217 riders from Dunedin birth cohort study. Computer questionnaire: select as many from the list of seven factors that influenced their decision to choose to ride a motorcycle.	• Excitement • Economical transport • Manoeuvrability in traffic • Ease of parking • Friends use motorcycles • A way of life • Freedom from supervision.
(73) Wilson *et al.* 2009 Gasoline prices and their relationship to rising motorcycle fatalities, 1990-2007	Analyses of fuel prices and motorcycle registrations in the US 1990-2007 based on the following data: • Weekly gasoline retail prices provided by the US Energy Information Administration • Proportion of motorcycles of all registered vehicles in the US.	• Higher fuel prices • Thrill • Sense of freedom.
(69) Zamani-Alavijeh *et al.* 2009 Accident-related risk behaviors associated with motivations for motorcycle use in Iran: a country with very high traffic deaths	Focus groups and in-depth interviews with motorcyclists and motorcycle passengers in Iran. Open-ended questions to elicit their main reasons for riding motorcycles. Thematic analysis of notes taken by the interviewers.	• Convenient commuting • Occupational transportation • Recreation an sensation seeking • Criminal activity.

TABLE ENDS HERE.

2.4.3 Self-report measure of riding motivations: MRMQ

The 24-item *Motorcycle Rider Motivation Questionnaire* (MRMQ) (70) is the first structured questionnaire that was developed to systematically assess the previously identified reasons for riding (76). The respondents are asked to rate on a 5-point Likert scale from strongly disagree to strongly agree with statements about the reasons for motorcycling. These reasons were described as pleasure (escapism, hedonism, flow, identification with the bike, social); fast competitive sport (dynamism, performance, exhibition, thrill seeking, rivalry); and control beliefs (76). In this thesis, self-report measurement of riding motivations is assessed with respect to the MRMQ.

Understanding riding motivations amongst novice riders in particular can be beneficial to address their overrepresentation in crashes (42, 43). However, no published study has examined the applicability of the MRMQ to novice riders in Australia or examined riding motivations specifically amongst novice riders. It is therefore worthwhile to examine the applicability of the already developed MRMQ amongst novice riders before considering the development of alternative measures.

2.4.4 Psychometric properties of the MRMQ

Only one study has examined the psychometric properties of the MRMQ (70). Principal component analysis of the MRMQ with VARIMAX rotation indicated a tripartite typology of riding motivations amongst experienced UK riders (70), namely convenience, pleasure, and speed. These three scales had acceptable internal reliability and predictive validity of on-road rider behaviours as measured by the MRBQ (18), including traffic errors, control errors, stunts, speed violations, and safety equipment use. Specifically those who had stronger pleasure motivations for riding self-reported more frequent use of safety equipment, while those with stronger speed motivations self-reported more frequent control errors, speed violations and stunts as measured by the MRBQ (70). The convenience scale of the MRMQ was found to be correlated with none of the MRBQ behaviours (70).

However, three key psychometric features of a sound questionnaire remain untested. First, Sexton et al's (2004) study did not examine the predictive validity of the MRMQ with respect to self-reported crashes directly, or police-recorded crashes and offences. The model Sexton et al (2004) investigated via path analysis assumed that motivations (as measured by the MRMQ) precede behavioural choices (as measured by the MRBQ), which in turn influence crash risks. However, there may be other behavioural choices that are not measured by the MRBQ, through which motivation influences crashes. This hypothesis can be tested by examining the direct relationship between riding motivations and crashes. As stated earlier with respect to the MRBQ, consistency motif bias and self-report versus police records of crashes may influence the MRMQ and crash/offence relationships. Therefore in this study the direct relationships of the MRMQ with not only self-reported crashes and near crashes but also police-recorded crashes and offences were examined.

Second, Sexton et al's (2004) study did not examine the content validity of the MRMQ scales. Uncertainty about self-reports can be minimised when multiple sources of validation promote the same inferences (39). The MRMQ can be validated based on logical premises by collecting converging evidence from thematically related measures from the same individuals (39). For example, it is plausible that those with stronger speed motivations could be more likely to make more riding trips in high speed zones. Therefore in the present study correlations of the MRMQ with self-reported number of riding trips in different contexts were used to test the content validity of the MRMQ.

Third, Sexton et al's (2004) study did not examine the stability of the MRMQ. Stability of the MRMQ is critical to ensure its ability to measure riding motivations consistently over time, especially if they can be expected to be stable over time in practice. The stability of the tool can also reflect the modifiability of motivations over time, which has implications for the development and evaluation of rider interventions. Therefore the stability of the MRMQ was examined in the present study.

Furthermore, the motorcyclists in Sexton's study were from the UK and overall more experienced riders with an average of 15 years of riding experience (70) and the generalisability of their results to Australian novice riders is not known. Riding motivations may systematically differ between novice riders who are in the formative years of riding and more experienced riders who have chosen to continue riding. For example, novice riders may start out riding to save money on fuel but they may change their reasons for riding with more riding experience to enjoy the social aspects of riding. The present study therefore firstly conducted confirmatory factor analysis to test the fit of the factor model proposed by Sexton et al (2004) within an Australian novice rider sample. When the model was rejected, exploratory factor analysis was performed to respecify the factor model for the present MRMQ data.

2.4.5 Summary of the literature review

The following text box summarises the key take away points from the literature shown in Table 2.5 and Sexton et al's (2004) study.

KEY TAKE-AWAY POINTS FROM THE LITERATURE REVIEW TABLE 2.5 AND SEXTON ET AL'S (2004) STUDY:

- It has been suggested that people are attracted to motorcycling for a variety of reasons.
- However, previous studies that have identified motivational themes for riding are observational commentaries or qualitative research that does not demonstrate rigorous empirical methodology.
- The *Motorcycle Rider Motivation Questionnaire* (MRMQ) is the first structured questionnaire that was developed to systematically assess the reasons for riding.
- Principal component analysis of the MRMQ indicated a tripartite typology of riding motivations amongst experienced UK riders.
- The three scales of MRMQ, namely convenience, pleasure, and speed, had acceptable internal reliability and predictive validity of on-road rider behaviours as measured by the *Motorcycle Ride Behaviour Questionnaire* (MRBQ).
- The generalisability of the MRMQ results amongst experienced UK riders to novice riders in Australia is not clear.
- Three key psychometric features of a sound questionnaire remain untested for MRMQ, namely, stability, content validity and predictive validity of self-reported as well as police-recorded crashes and police-recorded offences.

2.4.6 Research objectives arising from the MRMQ literature review

Study 3 in the present thesis therefore had the following objectives:

1. To examine the previously examined psychometric properties of the MRMQ including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the MRBQ;

2. To examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences and self-reported crashes and near crashes;

3. To assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ has not been applied to date.

2.5 Measurement of perceived value of rider training

2.5.1 Background

Public and private support, and thus funding, is critical to evidence-based practice. However, one of the greatest challenges in road safety is the mismatch between scientific evidence and community belief. Some interventions can be scientifically shown to be effective but they may not receive public and private support, while others are not supported by scientific evidence but receive public and private support. Such a conflict is observed for example, in relation to speed camera and bicycle helmet legislation (77, 78), and driver and rider training respectively (79, 80). Thus the measurement of the values riders place on rider safety interventions such as rider training bears relevance in the decision making process.

2.5.2 Self-report measurement of perceived value: CV surveys

One of the ways in which community or user value of road safety interventions can be systematically measured is the contingent valuation (CV) method. The contingent valuation method is a survey-based approach in which individuals of a representative sample of the population at risk are directly asked to value in monetary terms (willingness to pay) a hypothetical reduction in risks of their own and possibly other people's resulting risk resulting from an intervention (81, 82).

Willingness to pay (WTP) values that are elicited through the CV surveys are traditionally used in cost-benefit analyses in the fields of environmental economics, health economics and increasingly in transport economics (83). However, it is posited that the WTP values can also have direct practical use in terms of providing a proxy measure of the acceptability or the extent to which an effective intervention may need to be promoted to the community. Such use of the WTP values can be understood as the perceived value of interventions.

2.5.3 Methodological review of the CV method

Ample research exists on the methodological issues of contingent valuation method, particularly in the areas of health and environmental economics. These methodological critiques apply to the application of contingent valuation method in road safety. Hence the literature on the CV methodological issues was reviewed to design a best practice CV survey that measures the value of rider training amongst its users for the present thesis. The review of the literature was published in the *Proceedings of the 2012 Australasian Road Safety Research, Policing and Education Conference* (84). The paper describes the methodological issues that need to be accounted for in the design and analyses of CV survey data, and the different question formats to elicit the monetary values of interventions. Publications details and signed statements of authorship are provided in Appendix 8 under ***Paper 1***.

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The application of contingent valuation surveys to obtain willingness to pay data in road safety research: methodological review and recommendations

Abstract

Willingness to pay is increasingly utilized in cost-benefit analysis research in road safety. In other fields of research such as environmental and health policy evaluations, contingent valuation (CV) surveys have been developed and widely used as a method to elicit people's willingness to pay for the products being evaluated. Many authors have provided methodological critiques on CV surveys, which have been shown to be subject to various forms of biased responding such as hypothetical bias, starting-point bias, and strategic response bias. Various ways to control for these biased responses exist including the design of the survey and statistical analyses. Furthermore, different results have been found depending on the elicitation methods used (e.g. open-ended question versus referendum format; ex-ante valuation versus ex-post valuation), and the ways in which the context of the product provision is described and the product framed (e.g. private product versus public product) for the same product being valued. These methodological critiques are relevant to the use of CV method in road safety research that intends to elicit willingness to pay for road safety products. Furthermore, employing evidence-based survey designs and question forms are critical to obtain the best possible willingness to pay data in road safety research. The current paper presents the methodological limitations of CV surveys identified in previous research and offers best practice recommendations for CV survey designs in road safety based on the CV methodological literature.

Key words: willingness to pay; contingent valuation; survey design; bias

1. Introduction

The contingent valuation method is a survey-based approach for eliciting consumers' monetary valuations (willingness to pay) for a policy measure. Willingness to pay (WTP) is widely used in cost-benefit analyses in the fields of environmental economics, health economics and increasingly in transport economics. There are a number of potential advantages over other methods of economic evaluation. First, WTP is based on the utilitarian principle that underlies welfare economic theory in which benefits are deemed to be based on consumer preferences (1). Second, WTP approach imposes no restriction on the attributes people can place a value on, allowing a more comprehensive valuation of benefits than other approaches that strictly quantify the value of health outcomes only (e.g. quality adjusted life years (QALYs), incremental cost-effectiveness ratios (ICERs). Another advantage of WTP is its unit of measurement being the same as that of costs, enabling questions of allocative efficiency to be directly addressed (1). Recent literature on economic evaluation in road safety shows increasing interest in the use of WTP as a measure of road safety benefits (2-5).

A measure of WTP seeks individuals' valuation of an intervention in terms of the amount of money that individuals are willing to pay for it (6, 7). It is implemented predominantly through contingent valuation (CV) surveys in which individuals of a representative sample of the population at risk are directly asked to value in monetary terms a hypothetical reduction in risks of their own and possibly other people's resulting from an intervention (2, 8). While CV surveys have been widely implemented in the fields of environmental and health economics to value a wide range of matters such as forest preservation (9), medical, surgical, and pharmaceutical interventions for respiratory diseases and cardiovascular diseases (7), many authors have also provided methodological critiques on CV surveys applied in those fields. These methodological critiques are relevant to the use of the CV method in road safety research that intends to elicit WTP for road safety intervention products. Researchers attempting to obtain the best possible WTP data in road safety research must be cognisant of the previously identified CV methodological issues to ensure best practice applications of the CV surveys in road safety research.

The WTP values have practical use in terms of understanding the value the community places on road safety policy/interventions and thereby providing information on acceptability or the extent of the need to promote an effective intervention to the community. Strictly speaking CV surveys are typically employed to value products with no market transactions (e.g. clean air) and revealed preference method (where the value data are obtained from real/hypothetical market transactions) is preferred to value products for which market transactions are possible. However, the prices charged for road safety measures such as training, that are provided and potentially heavily subsidized by government, may not necessarily reflect their 'market value'. Consequently stated preference studies may be useful in deriving shadow prices for such goods.

The present paper aims to identify the key issues highlighted in the long-time environmental and health economics literature on the contingent valuation method and how they have been addressed, and to provide recommendations for the application of contingent valuation in road safety economic evaluations. While this paper offers recommendations for CV survey design in road safety research, discussion on the use of WTP values to calculate the value of statistical life (VOSL) is beyond the scope of this paper.

2. Addressing the methodological problems in the road safety CV applications

WTP values are explicitly intended to reflect preferences, perception and attitudes toward risk of those affected by the decisions to implement the policy measure, and hence it is natural that WTP for a product differ among different situations (8). However, CV surveys must be designed in a manner which allows the real respondent factors such as individual differences in income, risk, and attitudes to be distinguished from the methodological factors that influence the WTP estimates. The ample methodological research on CV surveys particularly in the environmental and health economics literature (e.g. 10-12) has provided clues to the ways in which the common methodological problems encountered in CV surveys (see Table 1 for summary) can be circumvented or managed in the CV design and analyses. Many of the recommended CV designs tackle two or more of the potential methodological issues, hence the information is organized by each design and/or analysis strategy.

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Table 1. Types and sources of methodological problems in CV surveys

Types	Sources
Hypothetical bias and yeah-saying responses: Values offered in hypothetical survey contexts are significantly different from values offered in real market conditions (13, 14). Yeah-saying responses refer to responding yes to a question without really meaning it.	• Lack of relevant information provided to the respondents before eliciting their willingness to pay (15, 16). • Close-ended WTP survey questions are not administered in a manner that encourages the respondents to seriously think about and respond to the questions (17).
Non-responses: Non-responses can include a genuine 'don't know' responses or strategic refusal responses (18), which are distinct from genuine real zero valuations.	• Lack of information provided to the respondents about the product and its implementation context (17). • Open-ended WTP questions (17).
Strategic responses (protest zeros/free-riding): Respondents understand the WTP question and support the product provision but demonstrate their refusal to pay themselves by giving a nil response in the hope that someone else (e.g. government) will pay for the product (19).	• Can be induced by the ways in which the product is framed in terms of private versus public with respect to provision and use. (2, 15, 20).
Scope and scale biases: WTP estimates being insensitive to changing health outcomes in terms of • consequences (scope bias) *e.g.* minor injury versus serious injury, and • magnitude of risk reduction (scale bias) *e.g.* 5% versus 10% reduction (15, 21, 22).	• The product outcomes in terms of risks and uncertainty are not clearly communicated in the CV surveys (19, 23) • The valuation is sought for changes in small probabilities of risks (24). • When respondents value the product in terms of moral satisfaction from the act of giving or from contributing to what the respondents believe as a good cause (warm glow effect), rather than the product itself (25, 26).

Range bias: The final WTP estimate restricted by the range of values presented in the CV survey (27, 28).	• The bid values presented in the payment card or bidding formats do not cover all the possible values for the product in practice.
Starting point bias: The final response is influenced by the initial value presented in the bidding format (29-31).	• The order of the bid presentations are the same across all survey respondents.
***Oder bias*:** The same product is valued differently depending on the order in which the product was presented in the survey (2). *e.g.* Product A that can achieve a 5% risk reduction is more highly valued if it was presented before product B that can achieve a 10% risk reduction than if product A was presented after product B.	• Valuing the more valuable good before the less valuable one may create a larger difference in valuations than vice versa because people perceive a loss as worse than an equal gain (prospect theory; 32). • Respondents may demonstrate the warm glow effect with the product that was presented first and the glow effect fades with subsequent presentation (33).

TABLE ENDS HERE.

2.1. Sampling

Because road safety measures often bear significant amenity value (e.g. protective clothing has aesthetics, comfort, branding, etc) in addition to their safety benefit, willingness to pay values generated across different products are likely to provide a wide range of implied VOSL valuations.

It may be useful to obtain WTP values for each road safety measure that is targeted for a specific group, rather than simply obtaining an overall WTP estimate for all road safety measures (8). This may be particularly relevant for products that would only be used and paid by a particular group, particularly those who may have a role in the decision making process, for example relating to the use of motorcycle helmets and protective clothing. Respondents can value the same product differently because of their individual differences in the need and use of the product (34). For example, current patients/clients will value the product based on current use (use-value). Non-current use respondents may gain utility from knowing a service is available for their use in future given uncertainty (option value out of insurance motives), or from knowing that a service is available to other individuals to use (existence value out of moral satisfaction), or out of concern for the welfare of future generations (caring externality). What type of value is being estimated will depend on the sample used – users, convenient samples, general population – and the sample must be selected to best match the policy and research questions (7).

2.2. Survey design

2.2.1. Descriptor

The optimal CV survey design is what matches best with the intended real implementation context. A context specific design allows the measurement of preference of specific individuals or groups who are affected by certain proposals. CV studies can suffer from hypothetical bias, yeah-saying responses, non-responses, and unreliable WTP estimates if the terms of the product provision is poorly described (19). While the product description should be comprehensive enough to maximise the strength of the WTP approach, the product attributes to be included in the descriptor must also be guided by what are relevant and important to answer the research/policy questions. The CV survey must contain a descriptor to inform the respondents the relevant decision-making context, nature of the product to be valued, its use (private versus public risk reduction; current versus future use) and/or non-use values (option value in the form of insurance or externalities in the form of welfare of others), its expected outcomes (road safety improvement, duration, probability) and/or non-outcome attributes (process utility: information, anxiety reduction), the payment vehicle used (e.g. taxation, contributions to a fund, insurance premium, out-of-pocket, existing road safety budget), and the institutional setting in which the product will be provided (public or private) before asking about WTP (16, 17, 19). This is because they are all shown to influence the value provided by the respondents (11). The descriptor must be sufficiently informative to the extent that is feasible but not too complex to understand (19, 35). Avoid using scientific or technical words and possibly utilise visual aids for uncommon/unfamiliar products.

If the product being valued is likely to trigger strategic behaviour in the real world, then this ought to be directly dealt with within the survey (19). For example, if the product to be valued is likely to be publicly provided then this should be made transparent rather than hide it in order to suppress strategic behaviour.

From a purely economic point of view respondents must also be aware of the budget constraints and thus the opportunity cost in terms of the benefits forgone from placing a value on one program over another to avoid overestimates (17, 32, 36). This is especially relevant when the rationale for the cost-benefit analysis is allocative efficiency in which decisions to choose between two or more intervention alternatives must be made.

2.2.2. Description of risk or uncertainty

The main purpose of CV surveys is to estimate the value of risk reduction produced by the policy product being evaluated and the CV method assumes that people correctly perceive the risks (37). A general problem with road safety valuation is the low probability of a crash event. The risk reduction must be communicated in the CV survey in a way that is most likely to make sense to people. Use of percentage reduction in risk has been suggested assuming the current risk is understood by the respondents before being asked about the WTP value (38). Authors have also demonstrated that individuals are significantly more accurate at making judgment when presented with information as absolute frequencies than probabilities, hence minimizing scope and scale biases (39). For example, an absolute reduction in numbers of deaths and injuries (intervention reduces 50 deaths) rather than proportion (intervention reduces crashes from 8 to 7 in 10000 licence holders) may be more meaningful to respondents. Visual aids for the communications of risks have also been found to be helpful (40, 41).

2.2.3. Elicitation format

Psychological and health economics literature suggest that different elicitation techniques result in different WTP estimates (11). Generally higher response rates are achieved with closed-ended questions than open-ended questions because respondents find it easier to give a monetary valuation when they are guided with a price (17, 42). Various formats of open and closed-ended questions exist with differing advantages and limitations (Table 2). Being aware of the limitations and advantages of each type of elicitation methods is critical to choose the most appropriate elicitation format within each research context and to address the potential biases in the CV design and analyses.

In general it is recommended to avoid using open-ended questions. The potential starting point bias in the bidding format or double-bounded dichotomous choice format can be controlled for by randomising the ordering of the bids presentation within the sample (43). Range bias is not found unless the payment card does not present the upper and lower ends that respondents may desire to select, thus a pilot study is recommended to cover the range of possible values in practice (44). A ‘no answer’ option should be explicitly allowed in addition to the ‘yes’ and ‘no’ vote options to close-ended questions (17).

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Table 2. WTP elicitation formats, advantages and limitations

Elicitation format and example	Advantages	Limitations
Open-ended question *"How much are you willing to pay?"*	• Allows for smaller sample size than other formats. • Simple point-estimates	• Subject to non-response because it is harder than close-ended questions (e.g. yes/no questions).
Single-bounded dichotomous choice (referendum format) *"Are you willing to pay $__?"* *'yes' or 'no' vote to a single nominated value*	• Simple point-estimates	• Inflated mean WTP due to yeah-saying responses • Low statistical efficiency (45, 46)
Double-bounded dichotomous choice *"Are you willing to pay $x?"* *If yes, "Are you willing to pay $y (amount more than $x)?"* *If no, "Are you willing to pay $z (amount less than $x)?"*	• Increased information on the value. • Allow for smaller sample size than the single-bounded dichotomous choice	• Inflated mean WTP due to yeah-saying responses • Vulnerable to starting-point bias and range bias
Bidding format Like an auction the respondents are asked whether they are willing to pay a nominated amount, and depending on their answer, they are asked about lower/higher bids. This process continues until the maximum WTP amount is found.	• Higher response rate than an open-ended question • Closer to market situation	• Inflated mean WTP due to yeah-saying responses • Vulnerable to starting-point bias and range bias • Requires an interactive interview format (computer programming, or telephone/face-to-face interviews)

Payment card Showing respondents a series of values on a card and asking them to choose the value that most closely represents their WTP	• Higher response rate than an open-ended question • More valid (higher % of variance explained; stronger association with ability to pay) than estimates derived from open-ended questions (27)	• Vulnerable to range bias • Limited interview format in order to present the payment card to the respondents
Payment ladders Absolutely certain that I would pay at least $10 and that I would not pay $20, but I am unsure if I would pay $15.	• Allow for range of uncertainty over the value respondents place	• Only an interval estimation between the maximum rejected bid and the maximum accepted bid can be directly obtained.

TABLE ENDS HERE.

2.2.4. Follow-up questions

The motives for the chosen value such as the warm glow effect and protest responses can be identified by asking the respondents about their reasons for their choice of value (17, 19). Follow-up questions can also be used to make distinctions between the types of non-responses−indifference between yes or no, inability to make a decision without more information, preference for other products, disinterest or uncooperativeness in the survey. Protest responses can be indicated by reasons for their zeros as “I think the government should pay, not me”; “I pay taxes” (18). These are in contrast to real zeros where the reasons can include “I would prefer to pay for something else” (18). From attitudinal measurement and policy perspectives, the existence of different motives that influence the value placement are relevant (19, 47). If strategic behaviour and warm-glow effects are realistic phenomena in practice, then they need to be identified in the research process. This enables policy makers to be aware of the barriers to implementation and plan ahead ways to manage these barriers.

Follow-up questions on how certain the respondent are on their choice of value are also helpful to identify and manage hypothetical bias, yeah-saying responses to close-ended questions, and scale/scope bias (48, 49). When respondents are confident with their WTP responses the estimates do tend to be sensitive to changing magnitude of risk reduction (41). The data can be analysed excluding low certainty responses to obtain conservative estimates that are not influenced by potential biases and thus more reliable WTP estimates (50, 51). This CV analysis method is referred to as the certainty calibration.

2.2.5. Randomization of the order in which the products are presented if two or more products are being evaluated

This applies if two or more road safety products are being valued to determine the choice and allocation of resources between the intervention options. Similarly to the management of the starting-point bias in the bidding format elicitation method, the order bias of scenario presentations can be managed by randomizing the order of presentations across respondents. Randomization can cancel out the order bias to produce a more reliable mean WTP estimate.

2.3. Interview format

The NOAA Panel strongly recommends face-to-face interviews on the basis that it allows the presentation of large amount of information in a controlled sequence whilst maintaining respondent interest and attention as well as encouraging the respondent to carefully consider their response, thus minimizing hypothetical bias and yeah-saying responses (17). However, face-to-face interviews may be more prone to demand characteristics where the respondents desire to please the interviewer (52) and there is no solid evidence for its superiority to telephone interviews (43). While the choice between telephone and face-to-face interviews might depend on the cost-efficiency and practicality of conducting the research (43), postal surveys are not recommended due to the implications of the order of the question presentation and other complexities to the survey.

2.4. Analyses

Given WTP estimates can vary with potential biases, the robustness of the WTP estimate must be examined by conducting sensitivity analyses. For example, compare the WTP estimates between the entire sample and a sub-sample of only high certainty responses and (49, 51). Similarly, compare the WTP estimates between the entire sample and a sub-sample in which protest responses are excluded. Additionally, if other types of strategic or non-responses are evident, conduct similar sensitivity analyses to understand their influences on the final WTP estimates.

2.5. Reporting of the CV methods

Although methodological research in CV surveys is ample there is still room to refine CV methods such as the risk communication. Reporting of the CV methods used in each CV study in road safety will contribute to the advancement of CV methods and potentially identify strategies unique to road safety research.

3. Conclusion

Lessons learnt from the applications of CV surveys in environmental and health economics are relevant in the applications of CV surveys in road safety research. The literature suggests that potential methodological issues can be addressed and managed in the design and analyses of CV surveys to maximize the validity and reliability of WTP estimates. Employing evidence-based survey designs and question forms are critical to obtain the best possible willingness to pay data in road safety research.

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2.5.4 Determinants of perceived value

In addition to measuring perceived value, understanding its determinants can inform the ways in which effective road safety interventions can be promoted to increase the community demand for them. CV studies that examined the determinants of the perceived value of interventions are summarised in Table 2.8. In the table, the study population and the intervention of interest, the CV survey procedure and the value elicitation question format, the ways in which potential biases were managed, if any, analyses used to identify the determinants of the perceived value, and the significant predictors including the direction of association are shown.

Many of the studies in Table 2.8 lack the methodological considerations required for a best practice CV application as identified in Sakashita et al (2012). Open-ended questions are still quite common (e.g. 82, 85-91) despite the limitations highlighted in the literature. In order to make transparent potential biases in the interpretation of the results it is best practice to specify and justify the WTP elicitation format. However, CV studies that do not specify the elicitation questions still exist (e.g. 92-94). Many studies make nil (e.g. 91, 93-96) or only partial bias management in the design or the analysis (e.g. pilot study conducted but no further management such as informative descriptor and follow-up questions).

More research exists on the determinants of the perceived value of environmental and health interventions than for road safety interventions. Some studies have examined via the contingent valuation method the determinants of the perceived value of road safety products including a motorcycle helmet (87), an unspecified general safety product (88), mortality and injury risk reduction on roads (86), a hypothetical safety feature installed on their motorcycle (92), child safety seats (97), and car crash protection (85). However, to date no published study has sought to empirically quantify the perceived value of rider training and analyse what factors influence it.

The type of regression analyses employed to identify the determinants of the perceived value is another critical challenge in CV research. WTP values typically follow a non-normal distribution and require transformation for parametric analyses (98, 99). Log-transformation to manage the skewed WTP distribution is popular (e.g. 87, 91, 92, 94, 100-102) but log of zero is mathematically impossible and thus zero WTP values must be excluded from the analysis when in practice zero WTP values are meaningful (103). In order to avoid exclusion of zero values many studies choose logistic regression where zero and non-zero values are compared (e.g. 93, 94, 101, 104). However, this can be impractical because it assumes that zero is the turning point and all positive WTP values are equal thereby hiding the possible significant differences between different positive values in practice (e.g. those who are willing to pay $500 or more may be significantly different from those who are willing to pay $100). Hence the method of transformation and the regression type must be well considered to account for both mathematical and practical problems.

Once the WTP values are transformed the existence of heteroskedasticity must also be tested in order to ensure the method of transformation is appropriate for the final results to not suffer from bias and precision (105, 106). However, none of the studies in Table 2.8 that ran regressions on the transformed values reported tests of heteroskedasticity. Some studies failed even to specify the regression type (e.g. 85, 87, 89, 90).

Nevertheless, the research on the determinants of the WTP values shows that income (e.g. 87-93, 95, 97, 101, 102, 104, 107) and prior experiences of the product being valued or of the health outcome achieved through the product (e.g. 90-93, 95, 101, 102, 104, 107) are relevant factors. Age (e.g. 86-88) and exposure (e.g. 86) can also be influential factors of the valuation of road safety products. This thesis therefore examines prior experiences of motorcycle crashes and rider training as potential determinants of perceived value of the training after controlling for income, age, riding exposure and methodological biases.

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Table 2.8 Review of studies on the measurement of perceived value of interventions and its determinants via the contingent valuation (CV) method

Road safety interventions					
Reference	**Sample and intervention valued**	**CV survey procedure and elicitation question format**	**Bias management**	**Analyses**	**Significant predictors (direction of association +/-)**
(85) Muller and Reutzel 1984 Willingness to pay for reduction in fatality risk: an exploratory survey	N=77 senior undergraduate students aged 20-21, 68% females. Nearly one-third owned a car; 12% involved in a crash during the previous year. WTP for reduction in fatality risk (either on the base of 100 or 10,000) due to car crash protection either for their own or for unidentified lives.	Postal survey. Open-ended question– How much would you be willing to pay for the additional protection for own increased safety AND How much would you be willing to add to your monthly car payment for such protection for saving unidentified lives.	Two survey forms of different base (100 or 10,000) alternately assigned to manage scale bias and order bias.	Regression analysis but type or transformation not specified.	Living expenditure, crash experience, seat belt wearing, distance exposure, math ability test, and gender were tested but none of them were significant predictors.
(92) Fauzi *et al.* 2004 The value of life and accident costing: a willingness-to-pay study amongst motorcyclists in	N=320 randomly selected motorcyclists interviewed in the Seremban Municipality approximately 60km south of Kuala Lumpur, Malaysia. Study 1: WTP for a hypothetical safety	Face-to-face interview. Question formats not specified.	Pilot test conducted.	Regression on log WTP.	Study 1: Income (+), experienced serious injury in motorcycle crash (+), seen a motorcycle crash (-), motorcycle engine capacity (-). Study 2: Gender (reference not clarified).

Malaysia	feature installed on their motorcycle for 20% vs 50% fatality risk reduction. Study 2: WTP in order to travel using safer bus services with safety records of a 50% vs 80% lower risk of death.				
(86) Andersson 2007 Willingness to pay for road safety and estimates of the risk of death: Evidence from a Swedish contingent valuation study	Randomly chosen individuals aged 17-74 in Sweden. 2884/5650–51% response rate. WTP for a road mortality risk reduction (N=977). WTP for a reduction in injury risk (N=1907)	Postal survey. Open-ended questions–How much would you at the most be willing to pay for reducing your own annual risk of 1) dying by (1/10, 1/3, ½, or 99/100)? & 2) dying in a traffic accident by (1/10, 1/3, ½, or 99/100)?	Pilot study conducted. Protest answers excluded. Visual aid of a grid consisting 100,000 white squares where the number of squares corresponding to the different risks blacked out.	Non-linear regression and log-linear regression where zero WTP values included and excluded.	Risk reduction magnitude (+); age (-) self-perceived baseline risk of dying (-); annual mileage (+).
(87) Pham *et al.* 2008 Households' Willingness to Pay for a Motorcycle Helmet in Hanoi	Multi-stage random sampling of Vietnamese riders 18+ years, head of household or spouse, owned a MC, lived in sub/urban Hanoi. 414 out of 420 invited households in 2 urban and 1 suburban district of	Face-to-face interviews with a structured questionnaire on demographics, knowledge of and attitudes to helmet regulation and levels of fines. Double-bounded	Range bias managed through a pilot survey in 10 households to refine wording and to determine the first and second level distribution for the bids.	Interval regression for logarithmic DCQ elicited WTP. Multiple linear regression for OEQ elicited WTP (not clear if the transformed	DCQ: Age (-); knowledge of helmet regulations (+) and fine (+); belief in helmet use (+); support for helmet regulation (+); occupation (small trade employment higher WTP).

	Hanoi from Jan 2007 to February 2007. mean age=42.9. female=35.5%. WTP for a motorcycle helmet (trademark name of the helmet company, size, date of manufacture and quality sticker shown).	dichotomous choice questions (DCQ)−2 sets of yes/no questions to find lower and upper boundaries. Open-ended questions (OEQ)−How much will you be willing to pay for a helmet for head injury prevention if the price was partly subsidized by the government.	Two sub-samples responded to two starting point bids to confirm no starting point bias. Excluded possible 'yea-saying' (OEQ WTP much lower than the DCQ WTP) and protest answers (all bids in the DCQ rejected but much higher OEQ WTP) from analyses. Respondents were made aware of the opportunity cost for purchasing the helmet−that the money for the helmet could not be used for other purposes.	or raw values used).	OEQ: Annual income per capita (+); age (-); education (+).
(107) Andersson and Lindberg 2009 Benevolence and the value of road safety	N=1950 individuals aged 18-76 in the city of Orebro, Sweden. WTP for abstract safety device that would reduce the risk to zero for the	Postal survey. Single-bounded dichotomous choice question−Would you rent the device for your own use for SEK200 per	Informative descriptor. The six bid levels (200, 1000, 2000, 5000, 10K, 20K) based on pilot	Regression analysis with a bid-function approach.	Income (+); someone close to the respondent has been injured from a road crash (+); self-assessed that their risk is lower than average (-);

	user and could be rented on an annual basis.	year? The users varied and compared to self as the reference group with respondent's children <18 and living at home, all members of the household, relative/friend, or public.	study.		number of adults in the household (-); children (+); household members (+); relative/friend (-); public (-).
(88) Svensson 2009 Precautionary Behavior and Willingness to Pay for a Mortality Risk Reduction: Searching for the Expected Relationship	A random sample of 1500 individuals currently living in Orebro, Sweden. 552 observations - 59% response rate excluding missing data. mean age=43.06. female=52%. WTP for a 'safety product' that cuts your own risk (i.e. private good) of both fatalities and severe injuries.	Mail survey. Questionnaire framed using the Swedish Vision Zero−a long-term road safety objective that roads and vehicles should be designed so as to prevent accidents from happening but if they do, protect road users from fatalities and serious injuries. Open-ended question−How much would you at most be willing to pay each year for renting the safety product that cuts your own risk for fatal and serious traffic accidents	Informative descriptor. Follow-up question to determine protest response (defined as "question unclear" or "I don't believe the risk will be reduced") or true zero (defined as "risk reduction too small" or "cannot afford to pay").	Four regression models−Linear, Tobit (WTP cannot be negative), probit (WTP>0 or not), linear on ln (WTP+1).	Age (-), income (+), employed, have uni education, have children. No relationship between stated WTP and precautionary behaviour (front & back seatbelt, bicycle helmet & light, reflector, no speeding) even when accounting for age, gender, income, education, having children.

		in half?			
(82) Svensson and Johansson 2010 Willingness to pay for private and public road safety in stated preference studies: Why the difference?	A random sample of 1500 individuals currently living in Orebro, Sweden. mean age=42.96. The total sample (N=875) split in four subsamples with separate WTP questions for 1) both private and public risk reduction but asked to value the private good first; 2) both private and public risk reduction but asked to value the public good first; 3) private good only; 4) public good only.	Mail survey. Open-ended questions: 1) private good risk reduction: How much would you at most be willing to pay each year for renting the safety product that cuts your own risk for fatal and serious traffic accidents in half?; 2) public good risk reduction described as a public road safety investment.	Follow-up question to determine protest response (defined as "question unclear" or "I don't believe the risk will be reduced") or true zero (defined as "risk reduction too small" or "cannot afford to pay").	Factor analytic approach.	WTP for a private risk reduction three times higher compared to a public risk reduction. A significant part of the difference explained by the respondents' attitudes towards privately and publicly provided goods in general.
(97) Jarahi *et al.* 2011 Parental willingness to pay for child safety seats in Mashad, Iran	N=590 parents of kindergarten children who owned personal cars in Mashad, Iran. WTP for a child safety seat.	Face-to-face interview in selected kindergartens. Payment card of seven values ranging from 0-$300.	Descriptor including information on child car passenger deaths and evidence of efficacy of child safety seats to manage hypothetical bias. Pilot study to manage hypothetical bias	Logistic regression on <$100 versus >=$100.	Household income (+).

			and range bias.		
Non-road safety interventions					
Reference	**Sample and intervention valued**	**CV survey procedure and elicitation question format**	**Bias management**	**Analyses**	**Significant predictors (direction of association +/-)**
(101) Pedersen *et al.* 2011 The influence of information and private versus public provision on preferences for screening for prostate cancer: A WTP study	Representative (in terms of age, gender, geography and household size) sample of the Danish male population aged 50-70. N=1564 out of 3901 invited (40.1% response rate) Mean annual household income = EUR 73,473 WTP for a prostate specific antigen (PSA) test–prostate cancer screening test that is provided publicly versus privately with 3 levels of information within each provision.	Web-based questionnaire. Double-bounded dichotomous question format. A starting bid randomly allocated from a pool of bids DKK (50, 100, 200, 500, 1000, 3000), which represented 3 bids lower than the normal price of a PSA test. After the bidding, the respondents asked to state their maximum WTP from a payment card containing 20 different values ranging from DKK 0 – 10,000 with increasing intervals to gain a high sensitivity around DKK 0.	Range bias – pilot test verifying the bids unlikely to constrain the respondents' choices. Starting point bias and anchoring bias – random allocation of starting bids. Hypothetical bias – follow-up question on how certain the respondents felt about their stated maximum WTPs on a scale 1- 5; WTP with high certainty only used (certainty calibration). Protest responses ("I do not want to pay out-of-pocket on principle	Binary logit model to compare no WTP (inferred and expressed zeros) and positive WTP. Interval regression on log WTP values (only positive WTP) to adjust for skewness of data	Nothing significant for the logit model. Public setting: income (+); prior PSA test experience (-); negative attitudes towards fees (-); partly support fees (+); starting bids. Private setting: income (+); cancer history in family (+); partly support fees (+); starting bids.

			grounds") identified by asking the respondents their reasons for choosing WTP=0.		
(91) Togridou *et al.* 2006 Determinants of visitors' WTP for the National Marine Park of Zakynthos, Greece	Randomly selected Greek and foreign visitors accessing three main beaches of highest activity in the national park at peak visiting times. Every 10th visitor was approached. N=495/550 (90% response rate). WTP for National Marine Park of Zakynthos.	Paper questionnaire. A payment principle question (in principle in favour of paying at least some amount for the park), followed by a reason question for 'no' and open-ended question for 'yes' and their reason for the amount.	Nil.	Logistic regression on payment principle response. Multiple regression on the log WTP to account for the skewed distribution and to prevent the prediction of negative WTP amounts.	Payment principle: TV as source of information on environmental issues (+); perception of the national park's aim as regulation (+); the fee perceived to be low (+). WTP amount: income (+); travel cost (-); word-of-mouth on environmental issues (+); information from travel agency (-); environmental concern (+); Satisfaction with services and prices (+); satisfaction with infrastructure (-); belief that residents overexploit visitors economically (-).
(102) Leung *et al.* 2004 Physicians' perceptions	A representative physician population randomly selected from the full and limited	Mail survey. Single-bounded dichotomous choice question.	The bid levels determined by open-ended questions in a pilot	Log-linear regression.	Income (+); work in a corporate setting (+).

towards the impact of and WTP for clinical computerization in Hong Kong	registration lists of the HK Medical Council. N=810 out of 4850 mailed (16.7% response rate). WTP for computerisation in a hypothetical ambulatory solo clinic for administrative functions, clinical functions, or both.		study.		
(89) Bernard *et al.* 2011 Perception of alopecia by patients requiring chemotherapy for non-small-cell lung cancer: A WTP study	N=135 patients receiving chemotherapy for non-small-cell lung cancer from 3 French and 1 Belgian hospitals. mean age=58. 42% females. WTP for reducing the risk of alopecia from chemotherapy.	Face-to-face interviews. Hypothetical scenario: 2 chemotherapy drugs with the same efficacy, the same dosing schedule, and the same tolerability except for the risk of alopecia (A: 40% versus B: 5%). 4 separate open-ended questions on the amount they would 1) be inclined to pay; 2) not be inclined to pay; 3) certain to pay; 4) certain not to pay for product B This question repeated	Respondents asked to opt for product A or B to ensure they understood the scenario (1% preferred A but all patients were included in the analyses).	Type of regression analysis not specified.	Income (+); Females (+); increasing risk difference between A & B.

		the same except product B's risk reduction amount varied from 5% to 10, 20, and 30%.			
(93) Pinto *et al.* 2009 Identifying factors that affect patients' WTP for inhaled insulin	Random sampling of diabetes patients on subcutaneous insulin in USA. N=128 out of 1103 patients (11.6% response rate). Predominant respondents – Caucasian (85.1%), female (55.5%), 65+ (46.5%), an annual household income < $40K (67.2%). WTP for inhaled insulin (Exubera).	Mail survey. Background information on Exubera (how it was administered and how it should be stored) with a picture of the inhaled insulin device. The elicitation question not described in detail.	Nil.	Binomial logistic regression on no WTP versus positive WTP. Linear regression on the WTP amount (no transformation)	WTP dichotomy ($0 versus >0): household income (+); satisfaction with current insulin therapy (-). WTP amount: household income (+); current cost of insulin therapy (+).
(100) Wagner *et al.* 2000 WTP for mammography: item development and testing among five ethnic groups	N=52 low income ethnically diverse (African Americans, Filipinas, Latinas, White, Chinese) women aged 40-74 in San Francisco. mean age=58. 55% <$30K annual household income. WTP for mammography	Computer Assisted Telephone Interview (CATI). Bidding format question: Starting bid of $75 going up (if yes) to 100, 125, and 150, or down (if no) to 50, 25, 10. If they were willing to	Focus groups with 50 low income women, pilot test with 41 women to develop the WTP question.	Multivariate regression on the log transformed WTP (ordinary least squares and Zellner's seemingly unrelated regression).	Number of mammogram in the past 5 years (-); family history (+); need for mammogram (+) income (+) African American and Latina (+).

	amongst low income ethnically diverse women.	pay $150 (maximum bid) or not pay $10 (minimum bid), open-ended question−What is the most money that you would be willing to pay to get a mammogram?			
(94) Tsamboulas and Nikoleris 2008 Passengers' WTP for airport ground access time savings	486 passengers departing Athens International Airport. Demographics not reported. WTP for travel time reduction to an airport.	Paper questionnaire. The questions not clearly specified.	Nil	Probit model to compare zero WTP and positive WTP. Ordinary least squares linear regression on the natural logarithm of WTP.	WTP dichotomy: access time reduction amount (+). WTP amount: access time reduction amount (+); access mode (car/taxi users willing to pay more than PT users).
(95) Leighl *et al.* 2006 A WTP study of oral epidermal growth factor tyrosine kinase inhibitors in advanced non-small cell lung cancer	A convenience sample of 57 advanced non-small cell lung cancer patients aged 40-84 attending outpatient medical oncology clinics at a Canadian cancer centre. 54 healthy subjects aged 20-75 from nursing students and nursing faculty members not involved with cancer care.	Face-to-face interview. Bidding technique of bids going up (if yes) or down (if no) ranging from CAD$0-3000+.	Nil.	Mann−Whitney U or Kruskal−Wallis tests.	Married (+); prior chemotherapy (+); on pension income or on financial assistance (+) in univariate analyses but only prior chemotherapy remained significant (+) in multivariate analysis.

	WTP for a month of oral therapy.				
(104) Habbani *et al.* 2006 Household health-seeking behaviour in Khartoum, Sudan: The WTP for public health services if these services are of good quality	Multi-stage sampling of households in the capital of Sudan. N=460 (100% response rate) heads of households or their nearest relation aged 31-50. WTP at all for 1) specialist services, 2) advanced lab and X-ray analysis; 3) availability of drugs specially for children; 4) decreased waiting time amongst those who already pay for health costs (group 1) versus not (group 2).	Bidding game method with response options−"I would not hesitate" "I would go into debt" "If I have enough money" "I would not pay" to distinguish ability to pay and WTP. First three responses categorised as positive WTP, the fourth zero WTP.	Bid values based on the current costs of the public health services.	Logistic regression.	Group 1: Monthly income (+); use of health services (+) for all. Drug consumption (+) for 2& 3. House ownership (+) for 2, occupation (+) for 4. Group 2: family size (+) for all but 3. Education (+) for 1 & 3. Sick in the last 3 months for 4.
(90) Luzar and Cosse 1998 WTP or intention to pay: The attitude-behaviour relationship in CV	Rural residents owning a water well in the study area, Louisiana. N=664 out of 1938 (34% response rate). The majority fell into the $10K-19,999 income bracket, were white (96%), and males (73%). mean age=57.	Mail survey. Open-ended question format following a description of a hypothetical market for changes in water quality. This market compared to many other publicly provided goods e.g. police and	Possibility of protest response discussed but how it was identified not discussed.	Type of regression not specified.	Already making an effort to treat water quality (-), own a private well (+), have kids (+), income (+), age (non-linear relationship), low level education. Attitudinal variables enhanced explanatory and predictive power of

	WTP to accept changes in water quality at individual and state levels.	fire protection, highways, and education.			WTP estimations.
(96) Moen 2007 Determinants of safety priorities in transport – The effect of personality, worry, optimism, attitudes and WTP	Representative sample of Norwegian adults 18-65. N=1727 out of 4832 (37% response rate). mean age=41.73. 51% females. WTP to increase safety associated with road use.	Mail surveys. WTP is measured from 7 statements on a 5-point Liker scale−non-conventional operationalisation not consistent with the WTP literature.	Nil.	Correlation.	Worry (+), driver optimism (-), negative attitude (-), driver stress (+), trust (+), excitement seeking (-) significantly related to WTP.

μ(X): mean of X

TABLE ENDS HERE.

2.5.5 Summary of the literature review

The following text box summarises the key take away points from the literature shown in

Table 2.8.

KEY TAKE-AWAY POINTS FROM THE LITERATURE REVIEW TABLE 2.8:

- No published study has operationalised perceived value in terms of WTP as a way to understand the acceptability of road safety and to examine its determinants in order to inform ways in which effective road safety interventions can be promoted.
- No published study has sought to empirically quantify the perceived value of rider training and analyse what factors influence it via the CV method.
- Comprehensive and evidence-based bias management in the CV survey design and analysis is lacking in research practice despite the rich methodological critique in the CV methodological literature.
- A number of ways have been identified to manage the potential biases that can occur in CV surveys

  - range bias – pilot study; bidding format to elicit the WTP values
  - hypothetical bias – descriptor before the WTP elicitation question; certainty calibration
  - starting-point bias – randomisation of the bid values
  - strategic response bias – follow-up questions

- The appropriateness of the transformation method chosen to manage the idiosyncratic nature of the WTP distribution is not tested in most studies.
- Logistic regression comparing zero WTP value versus greater than zero WTP values is commonly employed to circumvent the non-normal WTP distribution. However, this can be impractical because it assumes that all positive WTP values are equal and hides the possible significant differences between different positive values.
- Income and prior experiences of the product being valued are commonly found to be influential factors of the final WTP values.

2.5.6 Research objectives arising from the CV literature review

Study 4 in the present thesis therefore had the following objectives:

1. To offer and design a best practice CV survey as a tool to empirically quantify the perceived value of *VicRide* rider training by its target audience, novice riders;

2. To conduct the CV survey and analyse the WTP data in ways that comprehensively manage all the possible methodological biases based on the CV methodological literature (i.e. evidence-based) including

    a. Pilot study to manage range bias
    b. Sufficiently informative and realistic scenario presented before the WTP elicitation question to manage hypothetical bias
    c. Bidding format to elicit the WTP values to manage range bias and hypothetical bias
    d. Randomisation of the bid values to manage starting-point bias
    e. Follow-up questions to identify protest responses and manage strategic response bias
    f. Certainty calibration to manage hypothetical bias;

3. To test and compare different regression models to determine the most appropriate transformation type to analyse the WTP data whilst maintaining the practicality of the WTP values;

4. To examine if prior experiences of motorcycle crashes and of the motorcycle training product influenced the perceived value of *VicRide* rider training amongst novice riders after controlling for methodological biases, income, age, and riding exposure.

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Chapter 3: Self-report riding exposure (*Study 1*)

3.1 Preamble

This chapter presents the study on self-report riding exposure amongst novice riders, which is in press in *Traffic Injury Prevention* (Appendix 7, p.375). Publications details and signed statements of authorship are provided in Appendix 8 under ***Paper 2***.

3.2 Aims and objectives of *Study 1*

The aim of ***Study 1*** was to examine and identify best practice self-report measures of riding exposure amongst novice riders with the following objectives:

1. To examine various self-report riding exposure questions of different units (distance, time, number of trips), sources (self-estimates, self-report odometer), and timeframes (week, month, three months) in order to assess the appropriateness of self-report to measure riding exposure amongst novice riders;
2. To conduct validity checks and reliability tests of different self-report riding exposure measures via a comprehensive set of statistical analyses;
3. To analyse possible sources of differential reliability of self-report riding exposure measures;
4. To provide recommendations on best practice self-report riding exposure questions based on the present results.

3.3 Manuscript

Over page.

ABSTRACT

Self-report methods to collect exposure information have large practical advantages in many research contexts, but it is important to confirm their reliability and validity. Little research has specifically investigated the reliability and validity of motorcyclists' self-reported exposure. The present study examined the reliability and validity of different self-report exposure measures amongst novice motorcyclists through t-tests, Bland Altman plots, coefficients of variation, and correlations. The most valid and reliable data were provided when riding exposure was asked for the current average week rather than earlier and longer periods, and in units of time rather than distance or number of trips. If self-reported odometer readings are used, questions on whether the respondents share their own bike or ride more than one bike, and a built-in process to ensure respondents report the exact odometer reading on their bike are recommended. The greater reliability of riding exposure found amongst commuting and rural riders compared to recreational and metropolitan riders respectively and at the second interview compared to the first suggests that factors such as riding purposes, geographical locations, and riding experience can contribute to measurement error. It is recommended that self-report riding exposure questions ask about the hours of riding for the current average week, and data on riding purposes, locations, and experience are also collected.

Keywords

Exposure, motorcycle, self-report, reliability, validity

INTRODUCTION

Reliable and valid riding exposure data are crucial to address motorcycle safety issues effectively (Lin & Kraus, 2008). Studies on motorcycle crash risks are often based on crash rates expressed in terms of self-reported exposure of unknown validity or reliability (e.g. Elliott, Baughan, & Sexton, 2007; Harrison & Christie, 2005; Özkan, Lajunen, Dogruyol, YildIrIm, & Çoymak, 2012), which may result in misleading conclusions. However, little research exists on the reliability and validity of motorcyclists' self-reported exposure. Ample research exists on car drivers' exposure and self-report is widely used to measure the amount of driving (e.g. Australian Bureau of Statistics (ABS), 2011; Lourens, Vissers, & Jessurun, 1999; Ouimet et al., 2010; Segui-Gomez et al., 2011). Self-report is employed in preference to other methods because of its significant practical advantages over other methods in some research contexts. Self-report can be a less intrusive procedure to collect individual-level exposure information for participants than having electronic devices installed in their cars (Murakami & Wagner, 1999) and can be more cost-efficient (Joly et al., 1993), especially for long-term studies with large sample sizes (Blanchard, Myers, & Porter, 2010). Self-report data can also be more readily handled than the copious amount of raw data recorded by electronic devices (Grengs, Wang, & Kostyniuk, 2008; Stopher & FitzGerald, 2008). Whilst an alternative method developed in this field, the quasi-induced exposure (where data on not-at-fault drivers in crash databases are employed as a proxy exposure measure, e.g.: Haight, 1986; Haque, Chin, & Debnath, 2012; Jiang & Lyles, 2010), is convenient in that it relies solely on crash data, a few major limitations, such as problems with reliability in fault-assignment and validity of the assumptions (for details see, Lenguerrand, Martin, Moskal, Gadegbeku, & Laumon, 2008) remain unresolved. These advantages of self-report in the measurement of driving exposure also apply to that of riding exposure, warranting the examination of the viability of self-report riding exposure measures.

Previous validation studies on self-report exposure measures have shown imperfect agreement with other measures of driving exposure amongst teen drivers (e.g. Leaf, Simons-Morton, Hartos, & Northrup, 2008) and elderly drivers (e.g. Blanchard et al., 2010; Huebner, Porter, & Marshall, 2006; Staplin, Gish, & Joyce, 2008). However, it is not clear if these findings translate to motorcycle riders or novices who are less experienced but not necessarily young. Moreover, existing self-report validation studies (e.g. Huebner et al., 2006; Leaf et al., 2008) have not assessed the best unit of measurement of driving exposure, let alone riding exposure. The units in which driving exposure is measured have varied from kilometres/miles travelled (e.g. Langford, Koppel, McCarthy, & Srinivasan, 2008; Lourens et al., 1999; Williams, 2003) and hours/days of travel (e.g. Chipman, MacGregor, Smiley, & Lee-Gosselin, 1992; Chipman, MacGregor, Smiley, & Lee-Gosselin, 1993; Ehsani, Bingham, & Shope, 2011) to number of trips (e.g. Beck, Dellinger, & O'Neil, 2007; Blanchard et al., 2010; Ouimet et al., 2010). The unit that produces the most reliable and valid exposure data is an important consideration in designing self-report exposure measures.

Furthermore, the reliability of exposure measures might be influenced by not only the question design but also respondent characteristics (Coughlin, 1990; Wolfe, 1982). The kinds of riding motorcyclists do, as indicated by their riding purposes and degree of urbanisation of the riding locations, may influence their focus on the units (kilometres versus hours) in which they appraise their amount of riding, thus the reliability of their self-reported exposure. For example differences in the reliability of self-reported exposure by its units have been reported between drivers with different driving purposes (Joly et al., 1993).

Amongst motorcyclists, those in their first years of riding are involved in more crashes than riders with more years of riding experience (ACEM 2009, VicRoads 2010). This study therefore focused on the application of self-report exposure measures amongst this particularly high risk group of novice riders. This study aimed to: 1) examine and compare the reliability and validity of different self-report exposure measures amongst novice motorcyclists; and 2) examine potential sources of differential reliability including riding purposes and degree of urbanisation of the riding locations.

METHODS

Participants and Procedure

Participants were drawn from a larger scale randomized control trial to evaluate a motorcycle rider coaching program for novice riders in the state of Victoria, Australia. VicRoads, the state authority of roads in Victoria, sent letters of invitation to motorcycle riders who had recently advanced from a learner’s permit to a probationary/restricted motorcycle licence (N=23,696) through the period May 2010 – June 2011. The study candidates could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The core eligibility criteria were that 1) they owned a motorcycle (not a scooter); 2) their motorcycle had an engine capacity of 125cc or greater, and was compliant with the VicRoads' Learner Approved Motorcycle Scheme (LAMS which includes motorcycles with an engine capacity up to and including 660cc but do not exceed a power-to-weight ratio of 150 kilowatts per tonne) and in good mechanical condition; 3) they had ridden at least 500km over at least 12 separate trips on public roads since obtaining their learner’s permit; 4) they had been on a Victorian probationary/restricted motorcycle licence for one year or less. If the candidates met all the eligibility criteria they were asked to provide informed consent to participate in the study.

Criterion 3 was particularly important to ensure that the present study participants had sufficient riding exposure to be able to meaningfully answer the riding exposure questions. This was an ongoing study and at the time of the present investigation 2375 candidates met all the eligibility criteria and data were available for 880 riders (37.1%) who completed two 30-minute surveys, a baseline interview between June 2010 and August 2011 (time 1) and a follow-up interview between September 2010 and December 2011 (time 2), which were on average 145.7 days (SD=35.2) apart. The final sample was aged between 18 and 74 (mean=35.5; SD=11.1) and 80.8% were males. This was in keeping with Victoria wide age and gender demographics. According to VicRoads March 2012 data, the novice rider population in Victoria was aged between 18 and 92 with a mean of 33.6 years (SD=11.1), and 84.4% were males.

The present novice rider sample had held a motorcycle licence (including the Learner's permit period) for an average of 13.4 months (SD=6.9). The majority (n=847; 96.2%) held or previously held a car licence with a mean of 17.4 (SD=11.2) years of driving experience as a provisional or fully licensed driver.

At the end of the baseline interview the riders were randomized into the treatment group (n=414; 47.0%) or the control group (n=466; 53.0%). No significant differences existed between the treatment and control groups at baseline on these variables or any of the riding exposure measures investigated in this study.

All the interviews were conducted through a computer assisted telephone interview by professional interviewers who were specifically trained in the surveys developed for this study. The research was approved by the University of Sydney Human Research Ethics Committee and Monash University Human Research Ethics Committee.

Self-report Riding Exposure Measures

Across the two phone interviews participants were asked to estimate the amount they travelled on-road on their motorcycle through ten questions of different modes (self-report odometer reading and self-estimates), timeframes (week, three-months, lifetime) and units (kilometers, hours, and number of trips). These exposure measures are summarized in Table A1 under original variables. The odometer question at time 1 (ODO_{t1}) was only asked if the participants always rode the same bike for on-road riding (N=826; 94%). In addition, the odometer question at time 2 (ODO_{t2}) was only asked if the participants rode the same bike as they reported at time 1 (N=743; 84%). At both time 1 and time 2, if the participants did not know their odometer reading at the time of the interview, they were asked to check it within the next 24 hours and email or SMS the reading. Of those who were asked to provide their odometer reading, 99% provided it at time 1 and 95% at time 2.

All the participants were required to provide their best estimate for all the exposure questions. Open-ended estimates that provide continuous data were preferred to multiple choice response categories of range used in previous research (e.g. Lardelli-Claret et al., 2011; Segui-Gomez et al., 2011) because a large range of answers was possible.

In-principle Validity Checks

Whilst only self-report riding exposure measures were available in the present study, in-principle validity checks were possible for the two odometer readings and the two self-estimates of KM/WK and HR/WK.

Validity of ODO_{t1} and ODO_{t2} In order for the two odometer readings to pass the in-principle validity check, the magnitude of ODO_{t2} was required to be equal to or greater than that of ODO_{t1}. Overall 213 (24.2%) of the total sample were missing ODO_{t1} and/or ODO_{t2}.

The in-principle validity check was performed on the 667 who provided both ODO_{t1} and ODO_{t2}.

Validity of KM/WK and HR/WK at time 1 and time 2 Three in-principle validity checks were performed on the two self-estimates KM/WK and HR/WK at time 1 and time 2. First, both values were required to be zero if either was zero. Second, KM/HR derived from KM/WK divided by HR/WK were required to be in the range of 20km/hr and 110km/hr. The 2009/10 Victorian congestion data showed that during congestion the average speed can drop to a minimum of 20.2km/hr in the inner undivided arterials with trams in the morning peak traffic (VicRoads, 2011). Hence 20 was considered an appropriate lower limit. The maximum speed limit in Victoria is 110km/hr, which the average speed is unlikely to exceed; hence 110 was considered an appropriate upper limit. This method of data exclusions was considered to be more theoretically justified than arbitrary cut-off points, such as the upper and lower 5% of the speed index distribution (Chipman et al, 1992).

Third, after applying the two exclusion rules above for KM/WK and HR/WK, their plausibility was further tested by comparing the calculated KM/HR by the degree of urbanisation of participants' residence. Participants' postcodes were available for 582 (66.1%) riders. The degree of urbanisation of the participants' residence was classified as metropolitan (central business districts), regional cities, and rural (population of up to 8000) based on their postcodes. The KM/HR should in principle be on average lowest for metropolitan residents and highest for rural residents and in between for regional city residents. These differences in average speed (KM/HR) between rural riders and metropolitan riders should be more exaggerated for those who self-reported more kilometers (KM/WK) because rural riders are likely to accumulate their kilometers on rural roads with higher speed limits whereas metropolitan riders are likely to accumulate their kilometers on metropolitan roads with lower speed limits and more congestion. To test this hypothesis, graphical relationships of KM/WK quintiles by KM/HR means within each quintile by the three levels of urbanisation were examined.

Reliability Tests

Consistency between self-reported motorcycle odometer and self-estimates of riding distance From the two odometer readings, two odometer derived variables (ODO-DERIVED KM/WK_{t2} and ODO-DERIVED KM_{t2} 3MTH) were created for time 2 (Table A1; Derived variables). These two odometer-derived distance variables were compared to the original distance variables (KM/WK_{t2} and KM_{t2} 3MTH) respectively to test the consistency between self-reported distance measures of two different modes (odometer and self-estimates).

Consistency between self-estimates of riding distance in different timeframes From the two original distance variables in the lifetime and three month timeframe (KM_{t1} LIFETIME and KM_{t2} 3MTH), two distance variables in the week timeframe (INTERPOLATED KM/WK_{t1} and INTERPOLATED KM/WK_{t2}) were derived for time 1 and time 2 respectively (Table A1; Derived variables). These two derived variables were compared to the original distance variables (KM/WK_{t1} and KM/WK_{t2}) respectively to test the consistency between self-reported distance measures of different timeframes.

Consistency between self-estimates of riding exposure in different units of distance, time, and number of trips The three riding exposure measures in units of distance (KM/WK), time (HR/WK), and number of trips (TRIP/MTH), were compared at time 1 and time 2 respectively to test the consistency between self-reported exposure measures asked in different units of measurement. Further, the odometer derived exposure (ODO-DERIVED KM/WK_{t2}) was compared with HR/WK_{t2} and $TRIP/MTH_{t2}$.

Reliability Analyses

In order to comprehensively assess the reliability of distance exposure measures of different modes and timeframes, four sets of analyses were conducted. First, existence of systematic bias between two different measures was examined through non-parametric Wilcoxon t-tests because all the exposure variables had strongly skewed distribution with skewness ranging from 1.8 to 12.7 and Kurtosis ranging between 4.9 and 258.4. A significant t-test would mean one measure shows systematically higher or lower exposure than the other (i.e. systematic bias exists). A non-significant t-test could either mean the differences between the two measures agree well or disagree in a non-systematic manner.

In order to disentangle the two possibilities, the Wilcoxon t-test results were thus interpreted in conjunction with the Bland-Altman plot, graphing the difference between the two measures against the mean of the two measures, with the mean difference and the limits of agreement identified (Bland & Altman, 1986). The plot provides more insight into the Wilcoxon t-test results and whether the level of agreement is related to the underlying value of the two measures. The limits of agreement were calculated as the upper and lower 95% confidence intervals ($\mu \pm 1.96 \times SD$ where μ = mean difference between the two measures; SD = standard deviation of the mean difference). If the two measures tend to agree, then the differences between the two exposure estimates should be within the limits of agreement centered around zero across all levels of exposure.

Third, the spread of the distributions of riding distance from different measures were compared through the calculation of the coefficient of variation (CV). The CV was calculated as the standard deviation divided by the mean. It is possible that the agreement between two methods is poor simply because one of the methods has a larger standard deviation relative to the mean. If the spread of the distributions of the two variables compared were similar as indicated by coefficients of variation of similar magnitude, then the two variables were considered comparable.

Fourth, a non-parametric Spearman's correlation was used to assess how well the relationship between two variables can be described using a monotonic function (Abdullah, 1990; Kendall & Stuart, 1958). The Spearman's correlations were also calculated to test the consistency between riding exposure measures of different units. If the two exposure measures differing in terms of modes, timeframes, or units are measuring the same thing they should have an increasing monotonic relationship (i.e. significant positive Spearman's correlation coefficient). Correlations above 0.7 are considered acceptable (Nunnally, 1994).

Sources of Differential Reliability

Methodological influence of the random allocation to the treatment group and control group Although the present data were drawn from an overall randomised control trial, the present study was only concerned with testing the validity and reliability of the various exposure measures. Thus comparisons of individual answers from different self-report exposure questions were made across the treatment group and control group riders. Although systematically different reliability and validity by study group were not logically possible, reliability tests were also conducted amongst the two groups independently as well as across the two groups combined to ensure the results did not differ by study groups.

Influences of riding purposes and locations The possible influence of participant characteristics – whether they rode on rural roads versus metropolitan roads and whether they rode mainly for commuting versus recreational purposes – on the reliability of the exposure measures was examined. If the participants only reported riding for commuting purposes, they were classified as 'commuting riders'. If the participants only reported riding for recreational purposes, they were classified as 'recreational riders'. If the participants reported a mixture of commuting and recreational purposes, they were excluded from this part of the analyses. Metropolitan and rural riders were classified based on the participants' postcodes. All those with a valid postcode were included in the analyses. The consistency between KM/WK and HR/WK was compared amongst commuting and recreational riders (riding purposes) and amongst metropolitan and rural riders (riding locations) at both time 1 and time 2 through Spearman's correlation analyses.

RESULTS

In-principle Validity Checks of Self-reported Exposure Measures

The ways in which cases were classified invalid and their frequencies are summarized in Table A2.

Validity of ODO_{t1} and ODO_{t2} Once missing and invalid ODO_1 and ODO_2 values were excluded, 69.2% (n=609) of the total sample remained.

Validity of KM/WK and HR/WK at time 1 and time 2 When missing and inconsistent KM/WK and HR/WK values in terms of zero responses were excluded, 95.9% (n=840) and 93.9% (n=826) of the total sample remained at time 1 and time 2 respectively. Examination of KM/HR and missing values showed that 79.1% (N=696) and 77.8% (N=685) of the total sample had a realistic range at time 1 and time 2 respectively.

Of the subset of viable data on KM/WK and HR/WK, the KM/HR were compared by the degree of urbanisation of the participants' residence to further test the plausibility of KM/WK and HR/WK data at time 1 and time 2. Those who resided in the metropolitan areas had the lowest overall mean KM/HR, followed by regional city residents, and then rural residents for both time 1 and time 2. The differences in the average speed between rural and metropolitan riders were more exaggerated with increasing self-reported KM/WK at both time 1 and time 2. The average speeds of regional city residents by their self-reported

KM/WK were not as consistent but they still had a higher average speed than metropolitan riders amongst those who self-reported to ride the highest end of kilometers at time 1 and time 2. Given the similar results between time 1 and time 2 the graphical representation of KM/HR by KM/WK is presented just for time 1 in Figure 1.

Reliability of Self-reported Exposure Measures

Further examination of the different exposure measures was performed only on data that passed the in-principle validity checks. All the comparisons between self-estimates and odometer-derived estimates were made on the subset of data when all the above mentioned exclusion rules were applied (n=468; 53.2% of the total sample). All the comparisons between different types of self-estimates were conducted on the subsets of data when invalid KM/WK and HR/WK were removed (i.e. included only cases when KM/WK and HR/WK were both equal to or greater than 0, and when KM/HR was between 20 and 110). These data subsets included 79.1% (N=696) and 77.8% (N=685) of the total sample at time 1 and time 2 respectively. All these exclusions were applied to ensure the analyses were based on the maximum valid data.

Consistency between self-reported motorcycle odometer and self-estimates of riding distance Two sets of comparisons were made to test the consistency between distance measures of two different modes (A and B in Table 1). Both comparisons had statistically significant different means. The correlations were significant but only moderate in magnitude (r_s = .54 and r_s = .57). The coefficients of variation for the odometer-derived distances were five to six times those of the original distances. The Bland-Altman plots showed that the observations were more concentrated above the difference of zero, but the magnitudes of the negative differences were much larger and increased with increasing kilometers (Figure 2A & 2B).

Consistency between self-estimates of riding distance in different timeframes Two sets of comparisons were made to test the consistency between distance exposure measures of different timeframes (C and D in Table 1). Only the means of the interpolated KM/WK from lifetime and the original KM/WK_1 were significantly different. Both correlations were significant but the correlation was lower for the lifetime (r_s =.60) than the three-month (r_s =.71) interpolation. The coefficients of variation were approximately one to one but larger for the lifetime than the three-month interpolation. The Bland-Altman plot for the lifetime comparison showed that overall more observations were above the difference of zero (Figure 2C). The plot for the three month comparison showed that the levels of observations above and below the difference of zero were similar (Figure 2D).

Consistency between self-estimates of riding exposure in different units of kilometers, hours, and number of riding trips The correlations between different exposures measures in different units are presented in Table 2. All the correlations were statistically significant ranging from .45 to .89. The correlations between distance and time were the highest at time 1 (r_s = .83) and time 2 (r_s = .89) and the only ones above the acceptable level of .70. The correlations for the corresponding pairs were larger at time 2 than time 1. The correlations of number of trips (TRIP/MTH) were larger for time than distance at both time 1 and time 2.

Sources of Differential Reliability

Methodological influence of the random allocation to the treatment group and control group The same analyses for the results presented in Tables 3 and 4 were conducted separately amongst treatment group and control group participants. Overall, they were similar to the results in Tables 3 and 4, with correlations differing only on average by 0.02. Hence, only results across the two study groups are presented here in Tables 3 and 4.

Influences of riding purposes and locations The differential reliability between commuting and recreational riders and between metropolitan and rural riders was only examined for the KM/WK and HR/WK variables because they were the most reliable measures in the present study. The reliability between KM/WK and HR/WK was greater amongst commuting riders (n=41) compared to recreational riders (n=143), and greater amongst rural riders (n=48) compared to metropolitan riders (n=451) at both time 1 and time 2 (Table 3).

DISCUSSION

The present study examined and compared the reliability and validity of various self-report exposure measures in terms of different modes (odometer reading and self-estimates), timeframes (week, three-months, lifetime) and units (kilometers, hours, and number of trips). It further analysed possible sources of differential reliability of self-report riding exposure measures.

Validity of Self-reported Riding Exposure

The in-principle validity checks of the self-reported odometer readings deemed nearly seventy per cent of the total sample valid. Whilst the exact proportion of erroneous reading or any other validity checks of the readings were not specifically reported, Harrison and Christie (2005) also noted that some odometer readings had to be excluded as the second readings were lower than the first.

Odometer readings could be considered accurate unless there is a mechanical error in the speedometer. Validation of self-report driving exposure measures has been made against self-reported odometer readings (Leaf et al., 2008; Staplin et al., 2008) with the assumption that they are valid and can be used as a standard. However, this study highlights that even odometer readings should not simply be taken at face value when they are obtained through self-report.

Further examination of the present odometer readings indicated that only 30.3% and 27.7% did not end with a “0” at the two time-points respectively. As this would be unlikely for the majority, this suggests that many riders rounded their readings up or down to the nearest 10, 100, 1000, and so on even though they were asked for the exact odometer reading. In order to minimize potential guessing or rounding up of the odometer readings by the respondents, a tighter protocol that ensures adherence to reporting the exact odometer reading might be required if self-reported odometer readings are used (e.g. the interviewer to directly check the respondent’s bike, or specifically request the respondent to go to the bike during the phone interview before asking them to report the exact reading).

Self-reported riding exposure measures of KM/WK and HR/WK provided the largest amount of plausible data. The present proportions compare favorably with Chipman et al’s (1992; 1993) studies in which 60.1% to 85.7% of the total sample of drivers were deemed plausible. The mean KM/HR estimate derived from KM/WK and HR/WK increased in value by decreasing urbanisation at both time-points, congruent with Chipman et al’s (1992) findings with drivers. These observed relationships are as would be expected with valid data.

Reliability of Self-reported Riding Exposure

The odometer-derived distance measures singly did not coincide well with the other exposure measures used in this study. The means of the odometer-derived distances by week and three months were systematically higher than the corresponding means of the original self-estimates. The Bland-Altman plots further indicated that this systematically higher estimation of self-estimates relative to odometer-derived distances occurred at distances of larger magnitudes (approximately over 300km in a week and 4000km in three months). Poor correspondence between odometer readings and self-estimated distance has also been found amongst car drivers (e.g. Leaf et al., 2008; Myers, Paradis, & Blanchard, 2008; Staplin et al., 2008; White, 1976).

The present poor correspondence between self-report odometer and self-estimated distance may have arisen because some participants shared their motorcycle and/or used other motorcycles for on-road riding. Previous research with car drivers has found larger differences between different exposure measures when the respondents shared vehicles than when they were the sole driver (Leaf et al., 2008). The odometer readings would indicate the distance travelled by the vehicle irrespective of the driver/rider and not necessarily reflect the riding distance travelled by the respondent rider. Riders who shared their motorcycles with others would have travelled less distance than the motorcycle odometer indicated. Those who rode motorcycles other than that from which the odometer was read for this study would have travelled more distance than the motorcycle odometer indicated. If vehicle is the reason for this effect, the systematically higher estimation of self-estimates relative to odometer derived distances by the present novice riders suggest that they were more likely to ride others' motorcycle than others to rider theirs. The Learner Approved Motorcycle Schemes (LAMS) have been introduced in some Australian jurisdictions including Victoria, from which the present novice riders were sampled, to provide access to a range of motorcycles that excludes high power-to-weight models for novice riders. It is plausible that novice riders would be more motivated to ride others' non-LAMS motorcycle than others would be motivated to ride their LAMS restricted motorcycle. This is one plausible account of the present observations. The extent to which the participants shared their motorcycle or rode more than the one motorcycle was unknown in the current study. Additional questions on the level of sharing their bike from which the odometer is obtained and of using more than one bike for on-road riding might help to improve the reliability of self-reported odometer measures in future studies.

Although the correlations of the two pairs of the interpolated and the original kilometers were positive, the correlation between the lifetime-interpolated weekly distance and the average week distance did not reach the acceptable correlation of 0.7. The significant t-test and the Bland-Altman plot suggested that distance reported for a lifetime systematically underestimated distance compared to that reported for a week. However, these results may reflect real differences in exposure from current weeks to total riding career, rather than inadequate or invalid measurement. This possibly arose as participants are more likely to be riding more and in more circumstances by time 2 than when they first start riding (de Rome et al., 2010; Mulvihill & Haworth, 2005).

The almost one to one coefficients of variation and the sufficient correlation of .71 suggest that distance exposure asked in three month and week timeframes provide reasonably consistent data. The non-significant t-test and Bland-Altman plot indicated that the levels of over and underestimations of distance asked in a three month timeframe and a week became worse, although not in a systematic way, with increasing exposure. This suggests that the reliability of self-estimated distance can be acceptable up to a certain distance where poorer recall is possible with more riding.

The present results suggest that the kilometers reported for their total riding career in particular is not suitable for interpolation to estimate the current average week distance and vice versa. However, this is only relevant if the one week exposure data are employed for individual-level analyses (e.g. correlation) or if the data for other variables used in association with the one week exposure (e.g. number of crashes) are collected over longer periods than one week. For group-level analyses (e.g. comparison between treatment group and control group) with sufficient sample size, extrapolation of the shorter period of exposure data can be expected to work without bias on the assumption that the group assignment or other variables are not systematically related to the variations between the weekly and the longer periods of exposure. That is, the appropriateness of extrapolation of weekly exposure data must be considered depending on how the exposure data are used. Nevertheless, logically it could be expected that exposure asked for more recent and shorter timeframes would be easier to recall and therefore would produce more reliable and valid data.

The average week distance and time exposure measures (KM/WK and HR/WK) had excellent reliability with correlations over 0.8 at both time-points. However, their respective correlations with number of trips were below 0.7 at the two time-points. This parallels similar findings amongst drivers (Ehsani et al., 2011). The poor correlations with number of trips may reflect poor recall of riding exposure in terms of number of trips or a genuine lack of correspondence of number of trips to distance and time. The latter would be observed if riding varied from mostly frequent short trips to occasional long trips across participants. Another possible account for the poor correlations is that the distance and time exposure data were obtained for an average week while the number of trips for the past month, resulting in poorer recall for a longer timeframe. However, average week kilometers were more highly correlated with the three-month kilometers than with the one-month number of trips. This is compelling evidence against this argument.

Number of trips was also more highly correlated with time than with distance at both time-points. This is a plausible observation in that, in practice, frequent trips of short distance are likely to occur on urban roads at lower speeds thus over a longer timeframe relative to distance, whereas infrequent trips of long distance are likely on rural roads at higher speeds over a shorter timeframe relative to distance (Janke, 1991).

All these observed patterns based on the self-estimates of kilometers, hours, and number of trips are as would be expected with valid data. However, in practice number of trips would not function as a good measure of exposure to risk in road safety compared to distance or time unless distance and time are the same across all trips. For example, a single trip of 200km (or say 3 hours) would not represent the same risk as a single trip of 2km (5 minutes). Thus, exposure expressed in the units of distance or time, if measured reliably and accurately, better represents actual exposure to risk in road safety than number of trips. The present study shows that among novice riders number of trips does not provide a reasonable functional approximation to the distance and time exposure measures. Further, the fact that the pairs including HR/WK had the highest correlations suggests that riding hours in an average week provide the most reliable riding exposure data, at least amongst novice riders. Moreover, KM/WK had more missing values than HR/WK at both time-points, reflecting respondents' greater confidence with providing hour estimates than kilometer. People are likely to estimate and remember the time it took to travel better than the distance they rode.

Sources of Differential Reliability of Self-reported Riding Exposure

Similar results between the treatment group, control group, and overall across the two groups confirmed that the random allocation to different groups for the overall study from which the present study was derived did not have a systematic influence on the reliability and validity of the self-reported riding exposure measures used in the present study.

All the correlations between self-estimates of distance, time, and number of trips improved from time 1 to time 2. Riders might have improved their self-estimations with more experience in riding or taken more note of their exposure after being asked to report it in their first interview. The reliability of self-estimates of riding exposure might depend on riding experience and bear some practice effects (in answering exposure questions) amongst novice riders.

Whilst the present classification method of commuting versus recreational and metropolitan versus rural riders to examine the consistency between KM/WK and HR/WK substantially reduced the sample size, it was considered the most appropriate method to examine their relative reliability for the data available. The statistically significant and high correlations indicate that the restricted sample did not negatively impact the statistical power of these analyses. These analyses showed that self-estimates of kilometers and hours of riding were more reliable for commuting riders than recreational riders, and for rural riders than metropolitan riders. Commuting riding is likely to be more regular throughout the week, making recall and/or estimations of riding kilometers and hours more reliable than for recreational riders. Similarly, rural riders may recall and/or estimate kilometers and hours more reliably than metropolitan riders because riding on rural roads may be more consistent across participants than riding on urban roads where riding time can be vary greatly depending on traffic even though the same distances are covered.

The present as well as previous findings suggest that reliability and validity of self-reported distance and time exposure may be influenced by the different nature of road use by different road user groups. Joly et al (1993) found long-distance truck drivers estimated distance more accurately than time while bus drivers estimated time more accurately than distance. This might arise because truck drivers commonly own the trucks they drive and the running costs, which are determined by the kilometers driven, are borne by the truck drivers themselves. On the other hand, bus drivers may be more focused on the hours of travel than distance because they drive their employers' buses and according to a timetable and driving hours are more relevant for their pay than time. Staplin et al (2008) found high mileage drivers tended to overestimate distance, whereas low mileage drivers as well as young and elderly drivers tended to underestimate distance.

The different reliability of self-report estimates found in previous studies and in the present study across riding purposes and locations has implications for disaggregating exposure data to more accurately estimate risks for different situations within motorcycle user group, similarly implied in Kam's (2003) study. Reliability of self-report of exposure may also be influenced by the locality of travel locations. It is possible that riders' self-estimates of time and distance of riding closer from home are more valid and reliable than those further from home due to likely better knowledge of their local areas. Further research to understand the factors that contribute to the reliability of self-report exposure measures such as the locality of their riding trips may help to develop exposure questions of maximum validity and reliability.

Overall Implications for Research, Policy, and Practice

Many studies on crash risks are based on crash rates expressed in terms of self-reported exposure of unknown validity or reliability (e.g. Beck et al., 2007; Langford, Methorst, & Hakamies-Blomqvist, 2006; Segui-Gomez et al., 2011). Further, some studies do not report the methods used to collect the exposure data in any detail (e.g. Elliott et al., 2007; Engström, Gregersen, Granström, & Nyberg, 2008; Özkan et al., 2012). The present study highlights that detailed analyses of reliability and validity and reporting of the methods of all self-report exposure measures are imperative to ensure the credibility of the overall study results.

Although the present results suggest that self-report riding exposure measures are imperfect in terms of validity and reliability, riding hours in an average week seems to provide the most reliable and valid riding exposure data, at least amongst novice riders. Further research to facilitate better design of self-report riding exposure measures is beneficial because alternatives to self-report exposure measures in an effort to collect more reliable and valid data are not without limitations. For example, objective measurement tools such as Global Positioning Systems are vulnerable to missing data from cold starts and signal loss (see Grengs et al., 2008; Stopher & FitzGerald, 2008). Installation of electronic devices in motorcycles is challenging in terms of security and protection from weather. While travel diaries might also improve self-reported exposure data, invalid diary entries have been reported when directly compared to data from an in-vehicle recording device (Blanchard et al., 2010). Diary-aided self-report exposure measures also face a major disadvantage of large attrition rates due to the onerous nature of keeping travel diaries (Ehsani et al., 2011; Keirnan, Cox, Kovatchev, Kiernan, & Giuliano, 1999; Wolf, Guensler, Washington, & Frank, 2000), and thus may produce data for only a biased sample of participants.

Limitations

A few limitations must be noted for the interpretation of this study. None of the self-reported exposure measures could be tested for accuracy with an objective measure of exposure such as electronic devices. Future validation studies using objective measures amongst novice riders would further confirm the results. Additional questions may have improved the reliability and validity of the current exposure measures as already discussed. However, the number of questions was limited in the present study to avoid participant fatigue and to maximize response rates. While there was no apparent incentive in the present study for riders to report more or less riding than they believed, riders with a crash history might have over-reported their riding to explain their involvement in a crash. Such potential for social desirability bias (Coughlin, 1990; Lajunen & Summala, 2003; Sullman & Taylor, 2010) was not controlled for in this study.

Conclusion

All the benefits and limitations of self-report and alternative methods of collecting exposure information must be considered within each research context to choose the optimal method. Acceptable reliability and validity of self-reported exposure data is critical to ensure the integrity of studies on crash risks and evaluation of road safety interventions that utilize exposure data. Recommendations can be made from the present results to maximize the reliability and validity of self-report riding exposure measures. It is recommended that self-reported riding exposure questions are asked 1) for the current average week rather than earlier and longer periods; 2) in units of time rather than distance or number of trips; and 3) as riding hours in an average week in preference to riding kilometres or self-reported odometer readings. People are likely to estimate and remember the time it took to travel better than the distance they rode. If self-reported odometer readings are used, questions on whether the respondents share their own bike or ride more than one bike, and a built-in process to ensure respondents report the exact odometer reading on their bike are also recommended. The greater reliability of riding exposure found in this study amongst commuting and rural riders compared to recreational and metropolitan riders respectively and at the second interview compared to the first suggest that factors such as riding purposes, geographical locations, and riding experience can contribute to measurement error. Concurrent data collection on riding purposes, locations, and experience is also recommended. Evaluation of the presently recommended self-report exposure questions with respect to objective measures such as GPS technology in future studies would be beneficial to confirm the present results. Further research to understand the extent and determinants of measurement error in self-report exposure measures amongst motorcyclists can help to further improve self-report riding exposure measures and to ensure their appropriate use in further motorcycle crash risk analyses.

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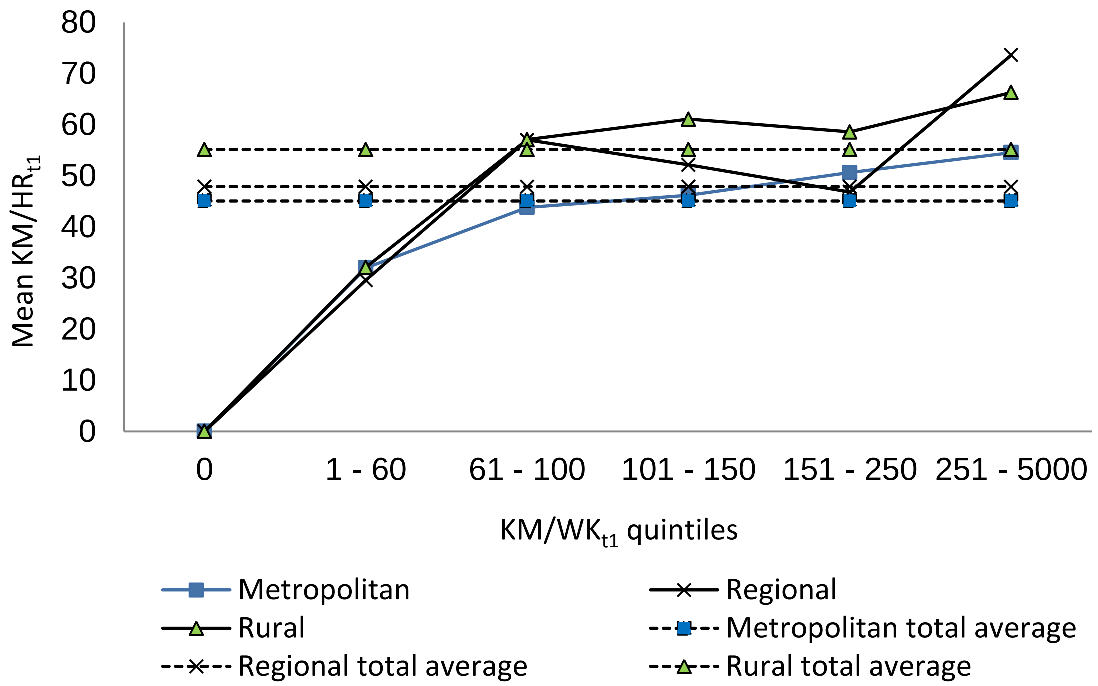
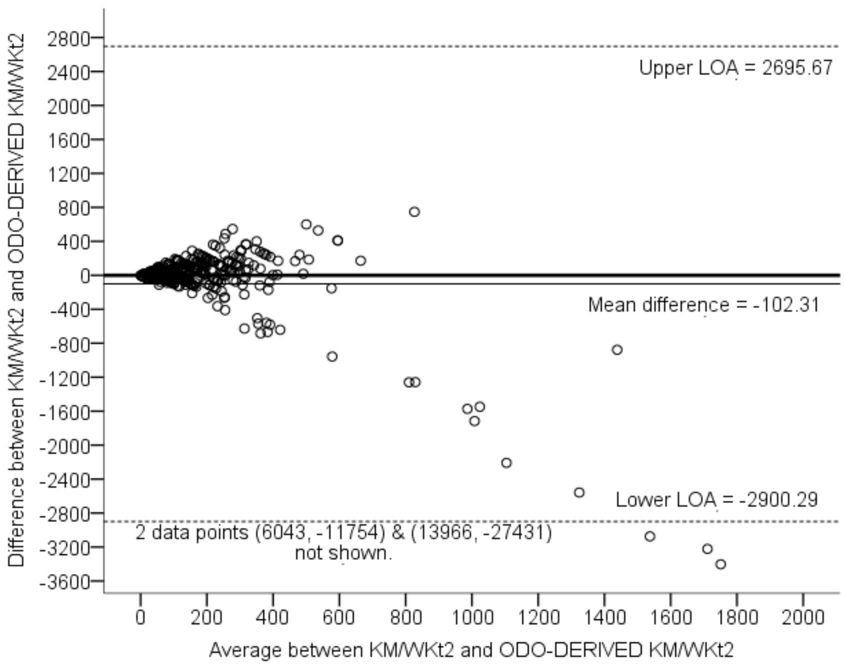


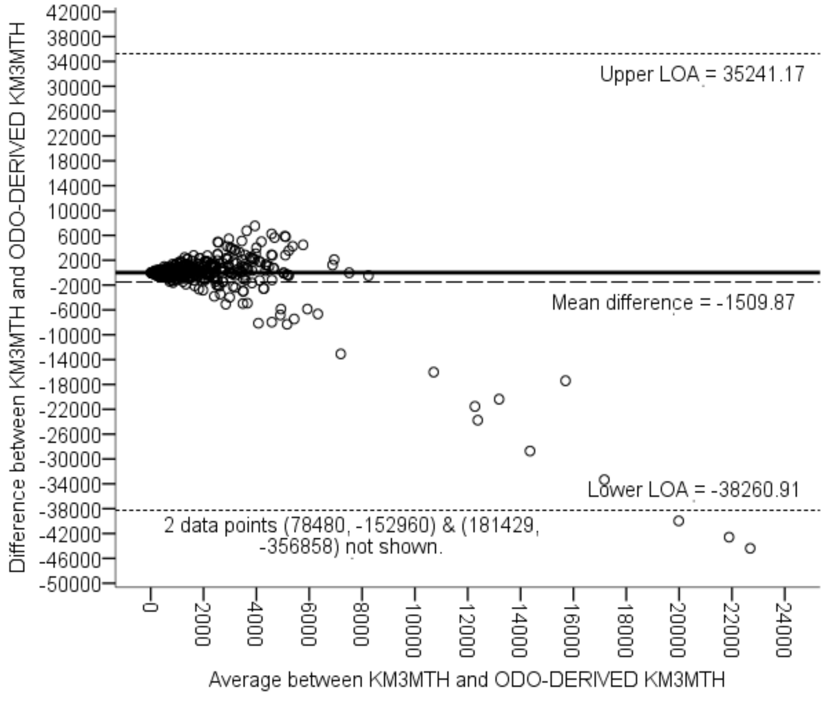
Figure 1. The graphical relationship between KM/WK and KM/HR by the degree of urbanisation at time 1. The solid lines show the relationship between KM/WK_{t1} in quintiles on the x-axis and the mean KM/HR_{t1} in each quintile group on the y-axis with an origin of zero. The dashed lines represent the total average KM/HR amongst metropolitan, regional, and rural groups respectively.

A.



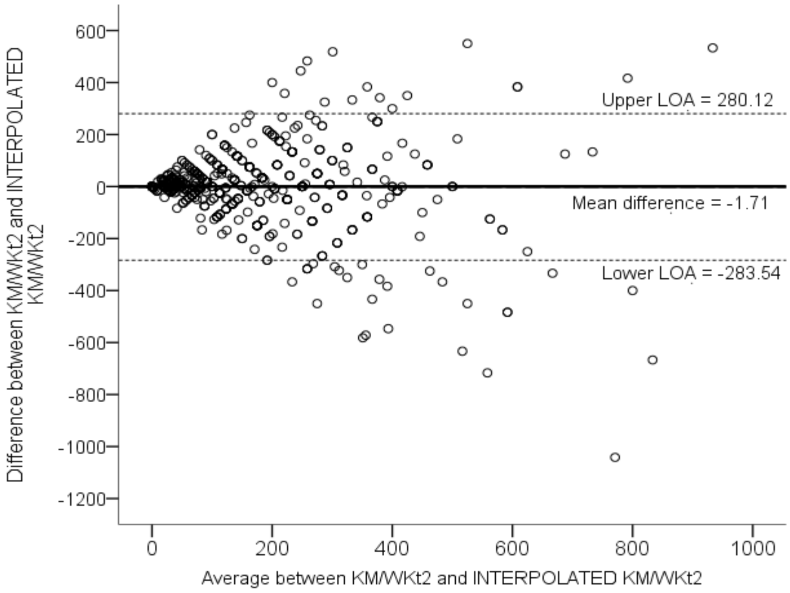
Difference between KM/WKt2 and ODO-DERIVED KM/WKt2
Upper LOA = 2695.67
Mean difference = -102.31
Lower LOA = -2900.29
2 data points (6043, -11754) & (13966, -27431) not shown.
Average between KM/WKt2 and ODO-DERIVED KM/WKt2

B.



Difference between KM3MTH and ODO-DERIVED KM3MTH
Upper LOA = 35241.17
Mean difference = -1509.87
Lower LOA = -38260.91
2 data points (78480, -152960) & (181429, -356858) not shown.
Average between KM3MTH and ODO-DERIVED KM3MTH

C.



D.

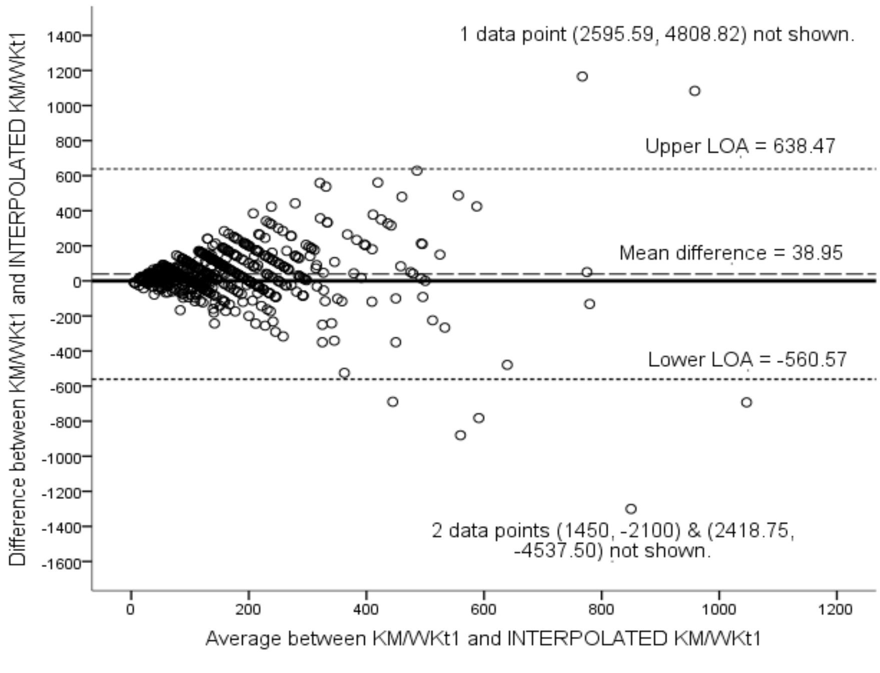


Figure 2. Bland-Altman plots for the comparisons presented in Table 1. The differences in the two distance exposure measures (y-axis) are plotted against each individual's mean of the two measures (x-axis). The solid line is the line of equality (zero difference), the dashed line represents the mean difference, and the dotted lines mark the 95% limits of agreement (LOA). Some data-points that were outliers of a large margin are not shown in the plots (A – C). These data-points are identified within the plots as (x, y) where x = mean of the two measures and y = difference between the two measures.

Table 1. Consistency of measures of distance travelled on-road on a motorcycle of different sources (A and B) and timeframe (C and D).

	Variable 1 ^ (V1)	Variable 2 ^ (V2)	V1 Mean (SD)	V2 Mean (SD)	Mean (SD) difference [V1-V2]	Wilcoxon test statistics	V1 CV	V2 CV	One-tailed Spearman's correlation
A.	KM/WK_{t2}	ODO-DERIVED KM/WK_{t2}	160.11 (154.01)	262.42 (1428.85)	-102.31 (1427.54)	-5.47*	0.96	5.44	.54*
B.	KM_{t2} 3MTH	ODO-DERIVED KM_{t2} 3MTH	1915.50 (1752.65)	3425.37 (18759.82)	-1509.87 (18750.53)	-3.83*	0.91	5.48	.57*
C.	KM/WK_{t1}	INTERPOLATED KM/WK_{t1} (from lifetime)	179.67 (237.76)	140.72 (244.60)	38.95 (305.88)	-10.89*	1.32	1.74	.60*
D.	KM/WK_{t2}	INTERPOLATED KM/WK_{t2} (from 3-month)	163.11 (151.29)	164.83 (170.45)	-1.71 (143.79)	-1.40	0.93	1.03	.71*

SD: Standard Deviation; CV: Coefficient of Variation (SD/Mean)
^All sub-scripts for variables 1 and 2 indicate the time-point that the data corresponds to, where t1 refers to time 1 and t2 refers to time 2.
*Significant at p<.001

Table 2. Correlations between different measures of exposure in different units

Variable 1^	Variable 2^	One-tailed Spearman's correlation
KM/WK_{t1}	HR/WK_{t1}	.83*
KM/WK_{t1}	$TRIP/MTH_{t1}$	.47*
HR/WK_{t1}	$TRIP/MTH_{t1}$	.54*
KM/WK_{t2}	HR/WK_{t2}	.89*
KM/WK_{t2}	$TRIP/MTH_{t2}$	.57*
HR/WK_{t2}	$TRIP/MTH_{t2}$	.61*
ODO-DERIVED KM/WK_{t2}	HR/WK_{t2}	.50*
ODO-DERIVED KM/WK_{t2}	$TRIP/MTH_{t2}$	.45*

^All sub-scripts for variables 1 and 2 indicate the time-point to which the data corresponds, where t1 refers to time 1 and t2 refers to time 2.
*Significant at p<.001

Table 3. Correlations between KM/WK and HR/WK amongst commuting riders versus recreational riders and metropolitan riders versus rural riders at time 1 and time 2

Variable 1^	Variable 2^	Commuting riders	Recreational riders	Metropolitan riders	Rural riders
KM/WK_{t1}	HR/WK_{t1}	.88*	.81*	.82*	.84*
KM/WK_{t2}	HR/WK_{t2}	.93*	.84*	.89*	.92*

^All sub-scripts for variables 1 and 2 indicate the time-point to which the data corresponds, where t1 refers to time 1 and t2 refers to time 2.
*Significant at p<.001

APPENDIX

Table A1. Summary of original exposure variables and variables derived from the original exposure measures at time 1 and time 2.

Original variables	**What it measured**	**For whom the question was asked**
ODO_{t1}^	Odometer reading on participant's motorcycle in km at time 1.	Those who always rode the same bike for on-road riding (N=826; 94%)
ODO_{t2}^	Odometer reading on participant's motorcycle in km at time 2.	Those who always rode the same bike for on-road riding and rode the same bike as time 1 (N=743; 84%)
KM/WK_{t1}^ KM/WK_{t2}^	Number of kilometers participant rides in an average week on-road at time 1 and time 2.	All participants (N=880)
HR/WK_{t1}^ HR/WK_{t2}^	Number of hours participant rides in an average week on-road at time 1 and time 2.	All participants (N=880)
$TRIP/MTH_{t1}$^ $TRIP/MTH_{t2}$^	Sum of all riding trips on-road in past month (commuting; as part of their job; recreation; general transport (e.g. visiting, shopping); and/or other) at time 1 and time 2 (with a journey from one point to another counted as one trip, and a round trip as two trips).	All participants (N=880)
KM_{t1}^ LIFETIME	Number of kilometers ridden on-road in participant's lifetime at time 1.	All participants (N=880)
KM_{t2}^ 3MTH	Total kilometers participant rode on-road in past three months of interview at time 2.	All participants (N=880)
Derived variables	**What it measured**	**For whom the variable was derived**
ODO-DERIVED KM/WK_{t2}^	$(ODO_{t2} – ODO_{t1})$ / (time 2 – time 1) days x 7days	Those who provided both ODO_{t1} and ODO_{t2} (N=667; 75.8%)
ODO-DERIVED KM_{t2}^ 3MTH	$(ODO_{t2} – ODO_{t1})$ / (time 2 – time 1) days x 91days	Those who provided both ODO_{t1} and ODO_{t2} (N=667;

		75.8%)
INTERPOLATED KM/WK_{t1}^	KM_{t1} LIFETIME divided by sum of number of months participants held their learner's permit and number of months they held their current probationary licence up to time 1, multiplied by four weeks (i.e. interpolated from self-estimates of riding in lifetime).	All participants (N=880)
INTERPOLATED KM/WK_{t2}^	KM_{t2} 3MTH divided by 12 weeks (i.e. interpolated from self-estimates of riding in three months)	All participants (N=880)

^All sub-scripts indicate the time-point that the data corresponds to, where t1 refers to time 1 and t2 refers to time 2.

Table A2. Summary of invalid cases by exposure variables

Variables	Minimum	Maximum	N (%) missing of the total sample	Definitions of invalid cases	N (%) classified as invalid out of non-missing cases
ODO_{t1}^	30	93,000	62 (7.0)	Cases where $ODO_{t2}<ODO_{t1}$	58 (8.7)
ODO_{t2}^	45	472,328	177(20.0)		
KM/WK_{t1}^	0	5000	30 (3.4)	Cases where either of the two variables (a) KM/WK_{t1} and (b) HR/WK_{t1} was 0 while the other was not.	a) 6 (0.7) b) 36 (4.1)
HR/WK_{t1}^	0	60	NIL		
KM/HR_{t1}^ (KM/WK_{t1} & HR/WK_{t1})	1	260	36 (4.1)	Cases where KM/WK_1 divided by HR/WK_{t1} produced KM/HR_{t1} (a) below 20km/hr and (b) above 110km/hr.	a) 131 (15.7) b) 17 (2.0)
KM/WK_{t2}^	0	1200	18 (2.0)	Cases where either of the two variables (a) KM/WK_{t2} and (b) HR/WK_{t2} was 0 while the other was not.	a) 36 (4.2) b) 46 (5.3)
HR/WK_{t2}^	0	30	8 (0.9)		
KM/HR_{t2}^ (KM/WK_{t2} & HR/WK_{t2})	0.33	250	54 (6.1)	Cases where KM/WK_2 divided by HR/WK_{t2} produced KM/HR_{t2} (a) below 20km/hr and (b) above 110km/hr.	a) 123 (15.6) b) 18 (2.3)

^All sub-scripts indicate the time-point to which the data corresponds, where t1 refers to time 1 and t2 refers to time 2.

Table A3. Glossary of terms

Abbreviation	Definition
SD	Standard deviation
CV	Coefficient of variation
LOA	Limits of agreement
ODO_{t1}	Self-reported odometer reading on participant's motorcycle in kilometers at time 1
ODO_{t2}	Self-reported odometer reading on participant's motorcycle in kilometers at time 2
KM/WK_{t1}	Self-reported number of kilometers participant rides in an average week on-road at time 1
KM/WK_{t2}	Self-reported number of kilometers participant rides in an average week on-road at time 2
HR/WK_{t1}	Self-reported number of hours participant rides in an average week on-road at time 1
HR/WK_{t2}	Self-reported number of hours participant rides in an average week on-road at time 2
$TRIP/MTH_{t1}$	Self-reported number of riding trips on-road in the past month of the interview at time 1
$TRIP/MTH_{t2}$	Self-reported number of riding trips on-road in the past month of the interview at time 2
$KM_{t1}LIFETIME$	Self-reported number of kilometers ridden on-road in participant's lifetime at time 1
$KM3_{t2}MTH$	Self-reported number of kilometers ridden on-road in the past three months of the interview at time 2
ODO-DERIVED KM/WK_{t2}	Number of kilometers in a week derived from the self-reported odometer reading
ODO-DERIVED $KM_{t2}3MTH$	Number of kilometers in three months derived from the self-reported odometer reading
INTERPOLATED KM/WK_{t1}	Number of kilometers interpolated from $KM_{t1}LIFETIME$
INTERPOLATED KM/WK_{t2}	Number of kilometers interpolated from $KM_{t2}3MTH$
t1	Baseline data collected at time 1
t2	Follow-up data collected at time 2

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Chapter 4: Self-report riding behaviours—MRBQ (*Study 2*)

4.1 Preamble

This chapter presents the study on self-report riding behaviours amongst novice riders, which is under review in *Transportation Research Part F: Traffic Psychology and Behavior*. The journal confirmation for the submission is shown in Appendix 7 (p.376). Publications details and signed statements of authorship are provided in Appendix 8 under ***Paper 3***.

4.2 Aims and objectives of *Study 2*

The aim of ***Study 2*** was to examine the applicability of a self-report measure of riding behaviours amongst novice riders, specifically the *Motorcycle Rider Behaviour Questionnaire* (MRBQ) that was developed amongst experienced riders based on the widely used *Driver Behaviour Questionnaire*. The objectives were:

1. To examine the previously examined psychometric properties of the Motorcycle Rider Behaviour Questionnaire (MRBQ) including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes (Elliott *et al.* 2007, Özkan *et al.* 2012);
2. To examine the psychometric properties of the MRBQ not yet examined in previous studies including stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes;
3. To assess applicability of the MRBQ amongst novice riders in Australia, a population to whom the MRBQ has not been applied to date.

4.3 Manuscript

Over page.

Abstract

The Motorcycle Rider Behavior Questionnaire (MRBQ) was developed to measure behavioral factors influencing motorcyclists' crash risk including errors and violations as well as the use of motorcycle safety equipment via self-report. The aims of the present study were to 1) examine the previously examined psychometric properties of the MRBQ including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes amongst experienced riders in the UK and Turkey; 2) examine the psychometric properties of the MRBQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes; and 3) assess the applicability of the MRBQ to a population of novice riders in Australia, to whom the MRBQ has not been applied to date. Novice riders (N=1305) in the state of Victoria, Australia participated in the present study. Confirmatory factor analyses showed that the present data did not fit with the previously found factor models in experienced riders in the UK and Turkey. Principal axis factoring was performed to respecify the MRBQ factor model amongst novice riders and revealed four scales: errors; speed violations; stunts; and protective gear. The insufficient internal consistency, stability, content and predictive validity demonstrated by the MRBQ in the present study and some inconsistencies amongst the three MRBQ studies suggest that the development and refinement of the MRBQ items are required before wider use of the MRBQ instrument, especially amongst novice riders. Possible causes of the limited reliability and validity of the current MRBQ are discussed to inform further development and refinement of the items, thereby making the MRBQ more useful in future research to understand and evaluate riders' behaviors.

Keywords

Motorcycle Rider Behavior Questionnaire; validity; reliability; motorcycle crash; traffic offence

1. Introduction

Understanding motorcyclists' on-road behavior is critical for not only the development but also the evaluation of interventions specifically targeted for motorcyclists. Risky on-road behaviors have been historically dichotomized broadly into errors and violations (Reason *et al.* 1990). The Motorcycle Rider Behavior Questionnaire (MRBQ) was developed to measure motorcyclists' errors and violations, as well as the use of motorcycle safety equipment, via self-report based on the widely used Driver Behavior Questionnaire (DBQ) and Reason et al's (1990) model of aberrant driver behavior (Elliott *et al.* 2007). Official records of traffic offences are useful to understand risky on-road behaviors. However, they do not necessarily capture all errors and violations and non-use of safety equipment by the motorcyclists, due to the variability in enforcement (people do not always get caught for breaking road laws) and because in most jurisdictions and countries the use of safety equipment is not mandated except for helmets. Self-report can be a useful additional tool when alternative data collection methods such as direct observations and official records are not feasible due to limited research resources. For these reasons development and evaluation of a self-report measure of on-road riding behaviors such as the MRBQ is beneficial for motorcycle safety research and practice. Ensuring the validity and reliability of any research instruments including the MRBQ is essential before their wider use.

Two studies have so far to some extent examined the validity and reliability of the MRBQ in motorcycle populations in the United Kingdom (UK; Elliott *et al.* 2007) and Turkey (Özkan *et al.* 2012). In both studies principal component analyses identified five components which were named traffic errors, control errors, speed violations, stunts, and safety equipment. These five sub-scales were shown to have good internal consistency; however, the item constituents of each scale were not exactly the same in the two studies. Although both studies reported the predictive validity of some of the MRBQ scales in terms of self-reported crashes, the findings were not consistent between the two studies. The stunts factor was found to be predictive of self-reported crashes in the Turkish rider sample, whereas traffic errors were in the UK rider sample, and additionally control errors and speed violations when restricted to crashes for which the respondents took blame. In the Turkish study, both speed violations and stunts were significant predictors of self-reported traffic offences.

Further, three key psychometric features remain untested for the MRBQ. The ability of a self-report questionnaire to predict police-recorded as well as self-reported crashes and offences would increase its utility in road safety research. These were not examined in the two European studies (Elliott *et al.* 2007, Özkan *et al.* 2012). Aside from the possible consistency motif bias (people's tendency to want to respond consistently across related measures; Podsakoff *et al.* 2003, af Wåhlberg 2011), MRBQ factor and crash/offence relationships may vary depending on whether the data were obtained via self-report (which includes minor crashes) or the police (typically limited to serious crashes) due to the different nature of crashes represented (Boufous *et al.* 2010). The two studies also did not examine the content validity or the stability of the MRBQ scales. For the results based on MRBQ to be meaningful it must also be able to measure what is intended to be measured – errors, violations, and use of safety equipment (i.e. content validity). If rider behaviors are expected to be stable over time, the stability of the MRBQ is critical to ensure its ability to measure behaviors consistently over time. The stability of the tool can also reflect the modifiability of behaviors over time, which has implications for the development and evaluation of rider interventions.

Furthermore, no published study has examined the applicability of the MRBQ to novice riders in Australia. Self-report behavioral measures for novice riders are lacking, and it is useful to examine the applicability of the already developed MRBQ amongst novice riders before considering the development of a new measure. The motorcyclists in the two European studies were experienced riders with an average of 11 years of riding (Elliott *et al.* 2007) or over 60,000km of riding (Özkan *et al.* 2012). The MRBQ psychometric properties for novice riders who are in the formative years of riding may be distinct from more experienced riders who have committed themselves to riding and possibly established their behavior on-road. Similarly, climatic and cultural differences amongst UK, Turkey, and Australia may have implications for the MRBQ psychometric properties. Demographic and cross-cultural variations have been identified as contributors to the different DBQ factor structures and DBQ-crash relationships (Blockey and Hartley 1995, Kontogiannis *et al.* 2002, Xie and Parker 2002, Hennessy and Wiesenthal 2005, Bener *et al.* 2008, de Winter and Dodou 2010).

Therefore the present study aimed to 1) examine the previously examined psychometric properties of the MRBQ including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes (Elliott *et al.* 2007, Özkan *et al.* 2012); 2) examine the psychometric properties of the MRBQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes; and 3) assess the applicability of the MRBQ amongst novice riders in Australia, a population to whom the MRBQ has not been applied to date.

2. Method

2.1. Participants and Procedure

Novice riders in the state of Victoria, Australia participated in the present study. They were drawn from a large scale randomized control trial to evaluate a motorcycle rider training program (*VicRide*) designed for novice riders. VicRoads, the state authority for roads in Victoria, sent letters of invitation to motorcycle riders who had recently advanced from a learner motorcycle permit to a probationary/restricted motorcycle licence (N=23,696) through the period May 2010 – June 2011. The study candidates could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The core eligibility criteria based on the *VicRide* design were that 1) they owned a motorcycle (not a scooter); 2) their motorcycle had an engine capacity of 125cc or greater and was compliant with the VicRoads' Learner Approved Motorcycle Scheme (that allows novices to ride motorcycles with an engine capacity up to and including 660cc but not exceeding a power-to-weight ratio of 150 kilowatts per tonne); 3) they had ridden at least 500km over at least 12 separate trips on public roads since obtaining their learner permit; and 4) they had been on a Victorian probationary/restricted motorcycle licence for one year or less. If the candidates met all the eligibility criteria they were asked to provide informed consent to participate in the study and for their police-recorded offence and crash records to be accessed as part of the study participation.

Of those approached 2375 candidates met all the eligibility criteria and 1305 riders (54.9%) completed two 30-minute interviews: a baseline and a follow-up interview, which were on average 142.9 days (SD=33.6) apart. The baseline interviews were conducted between June 2010 and August 2011 (time 1) and a follow-up interview between September 2010 and December 2011 (time 2). At the end of the baseline interview the riders were randomized into the treatment group (n=620; 47.5%) or the control group (n=685; 52.5%). This assignment was unknown to the interviewers and the respondents whilst completing the baseline interview because the randomisation was done at the end of the interview. Although the present data were drawn from participants recruited into a randomised control trial, the present study was only concerned with testing the validity and reliability of the MRBQ. Thus all the present analyses were performed on the baseline data that were collected before randomisation, except for the test of stability, for which both the baseline and follow-up data for the control group only was employed. Hence systematically different answers by study group or contamination of the present results by possible treatment effects were unlikely. Study participants' information before randomisation that is relevant to the present study is summarised in Table 1. No significant differences existed between the treatment and control groups at baseline on these variables.

All the participants whether recruited via the web or phone completed the same surveys via the same computer assisted telephone interview by professional interviewers who were specifically trained in the survey developed for this study. Hence biased responding by recruitment methods was unlikely. The combination of phone and web recruitment maximised the reach of participants so as not to exclude those who could not access the web or who could not be reached by phone (e.g. because the phone numbers were not current by the time of interview). The final sample comprised 79.2% males. The age range was 18 to 74, with a mean of 36.0 years (SD=11.3). This was in keeping with Victoria wide age and gender demographics. According to VicRoads March 2012 data, the novice rider population in Victoria was aged between 18 and 92 with a mean of 33.6 years (SD=11.1), and 84.4% were males.

The entire study involved a baseline interview, randomisation into treatment or control groups, *VicRide* participation for the treatment group only, then two follow-up interviews approximately four and thirteen months respectively from the baseline interview. Once the participants completed the second follow-up interview, their police-recorded crash and offence data were obtained from VicRoads. By January 2012, 651 participants had completed the entire study and thus their police-recorded offence and crash records could be accessed from VicRoads. The number of offences ranged from zero to 12 in the entire sample. Twenty-four riders (3.7%) had a recorded crash. None had multiple crashes. The research was approved by the University of Sydney Human Research Ethics Committee and Monash University Human Research Ethics Committee.

2.2. Measures

The survey included questions on demographics, riding activities, riding-related attitudes and behaviors, the motorcycles they ride, and experiences with driving, rider training, and crashes. The sample characteristics is summarized in Table 1 and all the measures relevant to the present research questions are described in more detail.

2.2.1. The Motorcycle Rider Behavior Questionnaire (MRBQ)

The 43-item MRBQ was developed to identify behavioral factors influencing motorcyclists' crash risk (Elliott *et al.* 2007). Based on the two studies in the UK (Elliott *et al.* 2007) and Turkey (Özkan *et al.* 2012), five sub-scales namely, traffic errors, control errors, speed violations, stunts, and safety equipment were expected. Respondents are asked to rate on a 6-point Likert scale from "never", "hardly ever", "occasionally", "quite often", "frequently", to "nearly all the time" on how often they display the behavior described while riding. The

MRBQ scale scores are calculated by adding each item score and dividing it by the number of items so that each scale score ranged from one to six. For all the scales, higher scores indicate more frequent display of the behavior described.

2.2.2. Riding exposure

Riding exposure prior to randomization was measured through self-reported kilometers and hours of riding in an average week (KM/WK and HR/WK), and number of riding trips in the past month. Amongst them, HR/WK was found to be most reliable (Sakashita *et al.* 2013). People are likely to estimate and remember the time it took to travel better than the distance they rode. Moreover, in the current data KM/WK had 38 missing values but HR/WK none, reflecting respondents' greater confidence with providing hour estimates than kilometer. Hence the HR/WK variable was used to control for riding exposure in the regression analysis to test the predictive validity of the MRBQ scales.

2.2.3. Self-reported near crash and crash experiences

The baseline data on self-reported crashes and near crashes collected before randomization was employed to test the predictive validity of the MRBQ scales. Riders were asked to report the number of 'near crashes or close calls while riding on a public road over the last 3 months'. These were defined as incidents when they 'almost had a crash but did not'. They were also asked to report the number of 'motorcycle crashes including minor spills or offs while riding on a public road over the last 12 months'. Whilst 3 months was considered to be an appropriate recall period, given crashes are rare events for an individual, 12 months can provide more data and the validity of 12-month data has been confirmed (Boufous *et al.*

2010). Motorcycle crashes were defined as ‘collisions with someone or something, or coming off the bike but excluding dropping or knocking it over while parked’.

2.2.4. Police-recorded crashes and offences

The predictive validity of the MRBQ scales was tested with respect to police-recorded crashes and offences against their licence before the baseline interview (i.e. before randomization into treatment and control groups). Only recorded crashes occurring whilst the participant was riding a motorcycle were selected for the purpose of this study. In Victoria, recorded crashes are defined as any apparently unpremeditated event reported to the police or other relevant authority and resulting in death, injury or property damage attributable to the movement of a road vehicle on a road. Fatal (death within 30 days of the crash) and serious (hospital admission) or other (sustained injury but not admitted to hospital and may or may not have sought medical advice) injury crashes are included based on the highest injury level recorded. Non-injury or property damage only crashes are not in the official crash data.

The recorded offences included the following 15 broad categories: careless riding/driving; disobey licence restriction; disobey licence sanction; disobey road rule; drink riding/driving; no helmet; not comply with police; not report/stop for a crash; parking; phone use; speeding; uninsured vehicle; unlawful number plate; unlawful vehicle use; unregistered/unroadworthy vehicle. The two offenses, ‘unlawful number plate’ and ‘unregistered/unroadworthy vehicle’ were considered behavioural in nature in the sense that the riders themselves chose to have unlawful number plate and drive unregistered/unroadworthy vehicles. Therefore all these 15 categories of recorded offences were also used to test the content validity of the MRBQ scales.

2.2.5. Coach assessment of protective gear use

Data on protective gear use was also available as assessed by the coaches who delivered the program amongst the treatment group riders. The coaches rated the level of use on a scale from one to three where one indicated low use and three indicated full use. This information was used to explore the content validity of the safety equipment use measured within the MRBQ, in addition to the police-recorded offences.

2.3. Analyses

2.3.1. Confirmatory factor analysis

Before exploring the factor structure of the MRBQ amongst novice riders, the fit of the factor structures previously found by Elliot *et al* (2007) and Özkan et al (In Press) respectively with the present MRBQ data were tested via confirmatory factor analysis (CFA) in Amos Version 21. To test Elliot's model the following indicators (see item numbers in Table 2) were used for each of the five factors: traffic errors (*1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 16, 17, 42*); control errors (*5, 7, 8, 12, 13, 14, 15*); speed violations (*8, 17, 18, 19, 20, 21, 22, 23, 24*); stunts (*22, 23, 25, 26, 27, 28*); safety equipment (*29, 30, 31, 32, 33, 39, 40, 41*).To test Ozkan's model the following indicators were used for each of the five factors: traffic errors (*1, 2, 3, 4, 6, 9, 10, 11, 16, 42*); control errors (*12, 13, 14, 15, 36*); speed violations (*5, 7, 8, 17, 18, 19, 20, 21, 22, 24*); stunts (*23, 25, 26, 27, 28, 37*); safety equipment (*29, 30, 31, 32, 33, 38, 40, 41*). One loading was constrained to unity and items with the highest loadings on each factor—*10, 15, 19, 25, 29*—were used as marker variables for traffic errors, control errors, speed violations, stunts, and safety equipment factors respectively in Elliot's model. The same marker variables were used in Ozkan's model except item *31* was used for the safety equipment factor. Less than 1% of data were missing, which appeared to be random.

Therefore no treatment of missing data were made and the conservative approach of listwise deletion was conducted. CFA was run using maximum likelihood estimation. The results were significant (χ^2 = 2679.99; 60526.90 respectively) and the root mean-square errors of approximation (RMSEA =.098; .093) were above the conventional cut-off of .08 (MacCallum *et al.* 1996). Furthermore, both CFI and TLI were 0 in both models. That is, both the previously found models were rejected, and a new model was re-specified using exploratory factor analysis.

2.3.2. Exploratory factor analysis

Both Elliot *et al* (2007) and Özkan et al (In Press) performed principal component analysis (PCA). However, PCA summarizes all variation in the measured variables and is unable to uncover latent factors (Mattsson 2012). Given the present objective was to find latent constructs that would explain the variation in observed variables, principal axis factoring (PAF) was the most appropriate analysis. Therefore PAF was performed on the MRBQ data collected during the baseline interview before randomization. The 43 items of the MRBQ were analyzed via the PAF with oblique rotation to ensure that the sample size was adequate, and that the items were appropriate for data reduction analyses. The factors were expected to be correlated based on a general factor of on-road risk/safety concern hence oblique rotation was applied. The MAP test (O'Connor 2000) indicated four factors to be most appropriate. Hence PAF with direct oblimin rotation was applied on the 43 items of the MRBQ retaining four factors. Only those items with loadings 0.3 or above were kept, as consistent with the two studies (Elliott *et al.* 2007, Özkan *et al.* 2012).

2.3.3. Internal consistency of the MRBQ scales

The internal consistency of each MRBQ scale derived from the PAF was examined on the data collected during the baseline interview before randomization through the calculation of Cronbach's coefficient alpha.

2.3.4. Stability of the MRBQ scales

The stability of each scale derived from the PAF over time was tested via the calculation of Pearson's correlation coefficients between each scale score at the two measurement time-points (i.e. data collected during baseline and follow-up interviews) for the control group responses only (n=685). The treatment group responses were not included in this specific analysis because the relationship of the scales between the first and second time-points may have been affected by the treatment (participation in *VicRide*).

2.3.5. Content validity of the MRBQ scales

For content validity, differences on the MRBQ scale scores between those with and without an offence relevant to the MRBQ items (speeding, careless riding/driving, road rule, drink riding/driving, and helmet offences) were tested. Given the non-normal distributions of the scale scores, the Mann-Whitney U test was applied.

Helmet use is the only safety equipment mandated in Victoria and is not included in the MRBQ. Whilst helmet offences were the best approximation to test the content validity of the items on safety equipment use, it was further tested by calculating a Spearman's correlation coefficient between the MRBQ scale scores on the use of safety equipment and the coach assessment of protective gear use during the *VicRide* program (treatment group participants only; n=507).

2.3.6. Predictive validity of the MRBQ scales

This study sought to examine whether the MRBQ was able to predict important road safety outcomes including near crashes, crashes, and traffic offences, over and above the common risk factors for crashes and risk taking behaviors−age, gender, and exposure (Blockey and Hartley 1995, Özkan *et al.* 2006, de Winter and Dodou 2010). The predictive validity of the MRBQ was thus tested via regression analyses controlling for age, gender, and riding exposure. The self-reported near crashes and crashes and number of police-recorded offences all had a Poisson distribution with excess zero counts, and thus the standard generalized linear modeling (GLM) with Poisson log-link was not a good fit. The standard GLM does not take into account the spurious over-dispersion created by the high number of observed zeros for the outcome variable, which can lead to under- or over-estimation of the predictor coefficients (Lee *et al.* 2002). Zero-inflated Poisson (ZIP) regression models, in which the HR/WK exposure variable was used to account for the excess zeros, were conducted to examine whether the ZIP models were superior to the standard Poisson regression models. The Poisson regression coefficients as part of the ZIP models were employed to test the predictive validity of the MRBQ scales with respect to self-reported near crashes and crashes and number of police-recorded offences. For the binary police-recorded crashes (none had multiple crashes), a logistic regression was performed. The correlations of all the independent variables were assessed to ensure no multicollinearity (less than .70). All the analyses were conducted using IBM SPSS Statistics 19 except for ZIP which was conducted in R-2.11.1 for Windows.

3. Results

3.1. Exploratory factor analysis of the MRBQ

Given both the previously found models were rejected, a new model was re-specified using exploratory factor analysis. The PAF of the baseline 43-item MRBQ data (N=1305) revealed four factors. The loadings that make up the final four scales are presented in italics (shaded cells) in Table 2. Based on the underlying themes of the constituent items, these four scales were named errors, speed violations, stunts, and protective gear. Ten items had loadings below 0.3 for all the factors and were not included in any of the final scales (Table 2). The moderate correlations between all the factors as well as with and between age, gender, and exposure (Table 3) confirmed the use of PAF and the need to test the independent predictive validity of each MRBQ scale controlling for the other variables in the regression models.

3.2. Internal consistency of the MRBQ scales

The internal consistency (N=1305) of the four scales varied from 0.47 (protective gear) to 0.81 (speed violations) as presented in Table 2.

3.3. Stability of the MRBQ scales

The test-retest reliability scores (n=685) varied from 0.59 (stunts) to 0.71 (speed violations) as presented in Table 2.

3.4. Content validity of the MRBQ scales

Those with a helmet offence showed significantly higher scores on the protective gear and speed violations scales than those without (Table 4). Those with a drink riding/driving offence showed significantly lower scores on the protective gear scale than those without but no other scales showed significant relationships with any of the offences (Table 4).

Furthermore, the protective gear scale had significant correlation with the coach assessment of riders' protective gear use (n=507; mean=2.52 (SD=.56); r_s=.17; p<.001).

3.5. Predictive validity of the MRBQ scales

Multicollinearity was not present for any of the independent variables included in the regression models with all the Variance Inflation Factor (VIF) around one. The Vuong tests showed that all the ZIP models were superior to the standard Poisson models and the Chi-squared tests showed that the ZIP models were a good fit (Table 5). The Hosmer and Lemeshow Test showed that the logistic regression model was a good fit (χ^2 = 4.78; p-value = .78). The significant beta-coefficients of the independent variables predicting self-reported near crashes and crashes (N=1305) as well as police-recorded crashes and offences (n=651) are shown in Table 5. The errors and speed violations were significant predictors of self-reported near crashes and crashes. However, only the stunts scale significantly predicted police-recorded crashes. Only the protective gear scale significantly predicted the number of police-recorded offences.

4. Discussion

The present study examined the psychometric properties of the MRBQ amongst novice riders in Australia. The present findings were not consistent with the previously found factor structure, internal consistency and predictive validity of the MRBQ in terms of self-reported crashes amongst experienced riders in the UK and Turkey (Elliott *et al.* 2007, Özkan *et al.* 2012). This study additionally examined the stability, content validity, and predictive validity of the MRBQ with respect to police-recorded crashes and offences. These psychometric properties of the MRBQ are discussed in detail in light of the present and previous results.

4.1 Factor structure of the MRBQ

4.1.1 The new MRBQ scales amongst novice riders

The five factor structure of the MRBQ found amongst experienced riders in the UK and Turkey (Elliott *et al.* 2007, Özkan *et al.* 2012) was not applicable to the present sample of Australian novice riders. Rather, a four-factor structure was found to be the most appropriate. Based on the underlying themes, these four scales were named errors, speed violations, stunts, and protective gear.

The previously found distinction between traffic errors and control errors (Elliott *et al.* 2007, Özkan *et al.* 2012) was not evident in our data and the constituent items of those two scales were found to load on a single errors scale amongst novice riders. The common theme underlying the errors scale items was misjudgment. The original control errors scales refer to misjudgment that specifically occurs on corners. This distinction of misjudgment at corners and elsewhere may be more prominent amongst experienced riders than novice riders who are still learning hazard perception skills.

The errors and speed violations distinction is consistent with the original dichotomy of aberrant driver behavior posited by Reason et al's (1990) model. The items on stunts and safety equipment use were developed specifically for motorcyclists but they were not represented in the DBQ on which the MRBQ was based, lending validity to the independent stunts and protective gear scales revealed in the PAF of the MRBQ data.

The constituent items of the speed violations, stunts, and protective gear scales were generally consistent with the previous speed violations, stunts, and safety equipment scales

(Elliott *et al.* 2007, Özkan *et al.* 2012). However, some dissimilarity was also evident mainly due to the redundant items found in the present analyses.

4.1.2 Redundant items

In the UK study (Elliott *et al.* 2007, Özkan *et al.* 2012), of the original 43 items, five items were dropped while six items were used across two scales (duplicate items). In the Turkish study (Elliott *et al.* 2007, Özkan *et al.* 2012) two items were dropped with no duplicate items. In the present study no one item sufficiently loaded across two different scales (i.e. no duplicate items) and ten items were dropped due to weak loadings on all the factors. One of these items was on drink riding and was also dropped in both European studies (Elliott *et al.* 2007, Özkan *et al.* 2012). While the item is applicable as a rider safety behavior, it is the only item that relates to drink riding behavior and is distinct from the rest of the violation items that specifically relate to speeding or stunts. This exclusion may also be appropriate given that the drink driving item in the DBQ was found to be strongly affected by social desirability bias (Lajunen and Summala 2003).

Four other of the ten deleted items were also dropped in the UK study (Elliott *et al.* 2007). The item "another driver deliberately annoys you or puts you at risk" relates to respondents' emotional response to another driver when all the other items relate to their own behavior. While such an emotional reaction may precipitate behaviors, it may not do so reliably across riders. Although this item was included in the final speed violations scale in the Turkish study, it appeared to be an ambiguous item that showed cross-loadings between the control errors and speed violation components (Özkan *et al.* 2012).

The item on having trouble with your visor or goggles fogging up is the only item about having trouble with equipment while the other items relate to actually using the equipment or not. This item loaded on the control errors scale in the Turkish sample (Özkan *et al.* 2012) but the item content did not seem to logically fit with the rest of the control errors items.

Two items on wearing a leather one-piece motorcycle suit and bright/fluorescent clothing are unlikely to be consistent with the rest of the protective gear use because if riders use at least one of the other pieces of gear (e.g. jacket and/or trousers; bright/fluorescent patches) they are unlikely to wear a one-piece suit or bright/fluorescent clothing as well. These two items loaded on the stunts and safety equipment scales respectively in the Turkish sample (Özkan *et al.* 2012). However, the leather one-piece motorcycle suit did not seem to logically fit with the rest of the stunts items. Furthermore wearing a leather one-piece motorcycle suit might not have loaded strongly on the present protective gear scale because it might be particularly rare for novice riders. In fact 93% reported they ‘never’ wear it. In order to more accurately represent riders’ use of protective gear it may be more appropriate to ask whether they wear a leather one-piece motorcycle suit or jacket in one question, one-piece motorcycle suit or trousers in a separate question, and bright/fluorescent clothing or patches on their clothing in another separate question.

One other of the ten deleted items on the use of daytime running lights or headlights in daylight was also dropped in the Turkish study (Özkan *et al.* 2012) but included in the safety equipment scale in the UK study (Elliott *et al.* 2007). Although the item relates to safety, lights come on automatically on many motorcycles and their use is not necessarily due to riders’ choice as in the use of the rest of the safety equipment.

Four other items were deleted in the present study but were deleted in neither European studies (Elliott *et al.* 2007, Özkan *et al.* 2012). First, wearing gloves may be over-determined by factors other than the underlying factor of the use of other protective gear (e.g. safety concern). Riders may wear gloves to protect themselves from wind or insects rather than for safety whilst the wearing of other protective gear may arise from safety concerns. Second, although the item “wear no motorcycle specific protective clothing” was included in the safety equipment scale in the two European studies (Elliott *et al.* 2007, Özkan *et al.* 2012), it is a negatively worded item which might confuse some respondents (i.e. poorly designed item).

Third, the item “attempt to overtake someone who you haven’t noticed to be signaling a right turn” refers to a very specific overtaking situation which might be too rare for the item to bear any relevance for most riders. Whilst this item loaded on the traffic errors scale in both European studies (Elliott *et al.* 2007, Özkan *et al.* 2012), it might not have loaded strongly on the present errors scale because overtaking behaviors might be particularly rare for novice riders who may not be able to ride fast or be confident enough to overtake. In fact 86.7% reported they ‘never’ undertook this behavior and none reported undertaking it ‘nearly all the time’.

Fourth, riding between two lanes of fast moving traffic may also be too rare for the item to bear any relevance for most novice riders. In fact, 83.9% reported they ‘never’ undertook this behavior and only 0.5% reported undertaking it ‘nearly all the time’. The rarity may be caused by the fact that such ‘lane splitting’ is illegal in Victoria and can only apply to riding where multi-lane roads exist, and/or novice riders may lack the confidence to do so. This item loaded on the speed violation scale in both European studies (Elliott *et al.* 2007, Özkan *et al.* 2012) but lane splitting is legal in UK and Turkey and experienced riders may have more confidence to do so.

These deleted items must be further examined in future studies to understand the possible causes of these inconsistencies (e.g. novice versus experienced riders; different traffic culture; poor wording) and if the contents that were originally intended to be measured by those items add value to the MRBQ scales. The inclusion of some of the deleted items in relation to gear use might depend on the purpose of using the protective gear scale. If the main research question is to find the type and level of wearing of protective gear, including the items such as a leather one-piece suit and motorcycle gloves would be useful. However, if the research question was to understand an underlying safety/risk concern those items may be redundant.

4.2 Internal consistency of the MRBQ scales amongst novice riders

The errors and speed violations scales had excellent internal consistency of .80 and .81 respectively, but the stunts and protective gear scales did not show sufficient internal consistency with the alpha coefficients below .70. The errors and speed violations scales also had the largest number of items, while the stunts and protective gear scales had particularly small numbers of items, which may have contributed to these different alpha scores. Development of well-designed additional items to measure the constructs of stunts and protective gear use might improve the internal consistency of these scales.

However, the low alpha score of the present stunts scale may be a genuine reflection of the variability of stunts performance behaviors across novice riders in particular who have not yet established their riding skills. Several accounts are also possible for the low alpha score of the protective gear scale. Wearing of protective gear may be partly determined by non-rider external factors such as climate other than rider factors such as safety concern. For example, the cost of discomfort of wearing gear in hot dry summer in Australia may overweigh riders' concern for safety. The wearing rate of protective clothing for different body parts has been shown to vary (Reeder *et al.* 1996, de Rome *et al.* 2011a, de Rome *et al.* 2011b, McCartt *et al.* 2011); e.g. those who wear protective jackets may not consistently wear protective trousers; those who wear protective clothing may not consistently wear high-visibility clothing).

4.3 Stability of the MRBQ scales amongst novice riders

Only the speed violations scale showed sufficient stability of .71 while all the other three scales had a test-retest reliability score below .70. This may indicate that speeding behavior is relatively resistant to change over time (at least for three to four months). These findings parallel with the DBQ literature (e.g. Parker *et al.* 1995, Burgess and Webley 1999, Özkan *et al.* 2006, Harrison 2009) in which the violations factor (which mostly concerns speeding) is consistently found to be more stable (0.69-0.81) across two time-points within the same sample than the errors factor (0.50-0.69). Errors may also be particularly amenable to change over time amongst novice riders who are still rapidly learning hazard perception skills with increasing experience (Liu *et al.* 2009, Hosking *et al.* 2010) . The low test-retest reliability score of the stunts scale may also suggest that levels of stunts performance (violations) change over time as novice riders gain more riding experience and confidence (de Winter and Dodou 2010). Protective gear use may also change over time with changing seasons or weather over time.

4.4 Content validity of the MRBQ scales amongst novice riders

The content validity of the MRBQ scales was tested through statistical significance tests on the differences in the scale means between those with different types of police-recorded offences and those without them. Only the protective gear scale seemed to demonstrate some content validity. Those who had a helmet or drink riding/driving offence scored significantly higher on the protective gear scale. That is, those who self-reported to use protective gear more frequently were less likely to have a recorded helmet and drink riding/driving offences. This parallels with the finding that drink riders were half as likely to wear a helmet as non-drink riders (Ouellet 2011). Protective gear use including helmets may reflect riders' underlying concern for safety and/or compliance with road laws. Furthermore, self-reported protective gear use as measured by the protective gear scale of the MRBQ was consistent with the coach assessment of protective gear use.

Those who had a helmet offence also scored significantly lower on the speed violations scale. That is, those who self-reported to speed less frequently were more likely to have a recorded helmet offence. It may be speculated that riders who ride in low speed environment, and thus tend to travel at a lower speed, may feel safe without a helmet. Related to this, riders who travel greater distances (thus more likely in high speed environments) have been found to be associated with increased helmet use (Ouellet 2011). No other scales showed significant relationships with a recorded police-recorded offence.

4.5 Predictive validity of the MRBQ scales amongst novice riders

The predictive validity of the MRBQ scales over and above the common associated factors of age, gender, and exposure were tested in relation to police-recorded offences and crashes as well as self-reported crashes and near crashes. The errors and speed violations scales were found to be significant predictors of self-reported crashes and near crashes, but only the stunts scale was of police-recorded crashes, and the protective gear scale of the number of police-recorded offences. These findings are discussed in relation to the previously found predictive validity in the next sections.

4.5.1 Predictive validity with respect to crashes and near crashes

Whilst the stunts scale was the only significant predictor of police-recorded crashes, the errors and speed violations scales were significant predictors of self-reported crashes and near crashes in the present study. Several accounts are possible for these different findings. Different types of crashes are included in police-recorded and self-reported data. For example, self-reported crashes include less severe (including low-cost property damage only) crashes than police-recorded crashes (Boufous *et al.* 2010, McCartt *et al.* 2011) and respondents may misreport crashes due to social desirability or recall error. In the present sample 21% self-reported a crash but, of these, 38% did not involve an injury, which are unlikely to be included in the police-recorded crash data. Novice riders who perform stunts may be higher risk takers and have had more severe crashes therefore reportable to police. Errors might more often than stunts result in near crashes and minor crashes but not severe crashes. Speeding would increase the risk of a severe crash (thus reflected in police data) but it would also depend on the extent of the speeding. For example the Power model (Nilsson 2004) shows that a percentage change in mean speed (e.g. 5% or 10%) lead to approximately double its percentage change in injury crashes (e.g. 10% or 20% respectively). In a 60km/h speed limit zone, the risk of an injury crash doubles with each 5km/h increase in travelling speed above 60km/h (Kloeden *et al.* 1997). The lack of predictive validity of the speed violations scale in terms of police-recorded crashes may be because the speeding questions do not distinguish between high level and low level speeding.

Another possible explanation is that those who are likely to self-report (admit to) errors and speeding may be more prepared to self-report their near crash and crash involvements as well. The traffic errors, control errors, and speed violation scales were also found to be significant predictors of self-reported crashes in the UK study (Elliott *et al.* 2007). The significant relationships between errors scales and speed violations scale with self-reported near crash and crash found in the present and UK studies may therefore be an artificial relationship created by the fact that they were both self-report known as consistency motif bias (de Winter and Dodou 2010, af Wahlberg *et al.* 2011).

However, in the Turkish sample that was 100% males, only the stunts scale was found to predict self-reported crashes (Özkan *et al.* 2012). This may be a unique feature of experienced male riders. The inconsistent findings amongst the three samples in Australia, UK, and Turkey suggest that further examination of the predictive validity of the MRBQ scales is required.

Whilst the use of protective gear may reflect an underlying safety concern that is relevant for consequential behaviors, it is not likely to be a determinant of a crash or a near crash, but more a measure of reducing the harm in the event of a crash. Hence, its lack of predictive validity in terms of crashes and near crashes is not surprising.

4.5.2 Predictive validity in terms of traffic offences

Higher scores on the protective gear scale (i.e. more use) were significantly related to less number of police-recorded offences in the present study. This is inconsistent with the Turkish study in which higher scores on the speed violations and the stunts scales were significantly related to more self-reported offences (Özkan *et al.* 2012). The difference may be due to the different constituent items of the scales between the present and the Turkish studies and/or attributed to the differences between self-report versus police-records. Moreover, given the present significant gender differences in the number of police-recorded offences, the Turkish data with 100% males may have identified unique behaviors that predicted offences amongst male riders (Özkan *et al.* 2012).

The negative relationship between the protective gear scale and the police-recorded offences means that respondents with more frequent use of protective gear have fewer police-recorded offences. This again may suggest that the level of protective gear use as novice riders reflects their broader concern for safety and hence are more likely to comply with road laws including wearing a helmet.

4.6 Overall reliability and validity of the MRBQ and implications for policy and practice

The present findings and some inconsistent findings amongst the three MRBQ studies in Australia, UK, and Turkey suggest that the current MRBQ has limited reliability and validity as it stands, at least in use with novice versus experienced riders or in cross-cultural research. It would be beneficial to develop and refine the MRBQ items to improve the overall reliability and validity before wider use of the MRBQ.

The speed violations scale showed the most consistent results amongst the three studies and demonstrated good reliability. This may suggest that speeding is more a global issue than other behaviors such as errors and protective gear use, which may have different cultural and legal implications between different countries (e.g. lane splitting). Items that reflect cross-country cultural and policy variations may be required in particular for errors and protective gear scales.

While the protective gear scale showed insufficient reliability overall in our analysis it demonstrated content and predictive validity in terms of police-recorded offences. This suggests that the protective gear use is a powerful construct but is poorly measured by the current items. The present protective gear scale consists of only five items. Refinement of the present items and development of additional items in future studies may improve the reliability. The validity demonstrated by the protective gear scale with respect to police-recorded offences also has important policy implications. The lack of protective gear use may reflect anti-safety behaviors and compliance with road laws such that introducing penalties for not using protective gear may reduce risky riding levels. It may also be of value to educate riders in the importance of protective gear. However, it is not clear that such education will cause riders to change other traffic offending behaviors. Enforcement of protective gear use is more likely to address both protective gear use and other offending behaviors that are shown to be significantly related in the present study.

The limited validity of the MRBQ demonstrated in the present study may be explained by several accounts other than the possible poor design of the MRBQ items. First, police-recorded offences may be over-determined by situational factors. A traffic offence will not be recorded unless enforcement exists at the time of offending and the chance of riders being caught for speeding and other dangerous riding behaviors tends to be very low. Riders who speed are not equally likely to be caught by police as enforcement can vary by riding locations (e.g. Mitchell-Taverner *et al.* 2003) such that the actual frequency of speeding self-reported by the respondents does not necessarily correspond with the police-recorded offences. Those who perform deliberate risk taking such as stunts would most likely to choose the locations where there was no visible police. Second, police-recorded offences could not be identified as exclusively riding-related for dual car and motorcycle licence holders in the present study. However, whether the offence was committed whilst riding or driving, the offence record against the same individual reflects that individual's level of risk-taking and/or compliance with the road laws.

Third, the validity was tested against past crashes and offences before they completed the MRBQ questionnaire. The experience of crashes and/or being caught for a traffic offence in the past may have influenced their behavior such that the current behavior reported by the riders through the MRBQ could not explain fully retrospective crashes and offences. The predictive validity has only been examined with respect to retrospective crashes in the previous European studies as well (Elliott *et al.* 2007, Özkan *et al.* 2012). Whilst results based on prospective crashes can be confounded by an unknown level of influence of having done MRBQ on future crash risks and offences, future studies to examine the predictive validity of the MRBQ in terms of prospective crashes would also be beneficial.

Despite the limited reliability and validity of the current MRBQ, the measurement of errors, speeding, and stunts is potentially useful because in practice such behaviors can be speculated to lead to a crash if they are exhibited often enough. The present study also suggests that protective gear use is a critical construct to measure an underlying concern for safety and/or compliance with road laws. Thus achieving changes in those behaviors through interventions and employing instruments such as the MRBQ to measure those behavioral changes in evaluation research can be beneficial even if the measured behaviors might not always lead to crashes or offences.

4.7 Methodological considerations in the interpretation of the present findings

All the present analyses were conducted on the data collected before randomization for both treatment and control group except for the tests of stability (where both baseline and follow-up data were used for only the control group) and of validity against coach assessment of protective gear use during treatment (where only treatment group data were used). Therefore all the analyses were conducted on maximum data available without introducing the potential impact of the treatment effect.

While the present sample was in keeping with Victoria wide age and gender demographics, it was voluntary. Whilst multiple call backs and appointments were made with the interviewees, data were not collected for those who did not answer their phones to participate in the study. They may be systematically different, which is possible in all research of similar types and the extent of which could not be known. Consent was obtained from eligible candidates to use their licence numbers to link with their police-recorded offence and crash data. Some riders might not have given consent to participate in the study due to this requirement. Hence the generalizability of the present results may be limited and must be interpreted with caution. However, without access to police-recorded offence and crash data, results would have had to rely on self-report only, and police-recorded data would add more value to the study. For example, whilst the evidence for the effect of social desirability on the DBQ is minimal (Sullman and Taylor 2010), the self-reported MRBQ-crash relationship may be spurious due to social desirability bias, which was not controlled for in the study. Examination of the relationships of MRBQ with crashes and offences via police-report also negated the possible effect of consistency motif (de Winter and Dodou 2010, af Wahlberg *et al.* 2011). Moreover, the combination of phone and web recruitment maximized the reach of participants so as not to exclude those who could not access the web or who could not be reached by phone (e.g. because the phone numbers were not current by the time of interview).

The different findings between the present and the previous European studies may partly be due to different methods between the studies including the interview method and analyses. Whilst the MRBQ and DBQ are usually administered using paper and pencil or online, the MRBQ was administered via a telephone interview in the present study. However, it is unlikely that the telephone interview method would have created systematically different results because the MRBQ utilizes an easy to understand response scale from "never", "hardly ever", "occasionally", "quite often", "frequently", to "nearly all the time" and the questions and answers were given in these words not numbers.

The present study performed PAF with oblique rotation, not PCA with varimax rotation used by the previous European studies (Elliott *et al.* 2007, Özkan *et al.* 2012), and this may have led to different constituent items of each scale. The results of PCA and PAF might differ especially when communalities are low because PCA assumes that items are measured without error and PAF does not. The use of PCA to test the theoretical constructs of the DBQ has been criticized on the basis that PCA does not uncover latent constructs (Mattsson 2012). MRBQ is based on the same theory as the DBQ and it is expected that the latent constructs of the MRBQ would to some extent mirror the theoretical constructs postulated by Reason (1990) who developed the DBQ. Future replication studies utilizing ESEM (Mattsson 2012) and reanalysis of the European data with PAF would be beneficial to confirm the present results.

It is possible that the present four factor structure may vary between groups selected on variables such as age and gender (Mattsson 2012). Similarly, comparing factor means in different groups of respondents such as the present analyses presented in Table 4 (e.g. drink riders versus non-drink riders) may be inappropriate without testing the assumption that the same factor structure is obtained in different groups. One method to ensure the factorial invariance of the MRBQ is to fit structural equation models to the data in a series of stages (e.g. Gregorich 2006, Dimitrov 2010, Mattsson 2012). The present study aimed to test the applicability of the MRBQ for novice riders, a population to whom the MRBQ has not been previously applied. The different factor structures found between the three studies on the MRBQ suggest that future research on factorial invariance of the MRBQ would lead to further understanding of Reason's (1990) theory of on-road aberrant behaviors and its application with different groups, which might require different versions of the MRBQ instrument.

While rider-driver distinction may not be large especially for those who both ride and drive, the influence of dual riding and driving could not be examined specifically in the present sample in which the majority (n=1258; 96.4%) held or previously held a car licence with a mean of 17.4 (SD=11.5) years of driving experience as a provisional or fully licensed driver. Car licence years was also highly correlated with age (r=.94) thus the former was not simultaneously included in the present investigation given age was accounted for.

5. Conclusions

The present study examined the psychometric properties of the MRBQ amongst novice riders in Australia. A four-factor model of errors, speed violations, stunts, and protective gear was found to be most appropriate in the present sample. The present findings were not consistent with the previously found five-factor structure, internal consistency and predictive validity of the MRBQ in terms of self-reported crashes amongst experienced riders in the UK and Turkey (Elliott *et al.* 2007, Özkan *et al.* 2012). This study additionally examined the stability, content validity, and predictive validity of the MRBQ with respect to police-recorded crashes and offences. The present findings and the inconsistencies amongst the three MRBQ studies suggest that the current MRBQ as it stands has limited reliability and validity. It would be beneficial to develop and refine MRBQ items to improve the overall reliability and validity before wider use of the MRBQ instrument, especially amongst novice riders. An improved behavioral measure of errors, speeding, and stunts amongst motorcyclists would be useful because in practice those behaviors can lead to a crash if they are exhibited often enough. The present study also suggests that protective gear use is a critical construct to measure an underlying concern for safety and/or compliance with the road laws. Thus the MRBQ is potentially useful in evaluation research even though the measured behaviors might not always result in crashes or offences. Further replication of the present study amongst novice riders, including in other Australian states, Europe and elsewhere would facilitate understanding the causes of the limited psychometric properties of the MRBQ in terms of the differences between novice and experienced riders, as well as cultural and licensing policy variations. This will inform further refinement of the items, which in turn will make the MRBQ more useful in future research to understand and evaluate riders' behaviors.

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Table 1. Sample characteristics

Variable name	Description of variable	N	Mean (SD)
Age	Age at time of baseline interview derived from date of birth	1302	36.0 (11.3)
Motorcycle licence months	Total months held motorcycle licence (including months holding learner's permit)	1299	12.7 (5.8)
Car licence years	Total years of driving experience as a provisional or fully licensed driver	1305	17.4 (11.5)
Exposure: HR/WK	Hours of riding in an average week	1305	4.1 (3.9)
Self-reported near crash	Number of near crash experiences in the past three months	1302	1.7 (2.9)
Self-reported crash	Number of crash experiences in the past 12 months	1305	0.27 (0.61)
Police-recorded offence	Number of police-recorded offences prior to study participation	651	.15 (.85)
Variable name	**Description of variable**	**N**	**Frequency (%)**
Gender	1 = female	1305	272 (20.8)
	2 = male		1033 (79.2)
Car licence	Participant previously held a car licence where	1305	
	1 = no		47 (3.6)
	2 = yes		1258 (96.4)
Police-recorded crash	A police-recorded crash prior to study participation where	651	
	1 = no		627 (96.3)
	2 = yes		24 (3.7)

Note: **SD**=standard deviation

Table 2. Principal axis factoring of the 43 MRBQ items (N=1305)

Item	Factor			
	Errors	**Speed violations**	**Stunts**	**Protective gear**
1. Pull onto a main road in front of a vehicle you haven't noticed or whose speed you misjudged.	*.57*	.08	-.03	.03
2. Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping	*.55*	.03	-.05	-.02
3. Distracted or pre-occupied, you suddenly realise that the vehicle in front has slowed, and you have to brake hard to avoid a collision.	*.52*	-.02	.004	-.04
4. Not notice someone stepping out from behind a parked vehicle until it is nearly too late.	*.52*	.07	-.06	-.001
5. Ride so fast into a corner that you feel like you might lose control.	*.49*	-.11	-.01	-12
6. When riding at the same speed as other traffic, you find it difficult to stop in time when a traffic light has turned against you.	*.48*	.05	.04	-.03
7. Run wide when going around a corner.	*.47*	-.02	-.13	-.01
8. Ride so fast into a corner that you scare yourself.	*.46*	-.18	.01	.14
9. Not notice a pedestrian waiting at a crossing where the lights have just turned red.	*.43*	-.02	-.13	-.01
10. Fail to notice that pedestrians are crossing when turning into a side street from a main road.	*.41*	.05	-.08	-.02
11. Queuing to turn left on a main road, you pay such close attention to the main traffic that you nearly hit the vehicle in front.	*.39*	-.01	-.01	-.04
12. Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble).	*.38*	.02	-.01	-.01

13. Needed to brake or back-off when going round a bend.	*.37*	-.15	.13	-.02
14. Skid on a wet road or manhole cover, road marking etc	*.35*	-.15	-.04	.03
15. Needed to change gears when going around a corner.	*.35*	-.04	.12	-.04
16. Miss ‘Give Way’ or ‘Stop’ signs and almost crash with another vehicle.	*.31*	.08	-.19	-.09
17. Ride so close to the vehicle in front that it would be difficult to stop in an emergency.	*.30*	-.23	-.02	-.05
18. Exceed the speed limit on a motorway.	-.04	*-.75*	.07	.05
19. Exceed the speed limit on a country/ rural road.	.002	*-.72*	.02	.09
20. Exceed the speed limit on a residential road.	.04	*-.71*	.06	-.03
21. Disregard the speed limit late at night or in the early hours of the morning.	.05	*-.65*	.03	-.09
22. Open up the throttle and just go for it on a country road.	.04	*-.54*	-.13	.08
23. Get involved in racing other riders or drivers.	.04	*-.41*	-.28	.01
24. Race away from the traffic lights with the intention of beating the driver/rider next to you.	.11	*-.41*	-.11	-.07
25. Attempt or done a wheelie	-.10	-.15	*-.72*	-.07
26. Intentionally do a wheel spin.	-.05	-.13	*-.59*	-.08
27. Pull away too quickly and your front wheel lifted off the road.	-.03	-.13	*-.53*	-.04
28. Unintentionally had your wheels spin.	.14	-.13	*-.31*	-.01
29. Motorcycle protective trousers (leather or non-leather).	-.01	-.01	-.04	*.57*
30. Motorcycle boots.	-.05	-.05	-.15	*.48*
31. A motorcycle protective jacket (leather or non-leather).	.10	-.004	.21	*.44*
32. Body armour / impact protectors (eg for elbow, shoulder or knees).	-.06	-.08	-.02	*.39*
33. Bright/fluorescent stripes/ patches on your clothing.	.01	.04	-.02	*.32*
34. Ride when you suspect that you might	.001	-.16	.-08	-.11

be over the legal limit for alcohol.				
35. Another driver deliberately annoys you or puts you at risk.	.18	-.21	-.12	.06
36. Do you have trouble with your visor or goggles fogging up.	.20	-.14	.03	.01
37. A leather once-piece motorcycle suit.	.01	.02	-.05	.02
38. Bright/fluorescent clothing	.02	.08	-.03	.17
39. Do you use daytime running lights or headlights on in daylight.	-.03	-.01	.09	.14
40. Motorcycle gloves.	-.02	-.02	.001	.28
41. Do you wear no motorcycle specific protective clothing.	.000	.003	.15	.20
42. Attempt to overtake someone who you haven't noticed to be signalling a right turn.	.295	-.06	-.29	-.07
43. Ride between two lanes of fast moving traffic.	*.11*	-.27	-.08	-.10
% of variance explained	13.1	4.5	3.5	2.5
Mean (SD) [1]	1.6 (.37)	1.9 (.74)	1.2 (.36)	4.9 (.99)
Number of items	17	7	4	5
Internal consistency	.80	.81	.65	.47
Stability	.65	.71	.59	.63

[1]Mean and standard deviation based on the included items of the final scales

Table 3. Intercorrelations between all the factors of the MRBQ scales as well as age, gender, and exposure

	Age	**Gender**	**Exposure**	**Errors**	**Speeding**	**Stunts**
Gender	-.09**					
Exposure	-.12**	.11**				
Errors	-.22**	.02	.07*			
Speeding	-.33**	.15**	.14**	.40**		
Stunts	-.20**	.10**	.06*	.23**	.34**	
Protective gear	.12**	-.09**	.04	-.09**	-.05	-.08**

** $p < 0.01$; * $p < 0.05$

Gender was coded 1=female; 2=male

Table 4. Mean scale scores by police-recorded offence and p-values based on the Mann-Whitney U test (N=651)

Police-recorded offence		**MRBQ Factor**			
		Errors	**Speed violations**	**Stunts**	**Protective gear**
Drink riding/driving	Y	1.9 (.47)	2.1 (.91)	1.2 (.24)	4.1 (1.3)
	N	1.6 (.37)	1.9 (.73)	1.2 (.34)	5.0 (.96)
	p	.063	.605	.627	.020*
Not wearing a helmet	Y	1.4 (.50)	1.0 (.00)	1.4 (.18)	3.5 (.71)
	N	1.6 (.37)	1.9 (.73)	1.2 (.34)	5.0 (.97)
	p	.536	.036*	.071	.044*
Speeding	Y	1.6 (.42)	2.1 (.68)	1.2 (.21)	5.2 (1.1)
	N	1.6 (.37)	1.9 (.74)	1.2 (.34)	5.0 (.97)
	p	.774	.276	.592	.442
Careless riding/driving	Y	1.6 (.38)	1.9 (.96)	1.3 (.27)	4.5 (1.0)
	N	1.6 (.37)	1.9 (.73)	1.2 (.34)	5.0 (.97)
	p	.911	.894	.117	.159
Road rule offence	Y	1.6 (.31)	1.4 (.47)	1.0 (.09)	4.3 (1.2)
	N	1.6 (.37)	1.9 (.74)	1.2 (.34)	5.0 (.97)
	p	.871	.067	.215	.078

First row refers to mean (SD) with the offence (Y), second row mean (SD) without the offence (N), and third row p-value based on ranks (p).

* $p < 0.05$

Table 5. Poisson regression coefficients (standard error) based on Zero-inflated Poisson (ZIP) log-link regression and odds ratios of logistic regression

Independent variables	**Self-reported near crashes β (S.E.)**	**Self-reported crashes β (S.E.)**	**Police-recorded offences β (S.E.)**	**Police-recorded crashes Odds ratios**
Age	-.06** (.002)	-.31** (.01)	.18 (.01)	.99
Gender	.14* (.06)	-.03 (.14)	2.1 *** (.59)	1.4
Exposure: HR/WK[a]	-.28*** (.04)	-1.2** (.07)	.01 (.06)	1.1
Errors	. 09*** (.06)	. 28** (.15)	-.02 (.31)	.84
Speed violations	.03*** (.03)	.34*** (.08)	.13 (.17)	.92
Stunts	.01 (.05)	.004 (.14)	-.15 (.33)	2.9^{+}
Protective gear	.01 (.02)	.15 (.06)	-.50*** (.09)	1.5
Chi-squared Test	-2540*** (df=9)	-819.6*** (df=9)	-215.8* (df=9)	NA
Vuong Test	-5.74***	-2.47**	-3.0*	NA

*** $p < 0.0001$; ** $p < 0.001$; * $p < 0.01$; $^{+}$ $p < 0.05$

[a] Coefficients presented in first three columns correspond to logit coefficients predicting excess zeros in the inflation model.

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Chapter 5: Self-report riding motivations—MRMQ (***Study 3***)

5.1 Preamble

This chapter presents the study on self-report riding motivations amongst novice riders, which is under review in *Transportation Research Part F: Traffic Psychology and Behavior*. The journal confirmation for the submission is shown in Appendix 7 (p.377). Publications details and signed statements of authorship are provided in Appendix 8 under ***Paper 4***.

5.2 Aims and objectives of *Study 3*

The aim of ***Study 3*** was to examine the applicability of a self-report measure of riding motivations amongst novice riders; specifically the *Motorcycle Rider Motivation Questionnaire* that was developed amongst experienced riders. The objectives were:

1. To examine the previously examined psychometric properties of the *Motorcycle Rider Motivation Questionnaire* (MRMQ) including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the MRBQ (Sexton et al 2004);
2. To examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences and self-reported crashes and near crashes;
3. To assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ has not been applied to date.

5.3 Manuscript

Overpage.

Abstract

The Motorcycle Rider Motivation Questionnaire (MRMQ) is the first structured questionnaire to be developed to systematically assess the reasons for riding. The aims of the present study were to 1) examine the previously examined psychometric properties of the MRMQ including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the Motorcycle Rider Behaviour Questionnaire (MRBQ), 2) examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes, and 3) assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ, developed using a sample of UK riders, has not been applied to date. The present findings showed some similarities but also differences with respect to the previously found item constituents of each scale, internal consistency and predictive validity of the MRMQ in terms of MRBQ behaviours. Confirmatory factor analysis showed that the previously found structure was not a good fit (χ^2 = 1661.10; df=246; p<.001; RMSEA =.066), and a new structure was explored. Principal component analysis identified a 20-item MRMQ with three scales, namely pleasure, speed, and convenience to be most appropriate in the present sample. The pleasure and speed scales showed acceptable internal consistency and stability (α=.75; r=.75-.76), but the convenience scale had alpha and stability scores just below the acceptable cut-off of 0.7. Although the size of the correlations was not large, all the three scales demonstrated results that would be expected with good content validity. All the three scales showed predictive validity in one way or another but differently in relation to the MRBQ behaviours, self-reported near crashes and crashes, and police-recorded offences. The present findings and the inconsistencies between the two MRMQ studies suggest that the current MRMQ as it stands is limited and further development and refinement of the MRMQ items are required before its wider use, especially with respect to the convenience construct and amongst novice riders. However, the predictive validity of the MRMQ in terms of the MRBQ paralleled observations in other studies, and the practical implications of the present findings overall are discussed.

Keywords

Motorcycle Rider Motivational Questionnaire; validity; reliability; motorcycle crash; traffic offence

1. Introduction

Research suggests that motorcycle riders are a heterogeneous group who can be characterised by different motivations for riding (Reeder *et al.* 1996), and that these underlying motivations for motorcycle use provide some explanation of why riders engage in different on-road risk behaviours and their propensity to crash (Sexton *et al.* 2004, Christmas *et al.* 2009, Zamani-Alavijeh *et al.* 2009). Measurement of riding motivations may therefore be useful to better understand riding behaviours and crash propensity, which in turn may lead to more effective programs to prevent or minimise risk of crash and injury. For example, the needs of those who are motivated to ride for low-cost mobility may be met more effectively through the provision of alternative mobility options that involve lower risks of injury and death in the event of a crash.

Motivational themes for riding have been identified in previous observational commentaries and qualitative research with non-systematic categorizations (Schulz *et al.* 1991, Reeder *et al.* 1996, Bellaby and Lawrenson 2001, Wilson *et al.* 2009, Zamani-Alavijeh *et al.* 2009, Haworth 2012). The Motorcycle Rider Motivation Questionnaire (MRMQ; Sexton *et al.* 2004) was the first structured questionnaire developed to systematically assess the reasons for riding identified by Schulz et al (1991). Principal component analysis of the measure indicated a tripartite typology amongst UK riders (Sexton *et al.* 2004). Sexton et al (2004) found that the three scales of MRMQ, namely convenience, pleasure, and speed, had acceptable internal reliability and predictive validity of on-road rider behaviours as measured by the Motorcycle Ride Behaviour Questionnaire (MRBQ; Elliott *et al.* 2007b). Specifically, those who had stronger pleasure motivations for riding self-reported more frequent use of safety equipment, while those with stronger speed motivations self-reported more frequent control errors, speed violations and stunts as measured by the MRBQ (Sexton *et al.* 2004). The convenience scale of the MRMQ was found to be correlated with none of the MRBQ behaviours (Sexton *et al.* 2004).

However, three key psychometric features of a sound questionnaire remain untested. First, having good predictive validity, that is, the ability to predict self-reported and police-recorded crashes and offences, would increase its utility in road safety research. Sexton et al's (2004) study did not examine the predictive validity of the MRMQ with respect to self-reported crashes directly, or police-recorded crashes and offences. The model Sexton et al (2004) investigated via path analysis assumed that motivations (as measured by the MRMQ) precede behavioural choices (as measured by the MRBQ), which in turn influence crash risks. However, there may be other behavioural choices that are not measured by the MRBQ, through which motivation influences crashes. This hypothesis can be tested by examining the direct relationship between riding motivations and crashes. Furthermore, aside from the possible consistency motif bias (people's tendency to want to respond consistently across related measures; Podsakoff *et al.* 2003, af Wåhlberg 2011), MRMQ and crash/offence relationships may vary depending on whether the data were obtained via self-report (which includes minor crashes) or police records (typically limited to serious crashes) due to the different nature of crashes represented (Boufous *et al.* 2010, McCartt *et al.* 2011).

Second, Sexton et al's (2004) study did not examine the content validity or the stability of the MRMQ scales. For the results based on MRMQ to be meaningful it must contain items that measure what is intended to be measured – reasons for riding identified by Schulz et al (1991) such as pleasure, speed, and control (i.e. content validity). If the motivations for riding are expected to be stable over time, the stability of the MRMQ is critical to ensure its ability to measure motivations consistently over time. The stability of the tool can also reflect the modifiability of motivations over time, which has implications for the development and evaluation of rider interventions.

Furthermore, no published study has examined the applicability of the MRMQ to novice riders in Australia or examined the riding motivations amongst novice riders specifically. Understanding novice riders' motivations for riding in particular can be beneficial to address their overrepresentation in crashes (ACEM 2009, VicRoads 2010) Self-report measures of riding motivations for novice riders are generally lacking as research tools, and it is therefore worthwhile to examine the applicability of the already developed MRMQ amongst novice riders before considering the development of alternative measures. The motorcyclists in Sexton et al's (2004) study were from the UK and overall more experienced riders with an average of 15 years of riding experience. Riding motivations may systematically differ between novice riders who are in the formative years of riding and more experienced riders who have chosen to continue riding.

The present study therefore aimed to 1) examine the previously examined psychometric properties of the MRMQ including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the MRBQ, 2) examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences and self-reported crashes, and 3) assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ has not been applied to date.

2. Method

2.1 Participants and Procedure

Participants were drawn from a large scale randomized control trial to evaluate a motorcycle rider training program (*VicRide*) for newly licensed riders in the state of Victoria, Australia. VicRoads, the state authority for roads in Victoria, sent letters of invitation to participate in the trial to motorcycle riders who had recently advanced from a learner's permit to a probationary/restricted motorcycle licence. The study candidates could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The core eligibility criteria were that 1) they owned a motorcycle (not a scooter); 2) their motorcycle had an engine capacity of 125cc or greater and was compliant with the VicRoads' Learner Approved Motorcycle Scheme (which includes motorcycles with an engine capacity up to and including 660cc but do not exceed a power-to-weight ratio of 150 kilowatts per tonne); 3) they had ridden at least 500km over at least 12 separate trips on public roads since obtaining their learner's permit; 4) they had been on a Victorian probationary/restricted motorcycle licence (first licence with restrictions and conditions after being on a Learner's permit for at least three months at the age of 18 or older) for one year or less. If the candidates met all the eligibility criteria they were asked to provide informed consent to participate in the study and for their police-recorded offence and crash records to be accessed as part of the study participation.

Respondents completed two 30-minute interviews: a baseline and a follow-up interview, which were on average 142.9 days (SD=33.6) apart. The baseline interviews were conducted between June 2010 and August 2011 (time 1) and a follow-up interview between September 2010 and December 2011 (time 2). At the end of the baseline interview the riders were randomized into the treatment group or the control group. Those assigned to the treatment group completed the follow-up interview after their participation in *VicRide*, and those assigned to the control group did not complete *VicRide* before completing the follow-up interview. The follow-up interviews were conducted at comparable times for the two groups. Although the present data were drawn from participants recruited into a randomised control trial, the present study was only concerned with testing the validity and reliability of the MRMQ. Thus all the present analyses were performed on the baseline data collected before randomisation except for the tests of stability, for which both the baseline and follow-up data for the control group (that this, those who had not participated in any intervention) only were employed. Hence systematically different answers by study group or contamination of the present results by possible treatment effects were not possible. All the interviews were conducted through a computer assisted telephone interview by professionally trained and experienced interviewers. They were also specifically trained in the survey developed for this study. The research was approved by the University of Sydney Human Research Ethics Committee and Monash University Human Research Ethics Committee.

2.2 Measures

2.2.1. The Motorcycle Rider Motivation Questionnaire (MRMQ)

The MRMQ consists of 24 items divided into three sub-scales: speed, pleasure, convenience (Sexton *et al.* 2004). The respondents are asked to rate on a 5-point Likert scale from strongly disagree to strongly agree with statements about the reasons and importance of motorcycling. For all the scales higher scores indicate they strongly agree with the statement. The baseline MRMQ data were used for all the analyses except for the tests of stability where both the baseline and follow-up data on the MRMQ were used for the control group only.

2.2.2. Types of riding

The baseline data on the number of different riding trips and belonging to a motorcycle group were used to test the content validity of the MRMQ scales because they were thematically related to what MRMQ was intended to measure (e.g. speed, pleasure, control over the vehicle, other road users, and riding situations). Riders were asked to report on the number of on-road riding trips in the past month for various purposes including commuting; as part of a job; recreational; general transport and in different conditions including in dark; rain; heavy traffic; on local suburban roads; winding rural roads; roads of 100km/hour or more speed zones; in the company of at least one rider. A trip to one destination and a trip from that destination were counted as two separate trips. The riders were also asked if they belonged to a motorcycle club or an organized ride group.

2.2.3. The Motorcycle Rider Behaviour Questionnaire (MRBQ)

The baseline MRBQ data were used to test the predictive validity of the MRMQ scales. The original MRBQ consists of 43 items with five scales of traffic errors, control errors, speed violations, stunts, and safety equipment (Elliott *et al.* 2007b). However, a 33-item with four scales, errors (17 items), speed violations (7 items), stunts (4 items), and protective gear (5 items), was found to be most appropriate for the present sample of novice riders (Sakashita *et al.* Under review). Broadly, this model combined items from the previous traffic errors and control errors scales into a single errors scale, and also included some selective protective gear items originally in the safety equipment scale in the protective gear scale

(Sakashita *et al.* Under review). The items for each scale are shown in the Appendix. Respondents were asked to rate on a 6-point Likert scale from 'never' to 'nearly all the time' how often they display the behaviour described while riding. Scale scores were calculated from the sum of item responses divided by the number of items in the scale, hence all the scale scores ranged from one to six. For all the scales, higher scores indicate more frequent display of the behaviour described.

2.2.4. Self-reported near crash and crash experiences

The baseline self-reported crash and near crash data were also used to test the predictive validity of the MRMQ scales. Riders were asked to report the number of near crashes or close calls while riding on a public road in the last 3 months. These were defined as incidents when they almost had a crash but did not. They were also asked to report the number of motorcycle crashes including minor spills or offs while riding on a public road in the last 12 months. Motorcycle crashes were defined as collisions with someone or something, or coming off the bike but excluding dropping or knocking it over while parked.

2.2.5. Police-recorded crashes and offences

The predictive validity of the MRMQ scales was further tested with respect to lifetime police-recorded crashes and offences against their licence before the baseline interview. The police-recorded crash and offence data were requested from VicRoads for the 651 respondents who had completed the entire study by January 2012. The recorded offences included the following 15 broad categories: careless riding/driving; disobey licence restriction; disobey licence sanction; disobey road rule; drink riding/driving; no helmet; not comply with police; not report/stop for a crash; parking; phone use; speeding; uninsured vehicle; unlawful number plate; unlawful vehicle use; unregistered/unroadworthy vehicle.

In Victoria, recorded crashes are defined as any apparently unpremeditated event reported to the police or other relevant authority and resulting in death, injury or property damage attributable to the movement of a road vehicle on a public road. Fatal (death within 30 days of the crash) and serious (hospital admission) or other (sustained injury but not admitted to hospital) injury crashes are included based on the highest injury level recorded. Non-injury or property damage only crashes are not in the official crash data. For all the crashes recorded before the participant's baseline interview date, if the registration information included a motorcycle, the crash was identified as a motorcycle crash.

2.3 Analyses

2.3.1 Confirmatory factor analysis

Before exploring the factor structure of the MRMQ amongst novice riders, the fit of the Sexton et al (2004) factor structure was tested via confirmatory factor analysis (CFA) in Amos Version 21. The results were significant (χ^2 = 1661.10; df=246; p<.001) and the root mean-square errors of approximation (RMSEA =.066) was below the conventional cut-off of .05 (Hu and Bentler 1998). That is, the data were not a close fit. A new structure was therefore explored in this sample. All the subsequent analyses were conducted using IBM SPSS Statistics 19.

2.3.2 Exploring the MRMQ scales

Principal component analysis (PCA) was performed on the baseline MRMQ data. The 24 items of the MRMQ were analyzed via the PCA with oblique rotation to ensure that the sample size was adequate, that the items were appropriate for data reduction analyses, and to determine the appropriate rotation and number of components. The non-correlated extracted components and the screeplot indicated orthogonal varimax rotation and three components were most appropriate. This was further confirmed by the MAP test (O'Connor 2000). Hence PCA with varimax rotation as used by Sexton et al (2004) was applied on the 24 items of the MRMQ retaining three components. Only those items with loadings 0.3 or above were assessed to be part of the scale, as consistent with Sexton et al (2004). The items that constituted the final scale were determined in conjunction with the Cronbach's alpha scores and item-total correlations.

2.3.3 Internal consistency of the MRMQ scales

The internal consistency of each scale derived from the PCA was examined on the data collected during the baseline interview before randomization through the calculation of Cronbach's coefficient alpha. The item-total correlations were also used to identify items that were contributing to lower reliability (Field 2005).

2.3.4 Stability of the MRMQ scales

The stability of each scale derived from the PCA over time was tested via the calculation of Pearson's correlation coefficients between each scale score at the two measurement time-points (i.e. data collected during baseline and follow-up interviews) for the control group responses only (n=685). The treatment group responses were not included in this specific analysis because the relationship of the scales between the first and second time-points may have been affected by the treatment (participation in *VicRide*).

2.3.5 Content validity of the MRMQ scales

The content validity of the MRMQ scales was tested based on logical premises by collecting converging evidence from thematically related measures from the same individuals. Therefore, Spearman's correlation coefficient was calculated between the baseline data on the MRMQ scales and the self-reported number of riding trips and belonging to an organised motorcycle group. The MRMQ scale scores were calculated based on the baseline data for each scale by adding each item score and dividing it by the number of items so that each scale score ranged from one to five.

2.3.6 Predictive validity of the MRMQ scales

This study sought to examine whether the MRMQ was able to predict on-road riding behaviours as measured by the MRBQ as well as important road safety outcomes of near crashes, crashes, and traffic offences, over and above the common risk factors for crashes and risk taking behaviors−age, gender, and exposure (Blockey and Hartley 1995, Lin and Kraus 2009, de Winter and Dodou 2010, Palk *et al.* 2011). The predictive validity of the MRMQ was thus tested via regression analyses controlling for age, gender, and riding exposure. Riding exposure was quantified as kilometers and hours of riding in an average week because they were the most reliable exposure measures and because combined use of distance and time as riding exposure measures has the added advantage of allowing calculation of typical speed, another useful risk exposure measure (Chipman *et al.* 1992, Sakashita *et al.* 2013).

The MRBQ sub-scale score distribution followed a Poisson distribution as did the self-reported near crashes and crashes and number of police-recorded offences. Hence, for those outcome variables, generalized linear modelling (GLM) with Poisson log-link was performed to test the predictive validity of the MRMQ scales. Logistic regression was performed on police-recorded crashes however because it was a binary variable (none had multiple crashes). The relationships of the MRMQ with crashes and police-recorded offences were also investigated after controlling for the MRBQ behaviours. This was to identify the role of riding motivations in crash involvements and traffic offence records, via behavioural choices other than those measured by the MRBQ.

3 Results

3.1 Descriptive statistics

In total 1305 newly licensed riders completed the baseline interview. The sample comprised 79.2% males. The age range was 18 to 74, with a mean of 36.0 years (SD=11.3). Police-recorded offence and crash records were accessed for the 651 participants who had completed the entire study. The number of offences ranged from zero to 12 in the entire sample. Twenty-four riders (3.7% of 651) had a recorded crash. None had multiple crashes. The descriptive statistics of the final sample are summarised in Table 1.

3.2 MRMQ scale structure

Given the previously found model was rejected, a new model was respecified. The PCA revealed three components. The loadings of 0.3 and above are shown in Table 2.

3.3 Internal consistency of the MRMQ scales

The Cronbach's alpha of component three was worse at below 0.5 when either of the two items that cross-loaded components two and three were excluded. The two items were more conceptually consistent with the rest of the component three items. Hence, they were kept in component three. However, three items— 'It is important to me that my motorcycle is economic in fuel consumption', 'A motorcycle is only a means of getting from A to B', and 'It is important to me that my motorcycle is stable and easy to control'—were excluded because they had item-total correlations below 0.3 and their exclusions dramatically improved the alpha of component three from .55 to .69. Three items were therefore included in the final scale referred to as convenience.

The item 'Motorcycling is safe as long as you know what you are doing' had an item-total correlation below 0.3 and its exclusion improved the alpha of component one. Therefore nine items were included in the final scale referred to as pleasure. All the eight items that loaded on component two were included in the final scale referred to as speed.

The items included in the final three scales are identified in shaded cells in Table 2. Their respective alpha scores (n=1305) varied from 0.69 (convenience) to 0.75 (pleasure and speed) as presented in Table 2.

3.4 Stability of the MRMQ scales

The test-retest reliability scores (n=685) varied from 0.69 (convenience) to 0.76 (speed), as presented in Table 2.

3.5 Content validity of the MRMQ scales

The correlations between the MRMQ scales and the self-reported number of riding trips and belonging to an organised motorcycle group are shown in Table 3. Across the three scales, the convenience scale had the highest significant positive correlations with the number of riding trips for commuting (r=.37), as part of their job (r=.09), general transport (r=.31), in dark (r=.38), rain (r=.32), and heavy traffic (r=.35), and on local suburban roads (r=.31). All those riding trips had the weakest correlations with the pleasure scale. Across the three scales, the pleasure scale had the highest significant positive correlations with the number of riding trips for recreation (r=.20), with company (r=.28), on winding rural roads (r=.21), and belonging to a motorcycle club (r=.15). All those riding trips had non-significant correlations with the convenience scale. Across the three scales the speed scale had the highest significant positive correlation with riding on high speed zones of 100km/hr or more (r=.21).

3.6 Predictive validity of the MRMQ scales

The significant standardised beta-coefficients of the independent variables predicting the four MRBQ scales (N=1305) are shown in Table 4. The speed and convenience scales had significant positive relationships with errors and speed violations. The speed and pleasure scales had significant positive relationships with stunts. The pleasure scale had a significant positive and convenience scale negative relationship with protective gear use.

The significant standardised beta-coefficients of the independent variables predicting self-reported near crashes and crashes (N=1305) as well as police-recorded crashes and offences (N=651) are shown in Table 5. The speed and convenience scales had positive relationships with self-reported near crashes. The convenience scale had a positive relationship with self-reported crashes. However, none of the scales were significant predictors of police-recorded crashes. The pleasure scale had a negative and the speed scale had a positive relationship with the number of police-recorded offences.

When the MRBQ was accounted for, the results slightly changed for self-reported near crashes and crashes. In addition to the errors scale of the MRBQ, only the convenience scale remained a significant predictor of self-reported near crashes. The errors and speed violations scales of the MRBQ were significant predictors but no MRMQ scales predicted self-reported crashes. The results for the police-recorded crashes and offences however did not change when the MRBQ was accounted for. None of the MRMQ scales remained to be significant predictors of police-recorded crashes. However, the stunts scale of the MRBQ was a significant predictor of police-recorded crashes. The pleasure and speed scales remained significant predictors of police-recorded offences as well as the protective gear scale of the MRBQ.

4 Discussion

The present study examined the psychometric properties of the MRMQ amongst novice riders. The present findings showed some similarities but also differences with respect to the previously found item constituents of each scale, internal consistency and predictive validity of the MRMQ in terms of MRBQ behaviours amongst riders who were on average more experienced (Sexton *et al.* 2004). This study additionally examined the stability, content validity, and predictive validity of the MRMQ with respect to police-recorded crashes and offences as well as self-reported near crashes and crashes. These psychometric properties of the MRMQ are discussed in detail in light of the present and previous results.

4.1 The MRMQ scales amongst novice riders

A 20-item MRMQ with three scales, pleasure (9 items), speed (8 items), and convenience (3 items) was found to be the best fit amongst the Australian novice rider population. The three-factor structure also followed Sexton et al's (2004) findings based on riders who were on average more experienced than the riders in the present study. The underlying constructs of the three scales were also consistent with the themes identified in previous observational commentaries and qualitative research, albeit with non-systematic categorizations, including motorcycle riding as a manoeuvrable means of transport, and for speed and pleasure (Schulz *et al.* 1991, Reeder *et al.* 1996, Bellaby and Lawrenson 2001, Wilson *et al.* 2009, Zamani-Alavijeh *et al.* 2009, Haworth 2012). However, the constituent items of the scales were not the same between the two studies. Of the original 24 items in the MRMQ, six items were used across two scales (duplicate items) in Sexton et al's (2004) study. In the present study no one item was used across two different scales (i.e. no duplicate items) and four items were dropped based on tests of improved variance and reliability.

The item 'Motorcycling is safe as long as you know what you are doing' loaded most strongly on the pleasure component in both the present and Sexton et al's (2004) studies but with the lowest loading amongst all the items singly loading onto the pleasure component. The exclusion of this item improved the internal reliability of the pleasure scale. This may be because this particular item relates to a cognitive belief rather than the emotive motivations that are expressed in the other pleasure scale items.

The item 'It is important to me that my motorcycle is stable and easy to control' had the lowest loading amongst all the items singly loading onto the convenience component in both studies. This item may also be influenced by the skill level of the rider and may not purely measure riding motivations. The item 'A motorcycle is only a means of getting from A to B' had one of the lower loadings in both studies, and cross loaded on the pleasure (negative) and convenience components in Sexton et al's (2004) study. The item 'It is important to me that my motorcycle is economic in fuel consumption' cross loaded on the speed (negative) and convenience components in Sexton et al's (2004) study. Whilst the two items singly loaded onto the convenience component in the present study, the item-total correlations indicated that they were contributing to the poor reliability of the convenience component. The exclusion of these three items improved the internal reliability of the convenience scale from 0.55 to 0.69. This may be because they differed from the remaining items on the convenience scale, which related to the ease provided by the particular vehicle design of motorcycles. It may be worth exploring alternatively worded or more items that relate to the contents of these items (ease of vehicle handling, means to an end, financial savings) in order to measure the convenience construct more reliably or potentially identify an additional construct currently missing from the MRMQ.

The total variance explained by the three components accounted for 37.3% only. Although this is more than that found in Sexton et al's (2004) study (32.2%), a large amount of common variance still remains unexplained. These results may reflect that the present MRMQ explains only a limited portion of rider motivation variance, and more items need to be developed to identify other riding motivations not represented in the current MRMQ. Other motivations might include the joy of 'solo-riding'spefically (the original pleasure scale items do not contain items on joy in relation to solo-riding per se) or necessity for transitory riders who are only riding until they can afford a car, as suggested in a qualitative assessment of motorcyclists' motivations (Christmas *et al.* 2009).

4.2 Internal consistency of the MRMQ scales

The speed and pleasure scales demonstrated good internal consistency but the alpha score of the convenience scale (three items) was just below the acceptable 0.7 cut-off. The alpha score of Sexton et al's (2004) convenience scale even with six items also did not reach 0.7. This suggests that the present MRMQ items are not measuring the convenience construct well. This further suggests that additional items may be needed to improve the reliability of the convenience scale.

The internal consistencies of the speed and pleasure scales were somewhat lower in the present study (both .75) than that in Sexton et al's study (.85 and .87). This lower reliability may be due to the fewer number of items included in the present scales. However, when Sexton et al's groupings were used for the present data the internal consistency of the two scales was insufficient (.55 and .68). The low reliability possibly reflects the reality that novice riders have not yet formed a consistent underlying riding motivation. More riding experience may help riders form a more uniform underlying riding motivation. For example, novice riders may not feel as if they were "at one with the machine" from time to time because that might depend on extraneous factors such as the extent to which their riding skills match with the riding conditions (e.g. feel worse when they are at corners where they are not yet used to), whereas more experienced riders may know their skill levels well enough to choose to ride at locations where they can feel "at one with the machine" all the time. It may also suggest that other factors that motivate novices to ride are not represented in the current MRMQ, as commented above.

4.3 Stability of the MRMQ scales

The speed and pleasure scales demonstrated good stability over time but the stability score of the convenience scale was just below the acceptable 0.7 cut-off. This further suggests more convenience scale items should be developed and refined. It may also reflect that convenience motivations are not stable as suggested by the transitory nature of riding for those who are not riding for passion but more for functional purposes (Christmas *et al.* 2009). This transience may apply particularly for novice riders who may still be establishing patterns of riding and change their views about "the best things" about motorcycle riding with more riding experience.

On the other hand, speed and pleasure motivations may be relatively resistant to change over time, or at least for three to four months for novices in the early months of riding (as per the present sample and follow-up period). The pleasure scale items are related to self-identity (e.g. "feel as if I am at one with the machine") and the intentions to speed are commonly found to be significantly related to sensation seeking personality (Jonah 1997, Jonah *et al.* 2001). That is speed and pleasure scale items may reflect stable traits more than transient states such as what constitutes convenience that are less stable over time.

4.4 Content validity of the MRMQ scales

Although the size of the correlations was not large, all the three scales demonstrated results that would be expected with good content validity. Across the three scales, the pleasure scale was most strongly correlated with the number of recreational trips, riding with company and belonging to a motorcycle club, and riding on winding rural roads. These findings are all consistent with the pleasure scale items that are characterized by the joy of riding and riding as a social activity. This construct relates to the concept of flow that has been found amongst drivers who find driving intrinsically rewarding (Heslop *et al.* 2010).

Across the three scales, the convenience scale was most strongly correlated with the number of riding trips for commuting and general transport, as part of a job, in dark, rain, and heavy traffic, and on local suburban roads. It is plausible that the ease of motorcycle use such as parking and manoeuvring in traffic becomes particularly attractive for those who ride in such conditions. The pleasure scale was most weakly correlated with the riding trips that were most strongly correlated with the convenience scale, and vice versa, further supporting the distinction between the pleasure and convenience motivations for riding. In practice, those who ride for pleasure are less likely to choose to ride when it is dark, raining, or in heavy traffic because the joy/fun aspect of riding is likely to be negatively impacted by those conditions whereas they are less likely to interfere with convenience motivations. Those conditions may also interfere with convenience but the convenience scale measures commuting purposes of riding, which might require riders to ride even when it is dark, raining, or in heavy traffic. On the other hand, recreational riders have more freedom to choose when to ride.

The speed scale had significant correlations with all riding types except for trips as part of their job or belonging to a motorcycle club, and was most strongly correlated with the number of trips in 100+km/hr speed zones compared to pleasure or convenience scales, supporting its content validity. It is plausible that the speed aspect of riding is not important for those riding as part of their job or belonging to a motorcycle club.

It must be noted that all the correlations between the MRMQ scales and types of riding were potentially overestimated because other possibly related factors were not controlled for. However, the present purpose was to examine convergence with thematically related measures. Further analyses of the correlations using the follow-up data on the riding trips for the control group (not shown) confirmed that the relative magnitudes of the associations remained the same across two measurement points, further confirming content validity.

4.5 Predictive validity of the MRMQ scales

The predictive validity of the MRMQ scales over and above the common associated factors of age, gender, and exposure were tested in relation to riding behaviours as measured by the MRBQ, and police-recorded offences and crashes as well as self-reported crashes and near crashes. These findings are discussed in relation to the previously found predictive validity in the next sections.

4.5.1 Predictive validity in terms of the MRBQ behaviours

Those who had stronger speed motivations for riding self-reported more errors, speed violations, and stunts whilst riding. Those who had stronger pleasure motivations self-reported more stunts and protective gear use. Those who had stronger convenience motivations self-reported more errors and speed violations, but less use of protective gear. These findings are similar to Sexton et al's (2004) findings to some extent where the speed motivations had significant positive relationship with self-reported control errors (close equivalent to the present errors scale), speed violations, and stunts, and the pleasure motivations with the safety equipment use (close equivalent to the present protective gear scale). These findings suggest that those with strong speed motivations tend to actually speed and it is likely that they are also motivated to take other risks such as performing of stunts. They may therefore tend to also make errors. Passionate riders as indicated by stronger pleasure motivations may tend to accept the risks involved in riding and take active steps to manage them by wearing protective gear as suggested in a qualitative study of motorcyclists (Christmas *et al.* 2009).

However, the present findings differed from Sexton et al's (2004) study in that the pleasure motivations were not significantly related to stunts, and the convenience motivations showed no significant associations with any of the MRBQ behaviours. Several accounts are possible for the different findings. First, riding motivations may predict riding behaviours differently between novice riders and Sexton et al's (2004) riders who were on average more experienced. Previous findings of differences in reasons for riding as well as types of riding trips and motorcycles between new and long-term riders and over time (Jamson and Chorlton 2009) support this account. Second, the inclusion of other variables (self-perceived riding skills, beliefs about whether motorcyclists or car drivers cause crashes, and riding styles) in the prediction models in Sexton et al's (2004) study may also have contributed to the different findings.

The present predictive validity shown by the convenience scale however parallels other findings. Similar to the present findings that stronger convenience motivations were related to less use of protective gear and more errors and speed violations, Iranian motorcyclists who rode for commuting and occupational needs tended not to use a helmet and to disobey traffic rules (Zamani-Alavijeh *et al.* 2009). Those who are only riding for functional purposes such as ease of parking and getting through traffic as indicated by stronger convenience motivations may tend not to invest in protective gear. On the other hand, those with stronger pleasure motivations were more likely to perform stunts, and their wearing of protective gear might be one way they believe they are managing their risks. Performing stunts and being seen to take such risks may be a part of what makes riding fun for those strong in pleasure motivations as also suggested in a qualitative study of motorcyclists (Christmas *et al.* 2009).

Other accounts can be speculated to explain the present findings. Those who are motivated to get through traffic (as measured by the convenience scale) may also achieve so through speeding as indicated here. As observed by the significant positive relationship of convenience motivations with riding in heavy traffic and on local suburban roads and their negative relationship with riding on winding rural roads, those who ride for convenience might more often ride in traffic conditions where they are more likely to detect their own errors. For example, if your riding was one meter off where it should be, you may be less likely to detect it as an error on a rural road, which may be wide and have sealed shoulders or where you may be the only one on the road, than on an urban road, where you may be more likely to notice almost hitting a pedestrian, another vehicle, or other objects. Future research to more closely examine the relationships between riding motivations and riding locations may help to tease apart these speculations.

4.5.2 Predictive validity in terms of crashes and near crashes

Those who had stronger speed and convenience motivations self-reported more near crashes. When the MRBQ was accounted for, the errors scale of the MRBQ and the convenience scale of the MRMQ remained significant predictors of self-reported near crashes. It is possible to speculate the causes of these patterns of results. Given stronger speed and convenience motivations were related to more errors, those motivations may influence near crashes via errors. Those with stronger speed motivations were found to more likely speed and both errors and near crashes are more likely when speeding. This may be due to car drivers estimating the time to arrival of smaller sized motorcycles to be later than bigger sized cars (Horswill *et al.* 2005) and/or spotting motorcycles less than cars in a far distance (Crundall *et al.* 2008), and therefore pulling out in front of a fast approaching motorcycle. That is, if the motorcycle is speeding, the risk of errors and near crashes created by car driver misperception as well as motorcycle speeding is much greater due to the shorter reaction time allowed to both car driver and motorcyclist. It is also possible that the present findings reflect social desirability bias, which was not controlled for in the present study. Those who are more likely to admit to speeding and/or errors may also tend to self-report near crashes. Future research to assess the social desirability effect on the MRMQ, MRBQ, and self-reported near crashes would be beneficial to test this account.

Those with stronger convenience motivations were found to more likely ride in heavy traffic and on local suburban roads. Similar to the account made in relation to the detection of errors, riders may tend to detect a near crash in busy traffic and on urban roads where they are likely to more often encounter pedestrians, other vehicles, and other objects. However, the fact that the convenience scale remained a significant predictor of near crashes even after accounting for the MRBQ behaviours suggests that the convenience motivations also influence near crash involvements via other avenues that are not measured by the MRBQ. Riding locations, determined by riding motivations, may play a major role in near crash involvements. Future studies to examine the roles of riding motivations and behaviours on rural versus urban roads may provide further insight into the causes of near crashes.

Those who had stronger convenience motivations self-reported more crashes. However, when the MRBQ was accounted for, the errors and speed violations scales of the MRBQ but no MRMQ scales predicted self-reported crashes. Again it is possible to speculate convenience motivations may influence crashes via errors and speed violations given stronger convenience motivations were related to more MRBQ errors and speed violations. Similar to the account posited for near crashes above, the riding locations and the behaviours that tend to be chosen by those with stronger convenience motivations may make them more subject to crash involvements.

None of the MRMQ scales were significant predictors of police-recorded crashes however, whether or not accounting for MRBQ behaviours. However, the MRBQ stunts scale was a significant predictor of police-recorded crashes. Both the MRMQ pleasure and speed scales were found to be significant predictors of stunts, but neither was a significant predictor of police-recorded crashes. This may suggest that there are other motivations not measured by the current MRMQ that influence stunts and police-recorded crashes.

The different findings between self-reported and police-recorded crashes may be due to the differences in the types of crashes that are included in the respective crash data. For example, self-reported crashes include less serious (including low-cost property damage only) crashes than police-recorded crashes (Boufous *et al.* 2010, McCartt *et al.* 2011) and respondents may misreport crashes due to social desirability or recall error. In the present sample 21% self-reported a crash but, of these, 38% did not involve an injury, which were therefore unlikely to have been included in the police data. The convenience motivations may influence less serious crashes (self-report), but other motivations and/or non-rider factors may influence more serious crashes (police-recorded). The current MRMQ design may be insufficient to measure or detect riding motivations that influence serious crash involvements. It is also possible that the low prevalence of police-recorded crashes limited the statistical analyses to find an effect of motivations on police-recorded crashes.

4.5.3 Predictive validity in terms of traffic offences

Those who had stronger speed motivations had more police-recorded offences, whereas those with stronger pleasure motivations had fewer such offences. In addition to these relationships, greater use of protective gear was related to fewer offences when accounting for MRBQ behaviors. It is possible to speculate the causes of these patterns of results. Given speed motivations were found to relate to greater errors, speed violations, and stunts, it may be likely that those with stronger speed motivations have more police-recorded offences. The positive relationship between pleasure motivations and protective gear use may reflect that those with stronger pleasure motivations tend to have an underlying concern for safety and/or compliance with road laws and thus have fewer police-recorded offences. Moreover, those riding for pleasure may also use more protective gear to fit in with the culture of recreational riders who tend to use protective gear more than commuting riders

However, the fact that both pleasure and speed motivations remained independent predictors of traffic offences even after accounting for the MRBQ behaviours suggests that those motivations affect traffic offences via other behaviours that are not measured by the MRBQ. One such possible mediating factor might again be riding locations, which in turn can influence the likelihood of being caught for traffic offences. In Australia, drivers in major urban centres were much more likely than those in other locations to have offences that were detected by speed cameras (Mitchell-Taverner *et al.* 2003). As observed in the present significant positive relationship between the pleasure scale and number of riding trips on winding rural roads and non-significant relationships with riding on local suburban roads and in heavy traffic, those who ride for pleasure might more often ride on non-busy rural roads, which may be less exposed to enforcement. On the other hand, as observed in the significant positive relationships with riding in heavy traffic, and on local suburban and winding rural roads, those who ride for speed motivations might more often ride on all types of roads in general and be more exposed to enforcement.

Stronger convenience motivations were related to less use of protective gear, and less use of protective gear was related to greater number of police-recorded offences. However, the convenience scale was not found to be a significant predictor of police-recorded offences. This suggests that there may be other riding motivations not measured in the current MRMQ that influence protective gear use and traffic offences. As discussed above, other non-rider factors such as enforcement levels may play a greater role in the infringement likelihood (Mitchell-Taverner *et al.* 2003, Howard *et al.* 2008).

4.6 Overall reliability and validity of the MRMQ and implications for policy and practice

The present findings suggest that there may be other riding motivations not represented in the current MRMQ that are critical in understanding riding behaviours and crash risks. They also suggest that riding motivations influence crashes and traffic offences via riding behaviours or other non-rider factors not represented in the MRBQ. These together imply that more research is required to develop theoretical models to understand motorcycle crash risks that incorporate the roles of riding motivations. In particular more research is required to develop theoretical models to understand how convenience motivations influence near crashes, and how pleasure and speed motivations influence traffic offences via factors that are not measured by the MRBQ. Research is also required to identify and add to the MRMQ motivations that are not represented in the current MRMQ. This is particularly useful to contribute to the understanding of risk factors for police-recorded crashes and offences.

One of the well-developed theoretical models is the Theory of Planned Behaviour (TPB) that posits behaviours are determined by intentions underpinned by cognitions, subjective norms, and perceived behavioural control (Ajzen 1985). Although this theory is empirically supported mostly amongst car drivers (e.g. Armitage and Conner 2001, Elliott *et al.* 2007a), it has also been criticised for the lack of full support amongst motorcyclists (Elliott 2010), and for focusing on purely cognitive processes and lacking consideration of affective determinants of behaviour (e.g. Eagly and Chaiken 1993, Ingham 1994). The latter gap may be particularly problematic to understanding motorcycle safety because motorcyclists are often found to cite affective motivations such as enjoyment as a key element for riding (Schulz *et al.* 1991, Christmas *et al.* 2009, Jamson and Chorlton 2009). The importance of affective motivations was further supported by the validity and reliability demonstrated by the pleasure and speed scales of the MRMQ. The present findings also suggest riding motivation is a critical determinant of rider behaviour and motorcycle crash risks, and support the need for behavioural theories like the TPB to incorporate motivational constructs. This may offer more useful insights into addressing motorcycle safety.

In the Iranian study, a combined group of motorcyclists who rode for either recreation or sensation seeking purposes self-reported high levels of speeding and stunts behaviours and helmet non-use (Zamani-Alavijeh *et al.* 2009). However, the present results indicate that speed and pleasure are distinct riding motivations and lead to different riding patterns. Convenience motivations additionally showed unique riding patterns. This suggests motorcyclists are a heterogeneous group, also suggested in other studies (Schulz *et al.* 1991, Christmas *et al.* 2009, Jamson and Chorlton 2009), and therefore rider safety interventions need also to be diverse with different foci to target different rider groups.

The predictive validity demonstrated by the convenience scale with respect to errors, speed violations, protective gear use, and self-reported near crashes and crashes for example has important policy implications. Targeting errors and speeding behaviours as well as educational campaigns on protective gear use in locations where convenience riders are more likely to ride (e.g. targeted enforcement, billboards) may help to reduce motorcycle crashes and near crashes as well as improve protective gear use respectively. In addition, those with stronger pleasure motivations tended to perform stunts, but were found to have fewer police-recorded offences. Given stunts was found to be a significant risk factor for police-recorded crashes, targeting stunts behaviours in locations where pleasure riders are likely to ride could benefit motorcycle safety. On the other hand, introducing penalties for non-use of protective gear and more pervasive enforcement may address all these issues at once. Further research is required to identify the best method to address rider needs and achieve improved road safety outcomes.

The effect of speed motivations on speed violations and stunts was the strongest across the MRMQ scales and across the MRBQ behaviours. Further, speed motivations had one of the strongest effects on police-recorded offences. These indicate speed motivations have a pervasive effect on many forms of risk taking. These findings as well as the ability of the speed motivation scale to predict near crashes highlight the importance of interventions to reduce the overall attraction of risk taking especially amongst riders who are particularly motivated by the speed aspect of riding. They also highlight the utility of the speed scale to evaluate the effects of interventions in terms of those central road safety outcomes amongst riders.

It is noteworthy that speed motivations showed significant relationships with traffic offences as well as self-reported speed violations but the speed violations did not show a significant relationship with traffic offences. This may further support the speculation that riding motivation is a better indicator of the likelihood of being caught than actual behaviours as discussed in 4.5.3. Enforcement is not everywhere at all times and people can speed without getting caught. Speed motivations may represent a dominant riding style – the way they ride most of the time (i.e. speeding) – thus more likely to be caught for speeding. On the other hand, speed violations may represent a sporadic behaviour that depends on riding circumstances. For example, it has been found some drivers speed irrespective of enforcement, while others speed when they believe there is no enforcements around, that is, they are selective about their speeding (Senserrick 2000).

Understanding the reasons why people choose to ride a motorcycle through a tool such as the MRMQ is one critical means to inform the development of tailored methods that are more conducive to rider safety. Understanding novices' motivations can be particularly useful to tackle their needs early on in their riding career and prevent future risks. Increasing use of motorcycles leads to increasing number of deaths and injuries amongst motorcyclists (Christie and Newland 2001, Christie and Newland 2006, Australian Bureau of Statistics (ABS) 2012). In this context, MRMQ may be useful to identify trends in riding motivations and therefore ways to prevent motorcycle related injuries and death. For example, MRMQ may show that people are increasingly taking up riding and/or novice riders tend to start out riding for convenience reasons, and the development of improved mobility options such as accessible and affordable public transport system or lanes dedicated to motorcyclists may be beneficial. While this study was concerned with the fundamental research question of the validity and reliability of the MRMQ amongst novice riders, the present findings suggest cluster analysis (e.g. see Senserrick 2001) in future studies would also provide further insight into the effective methods to address rider safety.

While the convenience scale showed insufficient reliability overall in our analysis it demonstrated content and predictive validity. This suggests that convenience motivation might be a powerful construct but is poorly measured by the current MRMQ items. The present convenience scale consisted of only three items. Refinement of the present items and development of additional items in future studies may improve reliability. While the pleasure and speed scales showed acceptable reliability, they may also benefit from development and refinement of items to increase their reliability amongst novice riders. Given the potential use of the MRMQ, it would be worthwhile to conduct similar studies in future in order to further inform the refinement of the MRMQ.

4.7 Methodological considerations in the interpretation of the present findings

The predictive validity shown by the MRMQ scales in relation to risk behaviours and crash involvements imply that riding motivations are a critical factor for motorcycle safety, and they need to be addressed. However, the effect sizes were not large indicating limited validity of the MRMQ. This may be explained by several factors other than the possible poor design of the MRMQ items. First, crashes and police-recorded offences may be over-determined by situational factors as discussed above. A traffic offence will not be recorded unless enforcement exists at the time of offending and the chance of riders being caught for speeding and other dangerous riding behaviors tends to be very low. Crashes may only occur when all possible risk factors including road designs are at play and riding motivations singly cannot cause a crash. Second, police-recorded offences could not be identified as exclusively riding-related for dual car and motorcycle licence holders in the present study. However, whether the offence was committed whilst riding or driving, the offence record against the same individual reflects that individual's level of risk-taking and/or compliance with the road laws.

Third, the validity was tested against past crashes and offences before they completed the MRMQ questionnaire. The experience of crashes and/or being caught for a traffic offence in the past may have influenced their motivations such that the current motivations reported by the riders through the MRMQ could not explain fully retrospective crashes and offences. The predictive validity has only been examined with respect to retrospective crashes in Sexton et al's (2004) study as well. Whilst results based on prospective crashes can be confounded by an unknown level of influence of having done MRMQ on future crash risks and offences, future studies to examine the predictive validity of the MRMQ in terms of prospective crashes would also be beneficial. In addition, while the present sample was in keeping with Victoria wide age and gender demographics, it was voluntary and the generalizability of the present results may be limited and must be interpreted with caution.

5 Conclusions

The present study examined the psychometric properties of the MRMQ amongst novice riders in Australia. A three-factor model of pleasure, speed, and convenience was found to be most appropriate in the present sample. The present findings showed some similarities but also differences with respect to the previously found item constituents of each scale, internal consistency and predictive validity of the MRMQ in terms of MRBQ behaviours (Sexton et al, 2004). The present findings and the inconsistencies between the two MRMQ studies suggest that the current MRMQ as it stands is limited. It would be beneficial to develop and refine MRMQ items before wider use of the current MRMQ, especially in relation to the convenience construct and amongst novice riders. However, the predictive validity of the MRMQ in terms of the MRBQ paralleled observations in other studies, and the present findings overall have practical implications. First, there may be other riding motivations not represented in the current MRMQ and other variables such as riding locations that are critical in understanding riding behaviours and crash risks. Not only further development of the MRMQ is needed to identify other motivational constructs not yet represented in the current MRMQ, but also incorporating motivational constructs in the Theory of Planned Behaviour research amongst motorcyclists may be fruitful. Further research to examine the relationships between riding motivations and riding locations is required. Second, this study supports previous research that motorcyclists are a heterogeneous group and need to be addressed with a different focus to improve rider safety overall. Cluster analysis of motorcyclists including but not limited to riding motivation, behaviour, and location variables in future studies may be useful. Third, the speed scale of the MRMQ demonstrated potential utility in measuring as well as in tackling risky riding through its use in the evaluation and development of interventions. Furthermore, a refined MRMQ is potentially useful to analyse trends in motorcycle use and to develop tailored interventions and thus address rider needs to improve road safety. Fourth, despite the risk behaviours as measured by the MRBQ related to all types of riding motivations, not all were significantly related to police-recorded offences. This highlights the importance of more pervasive and targeted enforcement to address all types of unsafe behaviours shown by different groups of riders. Finally, testing the social desirability effect on the MRMQ would further confirm its validity and increase its utility.

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Table 1. Sample characteristics

Variable name	Description of variable	
Age	Mean (SD) age at time of baseline interview derived from date of birth	36.0 (11.3)
Gender	Frequency (%) of	
	1 = female	272 (20.8)
	2 = male	1033 (79.2)
Motorcycle licence months	Mean (SD) total months held motorcycle licence (including months holding learner's permit)	12.7 (5.8)
Exposure: km/wk	Mean (SD) kilometres of riding in an average week	166.4 (227.2)
Exposure: hr/wk	Mean (SD) hours of riding in an average week	4.1 (3.9)
Traffic errors	Mean (SD) score on the traffic errors scale of the MRBQ*	1.4 (.36)
Control errors	Mean (SD) score on the control errors scale of the MRBQ*	1.9 (.54)
Speed violations	Mean (SD) score on the speed violations scale of the MRBQ*	1.8 (.64)
Stunts	Mean (SD) score on the stunts scale of the MRBQ*	1.2 (.36)
Safety equipment	Mean (SD) score on the safety equipment scale of the MRBQ*	5.1 (.85)
Self-reported near crash	Mean (SD) number of near crash experiences in the past three months	1.7 (2.9)
Self-reported crash	Mean (SD) number of crash experiences in the past 12 months	0.27 (0.61)
Police-recorded offence	Mean (SD) number of police-recorded offences prior to study participation	.15 (.85)
Police-recorded crash	Frequency (%) of a police-recorded crash prior to study participation where	
	1 = no	627 (96.3)
	2 = yes	24 (3.7)
Commuting	Mean (SD) number of on-road riding trips in the past month for commuting to work or study	13.9 (17.3)
Part of job	Mean (SD) number of on-road riding trips in the past month for work or as part of your job	.98 (5.4)
Recreation	Mean (SD) number of on-road riding trips in the past month for recreation	5.9 (8.0)
General transport	Mean (SD) number of on-road riding trips in the past month as a form of general transport e.g. visiting, shopping	5.8 (10.3)
Dark	Mean (SD) number of on-road riding trips in the past month when it was dark	6.8 (9.4)
Rain	Mean (SD) number of on-road riding trips in the past month when it was raining	3.9 (6.8)
Heavy traffic	Mean (SD) number of on-road riding trips in the past	10.9 (14.6)

	month in heavy traffic	
Local suburban roads	Mean (SD) number of on-road riding trips in the past month on local suburban roads	17.2 (18.2)
Winding rural roads	Mean (SD) number of on-road riding trips in the past month on winding rural roads	3.9 (8.1)
High speed zones	Mean (SD) number of on-road riding trips in the past month on high speed roads zoned 100km/hr or more	8.9 (12.2)
Riding with company	Mean (SD) number of on-road riding trips in the past month in the company of at least one other rider	2.0 (4.1)
Motorcycle club/group	Frequency (%) of belonging to a motorcycle club or an organized ride group where	
	1 = no	1109 (85)
	2 = yes	196 (15)

*MRBQ = Motorcycle Rider Behaviour Questionnaire

Table 2. Principal component analysis of the 24 MRMQ items (N=1305)

Item	Component		
	1 Pleasure	2 Speed	3 Convenience
Riding a motorcycle makes me feel good	.70		
Riding a motorcycle is a good social activity	.66		
When riding a motorcycle, I feel a sense of freedom	.65		
Motorcycle riding is exciting	.63		
I enjoy going on long motorcycle rides	.61		
It is fun to ride a motorcycle	.58		
When riding a motorcycle, I often feel as if I am at one with the machine	.56		
When I am with my friends, we often talk about motorcycles	.47		
Without motorcycles, my life would be less interesting	.41		
Motorcycling is safe as long as you know what you are doing	.30		
I enjoy riding my motorcycle at high speeds		.70	
I like to corner at high speed		.69	
I prefer to ride slowly[1]		.59	
It is important to me that my motorcycle has fast acceleration.		.58	
When riding, it is a good feeling when you overtake others.		.57	
I think that 100 km/h on a rural road is too slow.		.52	
It is important to me that my motorcycle has a high top speed		.51	
Without a certain level of thrill, motorcycle riding would be boring		.49	
One of the best things about riding a motorcycle is that it is easy to park			.69
One of the best things about my motorcycle is that it is easy to manoeuvre in traffic		.35	.64
One of the best things about riding a motorcycle is that you can get through traffic jams more easily		.50	.54
It is important to me that my motorcycle is economic in fuel consumption			.53
A motorcycle is only a means of getting from A to B			.42
It is important to me that my motorcycle is stable and easy to control			.31
% of variance explained	14.5	14.4	8.4
Mean (SD) [2]	3.9 (.44)	2.8 (.58)	3.6 (.52)
Number of items	9	8	3

Internal consistency (α)	.75	.75	.69
Stability (r)	.73	.76	.69

Note: Only loadings of 0.3 or above are shown. The items included in the final three scales are identified in shaded cells.

[1]Reverse scored.

[2]Mean and standard deviation based on the scale.

Table 3. Correlations between the MRMQ scales and types of riding (N=1305)

Riding trip type	Pleasure	Speed	Convenience
Commuting	-.01	.22**	.37**
Part of job	.01	.03	.09**
Recreation	.20**	.10**	.05
General transport	.08**	.22**	.31**
Dark	.03	.24**	.38**
Rain	.04	.22**	.32**
Heavy traffic	.05	.17**	.35**
Local suburban roads	-.01	.20**	.31**
Winding rural roads	.21**	.13**	-.03
High speed zones 100+ km/hr	.13**	.21**	.20**
Riding with company	.28**	.11**	.03
Motorcycle club/group	.15**	.02	-.004

**Significant at the p<0.01 level

Table 4. Regression coefficients (standard error) indicating the relationship between the MRMQ scales (pleasure, speed, convenience) and the MRBQ^ scales (errors, speed violations, stunts, protective gear), controlling for age, gender, and exposure based on GLM Poisson log-link (N=1305)

		Outcome variables			
		Errors	Speed violations	Stunts	Protective gear
Independent variables	Age	-.09***	-.09***	-.09***	.02**
		(.0006)	(.001)	(.0006)	(.0005)
	Gender	-.02	.02	.05*	-.0013*
		(.02)	(.02)	(.02)	(.01)
	Exposure: km/wk	.0008	.03	-.002	-.0008
		(.00004)	(.00005)	(.00004)	(.00003)
	Exposure: hr/wk	.01	.01	.01	.02*
		(.002)	(.003)	(.002)	(.002)
	Pleasure	-.02	-.1.59e-005	.04*	.02*
		(.02)	(.02)	(.02)	(.01)
	Speed	. 10***	.23***	.18***	.008
		(.01)	(.02)	(.01)	(.01)
	Convenience	.09***	.06***	.01	-.02**
		(.01)	(.02)	(.01)	(.01)

^MRBQ = Motorcycle Rider Behaviour Questionnaire
*** $p < 0.001$; ** $p < 0.01$; * $p<0.05$

Table 5. Regression coefficients (standard error) and odds ratios indicating the relationship between the MRMQ scales (pleasure, speed, convenience) and crashes and offences, controlling for age, gender, and exposure based on GLM Poisson log-link and logistic regression.

Independent variables	Outcome variables: Self-reported near crashes β (S.E.)	Self-reported crashes β (S.E.)	Police-recorded crashes Odds ratios	Police-recorded offences β (S.E.)
Age	-.06*** (.002)	-.30** (.006)	.99	.16 (.01)
Gender	.01 (.06)	.02 (.15)	.67	.92** (.59)
Exposure: km/wk	.00*** (.00007)	.00 (.0002)	1.0	.00 (.001)
Exposure: hr/wk	.05*** (.004)	.17* (.01)	1.1	-.22 (.05)
Pleasure	-.005 (.05)	-.09 (.13)	1.1	-.60*** (.26)
Speed	. 04*** (.04)	.20 (.11)	1.2	.39** (.22)
Convenience	.04*** (.05)	.28** (.11)	1.3	-.03 (.22)

*** $p < 0.001$; ** $p < 0.01$; * $p<0.05$

Appendix

Motorcycle Rider Behaviour Questionnaire (MRBQ) scale items

Speed violation scale
Exceed the speed limit on a motorway.
Exceed the speed limit on a residential road.
Disregard the speed limit late at night or in the early hours of the morning.
Exceed the speed limit on a country/ rural road.
Open up the throttle and just go for it on a country road.
Race away from the traffic lights with the intention of beating the driver/rider next to you.
Get involved in racing other riders or drivers.
Errors scale
Ride so close to the vehicle in front that it would be difficult to stop in an emergency.
Ride so fast into a corner that you feel like you might lose control.
Ride so fast into a corner that you scare yourself.
Run wide when going around a corner.
Needed to brake or back-off when going round a bend.
Needed to change gears when going around a corner.
Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble).
Pull onto a main road in front of a vehicle you haven't noticed or whose speed you misjudged.
Not notice someone stepping out from behind a parked vehicle until it is nearly too late.
Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping
Not notice a pedestrian waiting at a crossing where the lights have just turned red.
Fail to notice that pedestrians are crossing when turning into a side street from a main road.
Queuing to turn left on a main road, you pay such close attention to the main traffic that you nearly hit the vehicle in front.
Distracted or pre-occupied, you suddenly realise that the vehicle in front has slowed, and you have to brake hard to avoid a collision.
When riding at the same speed as other traffic, you find it difficult to stop in time when a traffic light has turned against you.
Miss a 'Give Way' or 'Stop' signs and almost crash with another vehicle.
Skid on a wet road or manhole cover, road marking etc
Stunts scale
Attempt or done a wheelie
Intentionally do a wheel spin.
Pull away too quickly and your front wheel lifted off the road.
Unintentionally had your wheels spin.
Protective gear scale
Motorcycle protective trousers (leather or non-leather).
Motorcycle boots.
Body armour / impact protectors (eg for elbow, shoulder or knees).
A motorcycle protective jacket (leather or non-leather).
Bright/fluorescent stripes/ patches on your clothing.

MANUSCRIPT ENDS HERE.

Chapter 6: Self-report perceived value of rider training—CV survey (***Study 4***)

6.1 Preamble

This chapter presents the study on self-report perceived value of rider training amongst novice riders, which was published in *Traffic Injury Prevention*. Publications details and signed statements of authorship are provided in Appendix 8 under ***Paper 5***.

6.2 Aims and objectives of *Study 4*

The aim of ***Study 4*** was to develop and conduct a contingent valuation (CV) survey and examine the perceived value of a motorcycle rider training program and its determinants amongst novice riders. The objectives were:

1. To offer and design a best practice CV survey as a tool to empirically quantify the perceived value of *VicRide* rider training by its target audience, novice riders;

2. To conduct the CV survey and analyse the WTP data in ways that comprehensively manage all the possible methodological biases based on the CV methodological literature (i.e. evidence-based) including

    a. Pilot study to manage range bias

    b. Sufficiently informative and realistic scenario presented before the WTP elicitation question to manage hypothetical bias

    c. Bidding format to elicit the WTP values to manage range bias and hypothetical bias

    d. Randomisation of the bid values to manage starting-point bias

  e. Follow-up questions to identify protest responses and manage strategic response bias

  f. Certainty calibration to manage hypothetical bias;

3. To test and compare different regression models to determine the most appropriate transformation type to analyse the WTP data whilst maintaining the practicality of the WTP values;

4. To examine if prior experiences of motorcycle crashes and of the motorcycle training product influenced the perceived value of *VicRide* rider training amongst novice riders after controlling for methodological biases, income, age, and riding exposure.

6.3 Manuscript

Over page.

Abstract

Objective: Evidence that rider training reduces motorcycle-related injuries or crashes is currently lacking. However, significant community demand for training persists, which in turn can influence policy. The present study aims to contribute to the understanding of this demand via two objectives 1) to offer a method, namely contingent valuation, to measure the value motorcyclists place on training; and 2) to examine determinants of such value.

Methods: Value was elicited through a willingness to pay question, using a bidding format, from novice motorcyclists who were randomly assigned to groups either offered the training or not.

Results: The group who were offered and subsequently received training provided a lower mean perceived value of the training than the group that was not. Perceived value increased with rider age and decreased with training participation and near crash experiences, controlling for bidding order, income, education, and experience of other training.

Conclusion: This study demonstrates the utility of contingent valuation in quantifying the perceived value of training, as well as the modifiability of perceived value, with age, training participation and near crash experiences key determinants. This indicates that research to find ways to align the perceived value with evidence on training effectiveness is worthwhile in order to facilitate more appropriate and justified allocation of road safety resources. Potential options to explore and evaluate may include community education on evidence of training effectiveness as well as on alternative measures with demonstrated effectiveness in reducing crash risks.

Keywords

motorcycle; training; contingent valuation; crash; safety

INTRODUCTION

The current literature shows no robust evidence exists to demonstrate the effectiveness of motorcycle rider training programs in motorcycle crash reductions (e.g. Kardamanidis *et al.* 2010). However, rider training is often promoted as a road safety measure, especially for novice motorcyclists (Haworth and Schulze 1996, Mayhew *et al.* 1998, Parliament of Victoria 1998). While the decision to fund and implement road safety programs should be based on their actual effectiveness in reducing crashes and related injuries, the community's perceived value in training can create a political will to provide and even mandate training even if no sound evidence exists to demonstrate its effectiveness (e.g. Kardamanidis *et al.* 2010). Measuring, understanding and therefore addressing perceived value of interventions is useful to manage this mismatch and enable resource allocation to the most effective interventions. However, to date no published study has sought to empirically assess the perceived value of a rider training program and analysed its determinants.

Contingent valuation (CV) surveys are one of the standard tools used to measure users' perceived value for an intervention with such valuations considered a standard measure of benefit in cost-benefit analyses (Drummond *et al.* 2005). In CV surveys a representative sample of potential users is directly asked to value in monetary terms an intervention with a stated reduction in risks of their own and/or others (de Blaeij *et al.* 2003, Svensson and Johansson 2010). In this context CV is used to assess potential demand for interventions among end-users. It is posited here that the existence of such demand contributes to the political appeal of training programs.

Previous CV research suggests that individuals' valuation of intervention products depends on individual experiences (O'Brien and Gafni 1996, Ryan 1998, Miller 2000, Jou and Wang 2012). In the case of motorcycle training this means that individual differences in the perceived value of training may arise from previous experience of either the training or a crash (*ex post* valuations). The conventional approach to CV is to elicit *ex ante* valuations i.e. valuations from individuals prior to consuming the product, akin to the way in which purchase decisions are made in economic markets. However, given that knowledge of such training programs and perception of individual risks are likely to be imperfect *ex ante*, *ex ante* valuations may be based on inaccurate perceptions of this road safety product. Both *ex ante* and *ex post* valuations are critical to examine this possibility and to address inaccurate perceptions.

While the community can include anyone from all road users to motorcyclists, this study examined the perceived value of a motorcycle rider training program, marketed as *VicRide* coaching program, specifically among its target group of novice motorcyclists. Novice motorcyclists can have a powerful impact on political decision making because they are the group that is directly affected by the implementation of such a program. Training is based on the assumption that it is the lack of experience that contributes to the higher involvements of crashes by novice motorcyclists and is therefore targeted at novices (Mullin *et al.* 2000, Haworth and Mulvihill 2005). It is therefore useful to begin the understanding and addressing of the mismatch between community value and scientific evidence with novice motorcyclists. Therefore, a CV survey was developed to empirically quantify the perceived value of *VicRide* among novice motorcyclists, and to examine the determinants of such values. The program was aimed at lowering crash risk among novice riders in their first year of motorcycle licensure. The CV survey was administered to novice motorcyclists who were randomly assigned to groups which were either offered the program or not. The hypothesised determinants are summarized in Figure 1.

METHOD

Participants and Procedure

Novice motorcycle riders in the state of Victoria, Australia participated in the present study. VicRoads, the state road authority, sent letters of invitation to motorcycle riders who had recently advanced from a learner's permit to a probationary/restricted motorcycle licence (N=23,696) through the period May 2010 – June 2011. The study candidates could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The core eligibility criteria based on the *VicRide* design were that 1) they owned a motorcycle (not a scooter); 2) their motorcycle had an engine capacity of 125cc or up to and including 660cc but not exceed a power-to-weight ratio of 150 kilowatts per tonne, compliant with the VicRoads Learner Approved Motorcycle Scheme; 3) they had ridden at least 500km over at least 12 separate trips on public roads since obtaining their learner's permit; 4) they had been on a Victorian probationary/restricted motorcycle licence for one year or less. Having taken a training course was not a selection criterion. If the candidates met all the eligibility criteria they were asked to provide informed consent to participate in the study.

Of those approached 2375 candidates met all the eligibility criteria and 1305 riders (54.9%) completed two 30-minute interviews: a baseline and a follow-up interview, which were on average 142.9 days (SD=33.6) apart. The baseline interviews were conducted between June 2010 and August 2011 and a follow-up interview between September 2010 and December 2011.

At the end of the baseline telephone interview the riders were randomized into treatment or control groups. Those assigned to the treatment group were invited to complete *VicRide* after the baseline interview within three months of the baseline interview date, and then completed the follow-up interview. Those assigned to the control group were not able to complete *VicRide* before completing the follow-up interview, but were also informed that they will be offered *VicRide* after the study participation. *VicRide* was provided free of charge in all cases. All the treatment and control riders were followed up at comparable times and asked to value *VicRide* through the CV survey during the follow-up interview. All the interviews were conducted through a computer assisted telephone interview by professional interviewers who were specifically trained in the survey developed for this study. The research was approved by the University of Sydney Human Research Ethics Committee and Monash University Human Research Ethics Committee in Australia.

Measure

The survey included a range of items on demographics and characteristics of the sample as summarised in Table 1. The CV component of the survey was designed in accordance with the recommended CV applications (Arrow *et al.* 1993). A descriptor presented the decision-making context (motorcycle crashes are a serious issue), the nature of the training program (e.g. duration, contents), its provision (delivered by commercial training providers but managed and coordinated by government for riders' voluntary participation), payment vehicle (out-of-pocket and separate from the licence fee), and the hypothetical outcome of the training (number of reductions in motorcycle related deaths and serious injuries), all of which were relevant if *VicRide* was to be implemented in practice.

The descriptor was followed by a question to elicit the monetary value of *VicRide* using the bidding format to cover a wider range of values rather than one nominated value. To avoid range bias (Rowe *et al.* 1996), the upper and lower ends of the seven bids (25, 50, 100, 150, 200, 300, 500 or more) in Australian dollars ($) were based on focus group results (VicRoads 2007). Participants were selected at random for the bids to be presented in either increasing order from the initial bid of $25 to half the sample, or decreasing order from the initial bid of $500 or more to the other half, to control for the potential starting point bias (Smith 2006). The highest accepted bid was taken as the respondent's final maximum value in the decreasing order, and the amount that was accepted just before the rejected bid in the increasing order. To further safeguard against range bias respondents were asked how much they were willing to pay in an open-ended question if they rejected the lowest bid of $25 or lower, or if they accepted the highest bid of $500 or more. As *VicRide* was offered to all study participants for free, including the control group, an anchoring effect, if any, would have applied to both groups.

After the final value was elicited, the respondents were asked the main reason for their valuation (for response options see Appendix) and the level of certainty in the value they provided on a scale from one indicating 'not certain at all' through to 10 indicating 'absolutely certain'. These questions were used to identify protest responses (Carson *et al.* 2001, Dalmau-Matarrodona 2001) and hypothetical bias where an erroneous value is provided in a hypothetical survey context (Blumenschein *et al.* 2001, List and Gallet 2001) respectively. A willingness to pay of zero was determined as a protest response if the reason for their choice of zero reflected their outright refusal to pay in-principle (e.g. "It's something the Government should pay, not me"; "It should be free for everybody"; "I have already paid to get my licence"). The whole CV survey (Appendix) was piloted to ensure that the questions were understandable.

Regression Analyses

Dependent variable The raw monetary values ranged from zero to 1000 with a non-normal distribution (kurtosis = 7.27; skewness = 2.12; SE of skewness = .07). In order to identify the significant determinants of the perceived value of *VicRide*, linear regression analysis was performed on the square root transformed values of the dependent variable. This accounted for the skewed distribution of the raw values and the impossibility of log transformation of zero values. Alternative statistical models including log transformed ordinary least squares (OLS) and generalised linear models (GLM) were also considered using the raw values plus one. In the present analyses, there was no evidence of heteroskedasticity in either of the OLS models and the log-scale error was heavy-tailed (kurtosis=11.45), therefore the OLS models were preferred to the GLM (Manning *et al.* 2003, Baser 2007). Between the two OLS models, the square-root transformation was preferred to log transformation because the square-root transformed monetary values followed the normal distribution more closely (SE of skewness = .07; skewness = .12; kurtosis=2.16) versus log-transformed values (SE of skewness = .07; skewness = -.2.83; kurtosis = 11.45) and the square-root standardised residual plots showed stronger homoskedasticity (Manning and Mullahy 2001).

Independent variables Study participants' information on riding-related factors collected during the baseline interview (Table 1) was included as independent variables in the regression analyses. No significant differences existed between the treatment and control groups at baseline except prior training experience (p=.043) and education (p=.002). Therefore, both prior training and education were entered in the multivariate model as covariates. All formal training programs available in Victoria are optional, therefore it is not expected that all riders have had prior training. Riding exposure prior to randomisation was measured through self-reported kilometers and hours of riding in an average week (kilometres per week and hours per week), and number of riding trips in the past month. Among them, hours per week was found to be most reliable (Sakashita *et al.* under review). People are likely to estimate and remember the time it took to travel better than the distance they rode. Moreover, kilometres per week had 38 missing values but hours per week had none, reflecting respondents' greater confidence with providing hour estimates than kilometer. Therefore the hours per week variable was used to examine the effect of riding exposure on the valuation of *VicRide*.

Control for potential CV methodological biases Group differences in the levels of protest response and hypothetical bias were examined through a Chi-square test and a Mann-Whitney-U test on mean certainty scores respectively. Group differences in the existence of starting-point bias were examined by testing for an interaction effect between group and order through a two-way ANOVA. While there were no significant group differences in the three methodological biases, starting-point bias existed in the entire sample. Therefore the order variable (increasing or decreasing) was included in the multivariate model as a covariate.

Certainty calibration was conducted where regression analysis excluding low certainty responses (below 6) were compared to those including all cases to test the sensitivity of the overall results to hypothetical bias (Johannesson 1999, Blomquist *et al.* 2009). The results remained robust whether the low certainty responses were excluded or not (available upon request), therefore only the overall results are reported here.

Final regression model Based on the above analyses of potential confounders, prior training, education, and order were entered in the model as well as income to account for one's capacity to pay. All the other variables significant in the univariate models at the 0.05 level were entered and their inclusion in the final multivariate model was determined through manual selection where the variable with the highest p-value was successively removed until the highest was .10. All the analyses were conducted using IBM SPSS Statistics 19.

RESULTS

In total 1305 novice riders completed the CV survey during the follow-up interview with no refusal responses. The sample comprised 79.2% males. The age range was 18 to 74, with a mean of 36.0 years (SD=11.3). According to VicRoads March 2012 data, the novice rider population in Victoria were aged between 18 and 92 with a mean of 33.6 years (SD=11.1), and 84.4% were males. Therefore the current sample was in keeping with Victoria wide age and gender demographics. The descriptive statistics of the final sample are summarised in Table 1. In the final sample 50.3% were presented with the bids in increasing order.

The sample mean perceived value was \$175.19±3.86 (SD=139.38) with a mode of \$200. The mean monetary valuation of *VicRide* was \$162.94±5.29 (SD=131.69) among treatment riders and \$186.28±5.55 (SD=145.19) among control riders. The proportion of those who valued *VicRide* to be \$0 was 3.4% among treatment riders and 2.2% among control riders.

The mean certainty was 8.0 (SD=1.9) with a mode of 10 and only 3.3% gave a certainty below five. Of those who valued *VicRide* to be \$0, 31.4% (n=11) were identified as protest responses. This equated to 0.8% of the total sample.

The significant predictors of the perceived value in univariate regression analyses are presented in Table 2. In the multivariate regression, age was entered but not car licence years because they were strongly correlated (r=.94), leading to possible multicollinearity. Age was deemed more valid and reliable because people would naturally remember their age better than the number of years they have driven a car. Multicollinearity was not present for any of the independent variables in the final multivariate analyses. Age, near crashes, and group remained significant predictors of the perceived value of *VicRide*, after controlling for order, income, and other confounders of education, and prior training (Table 3). Examination of the graphical relationship between age and perceived value showed a positive increasing trend of perceived value peaking among those in the fifties and dropping after the age of 60 to about the mean level among those in the twenties.

DISCUSSION

Perceived Value of a Motorcycle Rider Training Program

The present study utilised a CV survey to estimate novice riders' perceived value of a motorcycle training program and examined its determinants. The sample mean perceived value of $175.19 and mode of $200 found in this study were close to the market prices of the equivalent courses delivered in Victoria in the same interview time-period (approximately $150-200). This knowledge may have anchored the riders' monetary valuation of *VicRide*. However, only 3.7% of the respondents reported the main reason for their nominated value was because it approximated the prices of other training courses in the market.

Determinants of the Perceived Value

The perceived value of *VicRide* increased with age and decreased with the participation in the training and near crash experiences, after controlling for order, income, education, and prior training. Although the relationship between age and perceived value peaked and reversed at the fifties age group, age had a significant positive relationship overall with perceived value. This may be due to an income effect. However, income and age were weakly correlated (r=0.17) and the significant relationship between age and perceived value remained even after accounting for employment status and income. Age has been found to be a significant predictor of monetary valuation of motorcycle helmets (Pham *et al.* 2008) and a generic road safety product (Andersson 2007, Svensson 2009, Svensson and Johansson 2010), albeit in inconsistent (negative) directions with the present study. The present results suggest that training per se may be more attractive to older novice riders.

The mean monetary valuation of *VicRide* by treatment riders ($162.94) was 12.6% lower than that provided by control riders ($186.28). In addition, the proportion of treatment riders (3.4%) who valued *VicRide* to be $0 was 54% higher than that of control riders (2.2%). That is, riders allocated to the treatment group valued *VicRide* less than the control group (who were effectively making *ex ante* valuations since *VicRide* was offered to them after the study). Changes in perceived value from pre to post product experience are not uncommon in relation to transport policy such as congestion charges (Schuitema *et al.* 2010) and random breath testing (Job *et al.* 1997).

Near crash experiences in the three months before the baseline interview led to a lower valuation of *VicRide*. It may be evidence of the gambler's fallacy (Tversky and Kahneman 1971, 1974) where an individual erroneously believes that the occurrence of an event (near crash) results in it being less likely to occur in future. Alternatively, it may be evidence of a heightened level of confidence derived from having avoided a crash, reinforcing a sense of futility associated with training. This account is further supported by the fact that near crash experience reduced the training valuation but crash experience had no significant influence. The feeling that they managed to 'avoid' the crash in particular might play a powerful role in the devaluation because they believe they already have the skills they need. As an ad hoc analysis, the interaction effect of prior training and near crashes was examined and found to be significant. It showed that those who had around six to ten near misses valued *VicRide* less if they also had prior training than those who did not. However, after about ten or more near misses, both groups whether they had prior training or not devalued *VicRide*. This further confirms the present observation where the participation in training leads to its lower valuation.

Respondents were also asked if anyone including themselves were injured in the most serious crash that they self-reported. These injury crashes were not found to be a significant predictor of perceived value either. While crash-related injury experience by respondents themselves or their significant others has been found to have a positive significant relationship with the monetary value of a generic road safety device (Andersson and Lindberg 2009), crash experiences may not play a significant role in riders' monetary valuation of training per se even when they are framed as a road safety product.

The lack of role self-responsibility for a near crash/crash played in the training valuation may partly be due to a possible lack of reliability of this measure. Self-responsibility was still considered relevant because, whether accurate or not, it might be the perceived responsibility by the riders that influences their valuation of training.

In the case of rider training user perceived value is reduced by the participation in the training and with increasing near crash experiences. This suggests that solely *ex ante* approach to cost-benefit studies may lead to inflated benefit calculations of training, and those who have little or no knowledge of the effectiveness of training ought to have little weight in the decision making process. The findings also indicate perceived value is modifiable. Further research to find effective ways to align the perceived value with the evidence is worthwhile in order to facilitate more appropriate and justified allocation of road safety resources. Potential options to explore and evaluate may include community education on evidence on training effectiveness as well as alternative measures that have demonstrated effectiveness in reducing crash risks. Word of mouth reports from motorcyclists who have completed training may also be beneficial. The contingent valuation methods applied here may be employed to quantify effects of measures designed to reduce the perceived value of training.

The present findings have broader implications for road safety, where aside from scientific evidence politics plays a powerful role in road safety decisions. For instance, this is observed in relation to speed camera and bicycle helmet legislation (Walker *et al.* 2009, Walter *et al.* 2011). This study suggests contingent valuations of various road safety measures can be useful to understand and address the politics of these decisions.

Methodological implications

In terms of methodological implications, when the bids were presented in increasing order the mean final value was significantly lower than when the bids were presented in decreasing order. The bidding format commonly suffers from starting point bias (Boyle *et al.* 1985, Frew *et al.* 2004) and its effect seems pervasive whether the product provision is framed in a public or private setting (Pedersen *et al.* 2011). Starting-point bias was found to be a powerful influence on individual valuations in the present study, confirming the importance of the randomization of the bid presentation order to obtain a balanced overall mean perceived value.

The present CV survey was developed and analysed in ways to circumvent and control for potential methodological biases previously identified in CV research. The nil refusal responses to the CV survey, the high level certainty responses, and the insensitivity of the overall results to hypothetical bias all suggest that the present CV survey was implemented successfully. Furthermore the study found that respondents with higher income placed greater monetary value on *VicRide,* lending validity to the findings. Income is widely found to have a positive relationship with monetary valuations of environmental (Togridou *et al.* 2006), healthcare (Wagner *et al.* 2000, Leung *et al.* 2004, Pinto *et al.* 2009, Bernard *et al.* 2011, Pedersen *et al.* 2011), and transport products (Andersson and Lindberg 2009, Svensson 2009).

Some cautionary notes must be made in the interpretation of the present results. While the present sample was in keeping with Victoria wide age and gender demographics, the generalizability of the present results may be limited. The fact that the training was provided free of charge as part of the research participation might have affected its valuation. However, those who valued the training as $0 were only 2.8% (n=36) overall. It is possible that different valuations might have eventuated in the current study if different figures were used to describe the hypothetical reduction in the descriptor. Other information provided in the descriptor of the CV survey (i.e., marketing of *VicRide* as a coaching program instead of traditional training terminology; statistics provided to remind respondents of motorcycle crash risks) might also have influenced the valuation. However, previous research has demonstrated CV respondents' insensitivity to changing magnitudes of risk reduction (Beattie 1998, Olsen *et al.* 2004, Hultkrantz *et al.* 2006). The low goodness of fit (R-square=.233) of the overall regression model may suggest that other determinants of the perceived value, such as attitudes to risks, are missing from the present analysis. Further research to explore other determinants can be insightful. Community value is likely to extend far beyond novice motorcyclists to include, for example, motorcycle advocacy groups who may be led by more experienced and older riders. The present value was only derived from novice motorcyclists and the generalizability of the present results to the wider community is not clear. Future replication studies in other population groups would further contribute to this understanding and identify other potential sources of mismatch between scientific evidence and community value commonly faced in road safety.

Conclusions

This study is the first to empirically quantify the perceived value of rider training and analyse the determinants through a well-designed CV survey. Participation in the training and near crash experiences led to lower perceived value of training. This suggests contingent valuation exercises based solely on participants who have not yet experienced the training or have less near crash experiences may inflate the value attached to this type of intervention. The findings also indicate perceived value is modifiable. Further research to find effective ways to align perceived value with evidence on training effectiveness is worthwhile in order to facilitate more effective allocation of road safety resources. Possible options to explore and evaluate may include educating novice motorcyclists and the wider community about the evidence on training effectiveness as well as alternative measures with demonstrated effectiveness in reducing crash risks. Word of mouth reports from motorcyclists who have completed training may also be beneficial. The contingent valuation methods applied here may be employed to quantify effects of measures designed to reduce the perceived value of training. Future contingent valuation exercises on various road safety measures and among wider population groups would be beneficial to understand and address the politics of road safety decisions.

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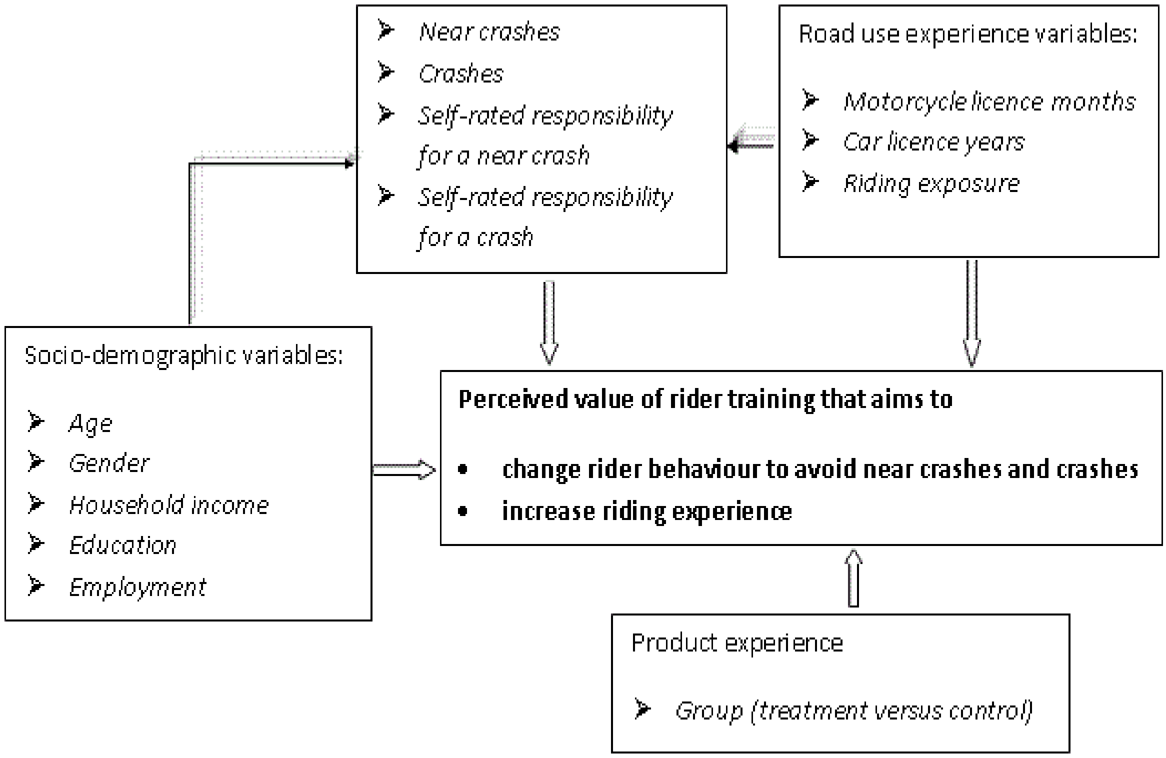

Figure 1. Hypothesized determinants of the perceived value of a motorcycle training program aimed at reducing motorcycle crash risks

Table 1. Sample characteristics

Variable name	Description of variable	Mean (SD)
Age	Age at time of baseline interview derived from date of birth	36.0 (11.3)
Motorcycle licence months	Total months held motorcycle licence (including months holding learner's permit)	12.7 (5.8)
Car licence years	Total years held car licence	18.1 (11.4)
Riding hours	Self-reported hours of riding in average week	4.1 (3.9)
Near crashes	Number of near crash experiences in past three months	1.7 (2.9)
Crashes	Number of crash experiences in past 12 months	0.27 (0.61)
Self-responsibility for a near crash	Self-rated responsibility for a near crash on scale from 0% to 100%	29.4 (36.2)
Self-responsibility for a crash	Self-rated responsibility for a crash on scale from 0% to 100%	72.7 (38.8)
Variable name	**Description of variable**	**Frequency (%)**
Household income	Annual household income where	
	1 = less than 30K	93 (7.4)
	2 = 30,001-50K	191 (15.2)
	3 = 50,001-100K	486 (38.7)
	4 = 100,001-150K	285 (22.7)
	5 = more than 150K	201 (16.0)
Education	Highest level of education attained where	
	1 = year 11 or less	174 (13.3)
	2 = year 12 equivalent	215 (16.5)
	3 = trade or other certificate	203 (15.6)
	4 = tertiary degree	703 (53.9)
	5 = post-graduate	10 (0.8)
Employment	Employment status where	
	1 = unemployed	24 (1.8)
	2 = student	101 (7.7)
	3 = part-time	103 (7.9)
	4 = not seeking work or retired/pensioner	23 (1.8)
	5 = full-time	1054 (80.8)
Gender	Binary variable where	
	1= female	272 (20.8)
	2 = male	1033 (79.2)
Prior training	Binary variable of participation in any formal rider training or coaching programs other than *VicRide* prior to study participation where	
	1 = no	460 (35.2)
	2 = yes	845 (64.8)

Order	Binary variable of bid presentations where	
	1 = in decreasing order from $500 or more	648 (49.7)
	2 = increasing order from $25	657 (50.3)
Group	Binary variable where	
	1= treatment	620 (47.5)
	2 = control	685 (52.5)

Table 2. Significant predictors in univariate linear regression models on square-root transformed monetary value of a motorcycle training program

Independent variable	Standardized beta	p-value
Age	.15	<.001
Car licence years	.14	<.001
Riding hours	-.08	.004
Near crashes	-.09	.002
Employment	.10	.001
Income	.07	.012
Order	-.43	<.001
Group	.09	.001

Table 3. Standardised regression coefficients of multivariate linear regression model on square-root transformed monetary value of a motorcycle training program

Independent variable	Standardized beta	p-value
Prior training*	-.01	.60
Education*	.03	.30
Income*	***.07***	.01
Order*	***-.44***	<.001
Age	***.15***	<.001
Group	***.10***	<.001
Near crashes	***-.06***	.01

*The model controls for prior training, education, income and bid order ($F=53.9$; $p<.001$; R square = .233).

Note: Significant coefficients are in bold italics.

APPENDIX

Descriptor

As you know, you are taking part in this trial of the *VicRide* coaching program to see whether it helps make newly licensed riders safer. I'm now going to present you a scenario and I'd like you to answer the following questions keeping in mind the context described to you.

[For CONTROL group only] I would like to remind you though as you are participating in the trial you will still be doing the course for free after the third interview.

In the past five years in Victoria, around 1050 riders have been killed or seriously injured every year in motorcycle crashes. The *VicRide* on-road coaching program was developed to reduce motorcycle related deaths and injuries.

The course:

- takes about 4 to 5 hours of your time to complete, and
- involves rides on road with an accredited and experienced riding coach and one or two other newly licensed riders, as well as
- discussions with the group about the rides covering basic theory.

The VicRide course is delivered through professional training providers like HART, Honda Australia Rider Training, but it is managed and coordinated by VicRoads to ensure safety standards are met.

The coaching course is being offered to newly licensed Victorian riders and it's your choice to participate or not, but the course has to be paid for by each rider (separate from the licence fee).

We expect that when all the Victorian riders complete the *VicRide* course, motorcycle related deaths and serious injuries will be reduced by 52 people per year.

Elicitation

[DECREASING ORDER: Stop the bidding when the respondent says 'yes'.]

1. Would you pay $500 or more to participate in the program? (If 'yes', ask item 8. If 'no', ask next item.)

2. Would you pay $300? (If 'yes', this is the respondent's maximum willingness to pay. If 'no', ask next item.)

3. Would you pay $200? (If 'yes', this is the respondent's maximum willingness to pay. If 'no', ask next item.)

4. Would you pay $150? (If 'yes', this is the respondent's maximum willingness to pay. If 'no', ask next item.)

5. Would you pay $100? (If ‘yes’, this is the respondent’s maximum willingness to pay. If ‘no’, ask next item.)
6. Would you pay $50? (If ‘yes’, this is the respondent’s maximum willingness to pay. If ‘no’, ask next item.)
7. Would you pay $25? (If ‘yes’, this is the respondent’s maximum willingness to pay. If ‘no’, ask next item.)
8. How much would you pay? (This is the respondent’s maximum willingness to pay.)
9. Don’t know.

[INCREASING ORDER: Stop the bidding when the respondent says ‘no.]

7. Would you pay $25 to participate in the program? (If ‘yes’, ask item 6. If ‘no’, ask item 8.)
6. Would you pay $50? (If ‘yes’, ask next item. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
5. Would you pay $100? (If ‘yes’, ask next item. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
4. Would you pay $150? (If ‘yes’, ask next item. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
3. Would you pay $200? (If ‘yes’, ask next item. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
2. Would you pay $300? (If ‘yes’, ask next item. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
1. Would you pay $500 or more? (If ‘yes’, ask item 8. If ‘no’, the previous value they said ‘yes’ to is the respondent’s maximum willingness to pay.)
8. How much would you pay? (This is the respondent’s maximum willingness to pay.)
9. Don’t know

Follow-up

How certain are you with your choice on how much you would pay for the program, on a scale from 1 to 10 where 1 is not certain at all and 10 is very certain?

What is the main reason for your choice of pay?

RESONSE CATEGORIES:

1) Reduction in crash risk is not important to me.
2) That's not enough crash reduction for me.
3) That's how much the course is worth to me.
4) It's something Government should pay, not me.
5) I don't believe such a course will make a difference to crash risk
6) I want to learn more riding skills and this is a good way to do it
7) I value safety
8) I just don't have a lot of spare cash
9) I want to finish the interview as quickly as possible.
10) Other (please specify)
11) I don't know.

MANUSCRIPT ENDS HERE.

Chapter 7: Discussion

7.1 Preamble

A detailed discussion of each of the ***Studies 1-4*** was included in the individual manuscripts presented in Chapters 3-6. This chapter therefore presents an overall discussion of the main features of the thesis. Specifically, it begins with a summary of the main results in the preceding chapters and identifies the methodological strengths and main limitations of the research undertaken for this thesis. It further provides an assessment of the appropriateness and relevance of self-report in motorcycle safety research, and highlights the future directions for research and recommendations for policy and practice based on the present findings overall.

7.2 Summary of principal findings

This section will recap the principal findings of each study before discussing the results overall.

7.2.1 *Study 1* – Self-report riding exposure (manuscript in press: 1)

Study 1 had the following objectives:

1. To examine various self-report riding exposure questions of different units (distance, time, number of trips), sources (self-estimates, self-report odometer), and timeframes (week, month, three months) in order to assess the appropriateness of self-report to measure riding exposure amongst novice riders;
2. To conduct validity checks and reliability tests of different self-report riding exposure measures via a comprehensive set of statistical analyses;

3. To analyse possible sources of differential reliability of self-report riding exposure measures;

4. To provide recommendations on best practice self-report riding exposure questions based on the present results.

The validity checks showed that self-reported riding exposure measures of kilometres and hours in an average week (KM/WK and HR/WK) provided the largest amount of valid data. The mean KM/HR estimate derived from KM/WK and HR/WK increased in value by decreasing urbanisation at both time-points as would be expected, and congruent with Chipman et al's (2) findings with drivers, further supporting the validity of the KM/WK and HR/WK measures. The KM/WK and HR/WK showed excellent correspondence. However, number of trips did not have acceptable correspondence with either of these measures. The odometer-derived distance measures did not coincide well with the other exposure measures assessed in this study.

Riding exposure self-reported for the week period did not coincide well with that for the lifetime period but it showed statistically acceptable correspondence with that for the three-month timeframe. The average week time exposure had the highest correlations with all the other exposure measures. Moreover, KM/WK variable had 30 cases where respondents did not know the answer but HR/WK none, probably reflecting respondents' greater confidence with providing hour estimates than kilometre estimates. All the results suggest that riding hours in an average week provide the most reliable riding exposure data, at least amongst novice riders.

Furthermore, the reliability between KM/WK and HR/WK was greater amongst commuting riders compared to recreational riders, and greater amongst rural riders compared to metropolitan riders. All the correlations between self-estimates of distance, time, and number of trips improved from the first measurement time point to the second approximately four months later. These findings suggest that factors such as riding purposes, geographical locations, and riding experience can contribute to measurement reliability.

Recommendations on best practice self-report riding exposure questions based on the present results are provided in detail in section 7.6.2.

7.2.2 *Study 2* – Self-report riding behaviours: MRBQ (manuscript under review: 3)

Study 2 had the following objectives:

1. To examine the previously examined psychometric properties of the *Motorcycle Rider Behaviour Questionnaire* (MRBQ) including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes (4, 5);
2. To examine the psychometric properties of the MRBQ not yet examined in previous studies including stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes;
3. To assess applicability of the MRBQ amongst novice riders in Australia, a population to whom the MRBQ has not been applied to date.

The five-factor structure of the MRBQ (traffic errors, control errors, speed violations, stunts, and safety equipment use) found amongst experienced riders in the UK (5) and Turkey (4) was only partially applicable to the present sample of Australian novice riders. Rather, a four-factor structure was found to be the most appropriate. Based on the underlying themes, these four scales were named errors, speed violations, stunts, and protective gear. The previously found distinction between traffic errors and control errors was not evident in the present data and the constituent items of those two scales were found to load on a single errors scale amongst novice riders. The constituent items of the speed violations, stunts, and protective gear scales were generally consistent with the previous speed violations, stunts, and safety equipment scales. However, some dissimilarity was also evident mainly because ten items were dropped in the present study from the original 43-item MRBQ due to weak loadings on all the factors.

The speed violation and errors scales had good internal consistency and stability but the protective gear and stunts scales did not show sufficient internal consistency or stability. However, only the protective gear scale demonstrated content validity showing converging evidence with police-recorded offences and the coach assessment of riders' protective gear use. The MRBQ scales also demonstrated differential predictive validity, but in different patterns from those found amongst the experienced riders in the UK and Turkey. Amongst novice riders in Australia, the errors and speed violations were significant predictors of self-reported near crashes and crashes. Only the stunts scale significantly predicted police-recorded crashes, and only the protective gear scale predicted the number of police-recorded offences.

These findings and the inconsistencies amongst the three MRBQ studies suggest that the current MRBQ as it stands has limited reliability and validity, and further development and refinement of the MRBQ items are required before its wider use, especially with respect to the protective gear construct and amongst novice riders.

7.2.3 *Study 3* – Self-report riding motivations: MRMQ (manuscript under review: 6)

Study 3 had the following objectives:

1. To examine the previously examined psychometric properties of the *Motorcycle Rider Motivation Questionnaire* (MRMQ) including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the MRBQ (7);

2. To examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences and self-reported crashes and near crashes;

3. To assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ has not been applied to date.

A 20-item MRMQ with three scales, namely pleasure, speed, and convenience was the most appropriate in the present sample of Australian novice riders. The present three-factor structure followed Sexton et al's findings based on riders who were on average more experienced than the riders in the present study. However, the constituent items of the scales were not the same between the two studies. Of the original 24 items in the MRMQ, no one item was used across two different scales as in Sexton et al's study and four items were dropped based on tests of improved variance and reliability.

The pleasure and speed scales showed acceptable internal consistency and stability, but the convenience scale did not have sufficient internal consistency or stability. Although the size of the correlations was not large, all the three scales demonstrated results that would be expected with good content validity. All the three scales demonstrated differential predictive validity in relation to the MRBQ behaviours, self-reported near crashes and crashes, and police-recorded offences. The present MRMQ-MRBQ relationships differed from Sexton et al's study to some extent but paralleled findings in other studies (e.g. 8, 9).

These findings and the inconsistencies between the two MRMQ studies suggest that the current MRMQ as it stands is limited and further development and refinement of the MRMQ items are required before its wider use, especially with respect to the convenience construct and amongst novice riders.

7.2.4 *Study 4* – Self-report perceived value of rider training: CV survey (published manuscript: 10)

Study 4 had the following objectives:

1. To offer and design a best practice CV survey as a tool to empirically quantify the perceived value of *VicRide* rider training by its target audience, novice riders;
2. To conduct the CV survey and analyse the WTP data in ways that comprehensively manage all the possible methodological biases based on the CV methodological literature (i.e. evidence-based) including
    a. Pilot study to manage range bias
    b. Sufficiently informative and realistic scenario presented before the WTP elicitation question to manage hypothetical bias
    c. Bidding format to elicit the WTP values to manage range bias and hypothetical bias
    d. Randomisation of the bid values to manage starting-point bias
    e. Follow-up questions to identify protest responses and manage strategic response bias

f. Certainty calibration to manage hypothetical bias;

3. To test and compare different regression models to determine the most appropriate transformation type to analyse the WTP data whilst maintaining the practicality of the WTP values;

4. To examine if prior experiences of motorcycle crashes and of the motorcycle training product influenced the perceived value of *VicRide* rider training amongst novice riders after controlling for methodological biases, income, age, and riding exposure.

A CV survey that attempted to account for potential biases commonly found in CV research was designed by the present author. The CV survey was employed as a tool to quantify the value motorcyclists place on rider training. The most appropriate type of regression analysis was assessed and performed to examine the determinants of such value. Value was elicited through a willingness to pay question, using a bidding format, from novice motorcyclists who were randomly assigned to groups either offered the training or not. The group who were offered and subsequently received training provided a lower mean perceived value of the training than the group that was not offered training. Perceived value increased with rider age and decreased with training participation and near crash experiences, controlling for bidding order, income, education, and experience of other training.

This study demonstrates the utility of CV in quantifying the perceived value of training. It also identified the modifiability of perceived value, with age, training participation and near crash experiences key determinants.

7.3 Methodological rigor of the present research

7.3.1 Integrity of the phone interview data collection

The integrity of the phone interview data collection was maximised through the following procedures:

- The study participants could opt to either visit the study website or be called by an interviewer to answer eligibility questions and participate in the study. The recruitment website and recruitment phone interviews followed standard scripts (Appendices 2 and 3 respectively) with detailed information about the requirements of the study participation. Study participants were asked to respond to all the questions on the eligibility criteria and consent was sought only from those who answered and met all the eligibility criteria. Consent for study participation was obtained and recorded via respective recruitment methods (Appendices 2 and 3).
- The combination of phone and web recruitment maximised the reach so as not to exclude those who could not access the web or who could not be reached by phone (e.g. because the phone numbers were not current by the time of interview).
- The structured phone recruitment, baseline and follow-up survey scripts (Appendices 3, 4, 5 respectively) were imported into a Computer Assisted Telephone Interview (CATI) system. This system allows phone interviewers to follow a computerised script and enter responses directly into a secure database. Unless a response was entered it was not possible for the interviewer to move to the next screen. These features of the CATI system ensured standardisation of interviews, immediate capture of information (as opposed to later entering data from a written survey for example), and minimisation of missing data. The system also had the ability to alert to the interviewer when out-of-range values were entered. Instructions for the interviewers were also available on the

screen to assist quality data collection. All these features of the CATI system helped to minimise the potential for data entry errors.

- All the participants whether recruited via the web or phone completed the same surveys via the CATI system with professional interviewers at the Survey Research Centre (SRC) at Edith Cowan University, who were specifically trained in the surveys developed for this study. Hence biased responding by recruitment methods was unlikely.
- The SRC has an established CATI system and professionally trained interviewing team with extensive experience in interviewing wide demographics. Interviewer training involved observation as well as being observed followed by feedback. A supervisor was on duty at all times in the phone room to further ensure quality control. A supervisor was available to monitor interviewers as required via a telephone monitoring system, which allows the supervisor to listen to the interviews and to provide answers to interviewer and respondent queries on the computer screen.
- At the end of the baseline interview the riders were randomized into the treatment group or the control group. This assignment was unknown to the interviewers and the respondents whilst completing the baseline interview because the randomisation was done at the end of the interview, reducing the potential for interviewer and respondent bias.
- More than one telephone number (landlines and mobile phone numbers) was collected at baseline as well as mail and email contacts, if available. This was particularly important for the follow-up surveys as some contact details are likely to change over a four to five month period. If participants could not be contacted after repeated calling attempts, or if the phone numbers were disconnected or transferred to a different individual at the time of follow-up, the present author made attempts to contact the

participants via email to obtain their current phone number. That failing, participants were recorded as refusals and data were not collected for those respondents.

- Multiple call backs and appointments were made with the interviewees to maximise response rates unless the participants expressed definitively that they did not wish to be called back for an interview. These responses were recorded as refusals. Hard appointments were made where the interviewer spoke to the participant and arranged a specific call back time. Soft appointments were made where someone other than the participant took the call and informed the interviewer that the participant should be available at a particular time. The CATI system automatically prioritised hard appointments and if possible allocated them to the original interviewer. If not, call notes entered by the original interviewer were made available within the CATI system to other interviewers, who could make informed call backs.
- Weekly records of baseline and follow-up survey completion data including key variables of identification number, interview date, group assignment, odometer readings, primary phone number, and email were sent from the SRC to the author of the present thesis. Monthly completion figures were also sent and checked against the weekly records maintained by the present author to ensure no data were missing in the weekly records and to further ensure quality data.

7.3.2 Risk management of self-report

Aside from the direct tests of validity and reliability of the self-report measures conducted in ***Studies 1-3***, potential risks of self-report highlighted in the Introduction (see 1.4.2) were managed in the research and questionnaire design:

- Both self-report and police-records of crashes were collected for the present research and the predictive validity of the self-report measures were tested with respect to both self-report and police-records;
- Timeframes that were considered optimal were chosen to ask questions on self-report near crashes (three months) and crashes (twelve months)—short enough to recall but long enough for the event to occur relative to its likelihood. Different timeframes of self-report exposure measures were compared to identify the optimal timeframe in ***Study 1***;
- The overall baseline and follow-up survey length were kept to around 30 minutes in order to minimise respondent fatigue and boredom;
- Although in different population groups from the present, previously validated measures of MRBQ (5) and MRMQ (7) were used in the present research;
- Both the MRBQ and MRMQ apply a six-point Likert scale that ranged from never to nearly all the time or a five-point Likert scale from strongly disagree to strongly agree respectively, neither of which was positively biased (e.g. only positive options from agree to strongly agree) or negatively biased (e.g. only negative options from disagree to strongly disagree). Likert scales are shown to produce more reliable scales than open-ended or dichotomous response options with increasing scale points (e.g. five better than three) but plateauing benefits from seven points (11, 12);
- Multiple questions on riding exposure and within the MRBQ and MRMQ allowed the assessment of consistency in responses to questions about the same construct;
- Standardised phone interviews controlled the respondent's ability to preview, review, or skip items and change responses, and ensured that all questions were presented to all respondents consistently.

Furthermore, in addition to the multiple call backs of participants for the survey interviews, reimbursement for research participation was provided to the participants at the completion of the final follow-up survey. This facilitated a complete collection of data that were required for the present research. The research invitation materials (Appendix 1) as well as the professional interviewers ensured face validity of the research process, further facilitating increased response rates.

7.3.3 CV survey design

The present CV survey incorporated all the features of a best practice CV design that are shown to increase validity and reliability (13-15). In order for the respondents to value an intervention in a valid and reliable manner they must be informed of the relevant context and nature of the intervention appropriately to the extent that is feasible. A credible and realistic scenario that matched the real implementation context was presented in the descriptor (Appendix 5, p.393-394, Q81), facilitating reliable and valid value estimates (14, 16). All the recommended components were applied in the descriptor of the present CV survey – sufficiently informative but not too complex to understand, a description of the general context for the decision to be made, the intervention to be valued, the payment medium used, and the institutional setting in which the intervention will be provided (14, 15).

If the intervention being valued is likely to produce strategic behaviour such as protest against having to pay for an intervention then this ought to be directly dealt with within the survey (14). As recommended, a follow-up question (Appendix 5, p.395, Q82 & Q83) on why they chose the value they stated was included to understand the reasons behind the value they placed on training and to identify potential strategic behaviour triggered by the training being offered (14, 15).

Research suggests that out of the four broad elicitation methods, respondents find it easier to give a monetary valuation when they are guided with a price such as the referendum format ('yes' or 'no' vote to one nominated value), bidding format, or payment cards (13-15). The potential starting point bias produced by the latter two elicitation formats (17) can be circumvented by randomising the ordering of the bid presentation within the sample. In ***Study 4*** participants were selected at random for the bids to be presented in either increasing order from the initial bid of $25 to half the sample, or decreasing order from the initial bid of $500 or more to the other half (Appendix 5, p394-395). The potential range bias was managed by using the range that was provided by riders in a pilot study (18). The bidding format was used in favour of the referendum format to maximise the power of the statistical analyses (14).

The main purpose of WTP methodology is to estimate the value of risk reduction produced by the program being evaluated and so the risk reduction must be communicated in the question. Hence the risk communication that is most likely to make sense to people was investigated and used in ***Study 4***. The main aim of *VicRide* was to reduce crashes amongst motorcycle riders. According to the five year figures in Victoria before the commencement of the present research (2006 – 2010), 8 out of 1000 registered motorcycles were involved in a fatal or serious injury crashe. A 5% reduction will only bring this figure to 7.2 out of 1000 and it takes a 25% reduction to bring the figure down to 6 out of 1000 or 50% to 4 out of 1000. Respondents are unlikely to be sensitive to value changes when presented with such small differences in a small probability risk (14, 19, 20). It was possible that an absolute reduction in numbers of deaths and injuries may be more meaningful to respondents. Therefore the present risk was communicated as "We expect that when all the Victorian riders complete the *VicRide* course, motorcycle related deaths and serious injuries will be reduced by 52 people per year" (Appendix 5, p.394). The whole CV survey was piloted to ensure that the questions were understandable.

7.4 Appropriateness and relevance of self-report in motorcycle safety research

Appropriateness and relevance of self-report in motorcycle safety research is discussed here in light of the present findings overall. Whilst each measurement method has its limitations, the decision to use self-report methods in road safety research must be based on not only practical advantages outlined in the Introduction (see 1.4.1) but also justified with acceptable psychometric properties of those measures and having relevance to improving central outcomes in road safety.

The appropriateness of self-report is partly dependent on the nature of the phenomenon under study. Riding motivations and perceived value are by nature subjective experiences and self-report is in theory apt to measure those constructs as long as the questions do not induce social desirability and other biased responding. ***Study 3*** indicated that the speed motivation scale of the MRMQ in particular showed consistency with the previous study by Sexton et al (2004) and good reliability and validity overall, supporting the appropriateness of the MRMQ speed motivation scale. The pleasure scale demonstrated good validity and reliability overall but showed slight inconsistency with Sexton et al's (2004) findings with respect to its predictive validity of MRBQ stunts. The inconsistency between the two studies with respect to predictive validity was most evident for the convenience scale and it did not have sufficient reliability in either study. However, the content and predictive validity demonstrated by the convenience scale amongst novice riders suggests that convenience motivation is a powerful construct but is poorly measured by the current MRMQ items amongst novice riders. Therefore, the MRMQ is not fully appropriate to measure riding motivations as it currently stands. Specific recommendations to improve the validity and reliability of the MRMQ, thereby ensuring its appropriateness in measuring riding motivations, are discussed later in 7.6.3.

The ***Study 3*** findings also indicated that with improvements the MRMQ has the potential to be a relevant tool in novice rider safety research. The predictive validity of the MRMQ with respect to risk behaviours and crash involvements, which also paralleled other findings, suggests that riding motivations are a critical factor for motorcycle safety and they need to be understood and addressed through good measurement. The potential use of an improved MRMQ is further discussed in 7.6.5.

Study 4 demonstrated that CV surveys can be developed and analysed in ways to circumvent and control for the commonly found methodological biases, and under those conditions CV surveys can be an appropriate self-report tool to quantify perceived value and identify its determinants. The nil refusal responses to the CV survey, the high level certainty responses, and the insensitivity of the overall results to hypothetical bias all suggest that the present CV survey was implemented successfully. Furthermore the study found that respondents with higher income placed greater monetary value on *VicRide,* supporting validity of the values elicited. Income is widely found to have a positive relationship with monetary valuations of environmental (21), healthcare (22-26), and transport products (27, 28).

Study 4 also showed that perceived value of rider training is modifiable. This has important implications for strategies to implement road safety policy and interventions that are shown to be effective but lack community support, or that are shown to be ineffective but receive strong community demand. Understanding the determinants of perceived value of road safety policy and interventions via CV surveys can facilitate more appropriate resource allocation in road safety. ***Study 4*** therefore also demonstrated that CV survey is a relevant tool in novice rider and more broadly road safety research.

Self-report may be less than optimal to measure riding exposure and riding behaviours of errors and violations if alternative measures (e.g. GPS and official records of traffic offences respectively) are able to collect more objective, valid, and reliable data. However, ***Study 1*** and ***Study 2*** results suggest that with a more informed and improved question designs, a self-report riding exposure measure and the MRBQ can be appropriate alternatives or complementary tools to other objective measures. Self-report of riding exposure can provide manageable data readily and inexpensively relative to technological measures such as GPS. ***Study 1*** showed that when the unit and timeframe in which the amount of riding is asked are considered carefully, such that they are easier to estimate and recall, self-report riding exposure measures can provide valid and reliable results and are thus appropriate. The relevance of exposure measures is well understood in road safety and was discussed in Chapter 2 (see 2.2).

Self-report of riding behaviours has the potential to provide more information than official records of traffic offending, which can depend on not only rider behaviours but also exposure to and levels of enforcement. ***Study 2*** indicated that the MRBQ is not necessarily a good measure of riding behaviours in its current form. The speed violation and errors scales showed good reliability and predictive validity in terms of self-reported crashes and near crashes, but did not demonstrate good content validity. Findings for the stunts and protective gear scales showed them to be powerful constructs in that they respectively predicted police-recorded crashes and offences, but they did not demonstrate adequate reliability in this sample. The speed violations scale showed the most consistent results amongst the three studies (3-5) and demonstrated good reliability. This suggests not only that MRBQ speed violation scale is appropriate but also that speeding is more a global issue than other behaviours such as errors and protective gear use. For example, the errors item on lane splitting and protective gear use may have different cultural and legal implications between different countries. The item on overtaking in the original traffic errors scale might not have applied in the present sample because novice riders may not be confident enough to overtake yet. Some items may need to be developed that are sensitive to the culture and experience levels of the population to which the MRBQ is applied in order to ensure its appropriateness and relevance. Specific recommendations to improve the validity and reliability of the MRBQ are discussed later in 7.6.3, and the potential use of an improved MRBQ in 7.6.5.

The ***Study 2*** findings also indicated that with improvements the MRBQ has the potential to be a relevant tool in novice rider safety research. The differential predictive validity of the MRBQ with respect to crash involvements and traffic offences (the errors and speed violations scales were significant predictors of self-reported crashes and near crashes; the stunts scale of police-recorded crashes; the protective gear scale of the number of police-recorded offences), suggests that riding behaviours as measured by the MRBQ are critical factors for novice rider safety and they need to be understood and addressed through good measurement. The significant associations between protective gear scale and helmet offence, drink-driving offence, and number of traffic offences also suggest that protective gear use is a critical construct to measure an underlying concern for safety and/or compliance with road laws. Thus achieving changes in MRBQ behaviours through interventions and employing instruments such as the MRBQ to measure those behavioural changes could be a beneficial aid to evaluation.

7.5 Main limitations of the present studies

In this section the main limitations of the body of work presented in this thesis are identified and discussed.

7.5.1 Generalisability of the present results

The present research was focused on novice riders and the generalisability of the present results to other motorcycle population groups may therefore be limited. While the present sample was in keeping with the Victoria wide age and gender demographics of novice riders, the participation was voluntary and the present sample might be systematically different from those who did not volunteer to participate in this research trial. That is, the present sample may have suffered from unknown levels of self-selection bias and therefore not representative of the Victorian novice rider population. This may have impacted the validity and reliability of self-report and the valuation of rider training positively or negatively.

Several reasons are possible for why certain riders chose to or not to join the trial. First, those who volunteered to participate in such a study may be particularly interested in training. This may have particularly influenced the valuation of training more favourably in ***Study 4***. Second, whilst multiple call backs and appointments were made with the interviewees, data were not collected for those who did not answer their phones to complete the baseline interview. However, this is possible in all research of similar types. Third, some riders may not have given consent to participate in the study due to the randomised control trial study requirement of providing consent for their licence numbers to be used to link with their police-recorded offence and crash data. Thus, safer riders may have been overrepresented in the present sample, decreasing the power to detect predictive validity in terms of police-recorded crashes and offences. However, without access to police-recorded offence and crash data, results would have had to rely on self-report only, and police-recorded data would add more value to the study. Examination of the relationships of MRBQ and MRMQ with crashes and offences via police-report also negated the possible effect of consistency motif (29, 30).

The sample may also not be representative of novice riders in other states of Australia or other countries due to cultural and/or policy variations between jurisdictions and countries. Furthermore, the eligibility criteria for the overall randomised control trial meant that the present sample only included riders of a Learner Approved Motorcycle Scheme (LAMS) motorcycle as required by VicRoads and excluded scooter and moped riders. The level of impact of these study criteria on the generalisability of the present results to other riders who did not meet these criteria is unclear because the effects of these LAMS schemes have not been evaluated and because little is known with respect to the differences in crash risks between motorcyclists and scooter and moped riders (31). This is partly because in many jurisdictions scooter and moped riders are not clearly distinguished in crash data to enable crash risk analyses by motorcycle type. The present results must therefore be interpreted with caution.

On a related note these issues may particularly apply to the ***Study 1*** findings. The proportion of the ***Study 1*** sample out of the eligible participants was low (37%). Whilst the validity checks and reliability analyses were conducted on the maximum dataset available where both baseline and follow-up data were available, the effect of this low proportion on the findings might be that they are not generalisable. The reason for this low proportion was because ***Study 1***was conducted in the middle of an ongoing overall training evaluation study as noted in the Methods. The consequences of that were as follows. First, some of the eligible participants did not end up completing the baseline interview, therefore were not randomised to be part of the final study and thus did not complete the follow-up interview either. Second, the follow-up interview was not yet due at the time of ***Study 1*** for some of the eligible participants who had completed the baseline interview. When the final response rate can be determined after the completion of the entire project, its impact on the reliability and validity of the exposure measures could be assessed.

7.5.2 Social desirability bias

People can lie to present themselves more favourably to others than truthfully, or provide honest self-descriptions but that are positively biased, commonly referred to as social desirability bias (32). The possible social desirability bias was not controlled for in the present studies. Social desirability bias is underlined by two constructs of impression management and self-deception (11, 32). Impression management refers to the conscious purposeful deception of others, which is more likely under identified conditions than under anonymous conditions. Self-deception refers to a lack of self-knowledge or protection of self-beliefs, including maintenance of self-esteem where the individuals actually believe in their positive self-reports (11, 32). Self-deception has also been shown to be influenced by the level of anonymity in the reporting process (33).

No research exists on the social desirability effects on riding exposure, MRBQ, MRMQ, or CV specifically and the extent to which the present results might have been affected by social desirability bias is unknown. Specifically, the MRBQ-crash relationships found in ***Study 2*** may be partly due to social desirability. For example, those who are more likely to admit to speeding and/or errors may also tend to self-report near crashes and crashes. However, the evidence for the effect of social desirability on the DBQ, on which the MRBQ was based, is minimal (34).

Caution for social desirability bias would depend on not only the nature but also the context of the question. For example, for a question on the illegal activity of drink riding, respondents may tend to want to present themselves well and the responses can be biased (34). In fact all three studies (3-5) suggested that the single item on drink-riding in the MRBQ can be deleted due to its weak loading on all the MRBQ factors. On the other hand, a question on how many hours they ride in a week is unlikely to be sensitive to social desirability. However, survey procedures can influence biased reporting (34). Whilst crash and exposure questions were not asked in close association within the present surveys, it may be possible that people with a crash history wish to report more hours if the exposure question is asked in direct association with their crash experience in order to explain their crash involvement. Therefore careful consideration of the overall survey design and tests of social desirability effects on all self-report measures are recommended to ensure their appropriateness.

A concurrent use of a social desirability scale such as the *Balanced Inventory of Desirable Responding* (BIDR; 35) to control for this bias was an option in the present thesis. However, within the contracted questions allowed, this was not possible and it was crucial to keep the interview length to the minimum to avoid respondent fatigue and boredom. Nevertheless, respondents were informed at the outset that individual information would be treated confidentially and not be identified as well as reassured that there were no right or wrong answers, stressing the importance of honest answers. Such procedures are suggested to minimise socially desirable responding (34). In addition the standardised phone interviews controlled the respondent's ability to preview, review, or skip items and change responses. This would also have helped to reduce possible socially desirable responding (36).

Tests of social desirability effects on self-report measures of riding exposure, MRBQ, MRMQ, and CV by having the same respondents complete the *Balanced Inventory of Desirable Responding* (BIDR; 35) in future studies may help to increase the utility of those self-report measures.

7.5.3 Interview bias

All the present data were collected via phone interviews. There may be inherent biases in phone interview data collection such as stronger social desirability bias than with paper and pen, postal, or online survey completion methods for which respondents can complete the questionnaires privately and with greater anonymity and may perceive the process to be impersonal and non-judgemental (34, 37-39). This may have contributed to the insufficient reliability and validity of the self-report measures used in the present research. However, it can be expected that respondents perceive providing answers over the phone to have greater anonymity than in a face-to-face interview. Structured phone interviews also ensured that all the questions were answered in one sitting, consistently across respondents, and respondents were unable to preview or skip questions or revise their responses later, all of which could not be controlled for in paper and pen or postal surveys.

Therefore, phone interviews were considered most optimal for the present research context.

All the interviews were not conducted by the same person. The possible risks to the reliability of the survey administration include variations in the tone of the interviewers' voice, and in the accuracy in reading the questions and entering the responses. The extent to which these inconsistencies between interviewers occurred was not measured in the present studies and is unknown. It is possible that the imperfect consistency between interviewers may have influenced the reliability and validity of the measures used in the present studies. The most obvious and likely effect of any inconsistency is to decrease the reliability and validity of the measures.

Replication of the present studies using data collected via interview methods other than phone interviews would provide more confidence to the present results.

7.5.4 Test of predictive validity in terms of retrospective crashes and offences

The validity of the MRBQ and MRMQ was tested against past crashes and offences which were incurred before the participant joined the study and completed those questionnaires. The rather weak effect sizes found in ***Study 2*** and ***Study 3*** might also be explained by the fact that the analyses used these past crashes and offences. The experience of crashes and/or being caught for a traffic offence in the past may have influenced the riders' behaviours and motivations such that the current behaviours and motivations reported by the riders through the MRBQ and MRMQ respectively could not completely explain retrospective crashes and offences. The predictive validity has only been examined with respect to retrospective crashes in the previous European studies as well (4, 5, 7). Whilst results based on prospective crashes can be confounded by an unknown level of influence of having completed the MRBQ and/or MRMQ on future crash risks and offences, future studies to examine their predictive validity in terms of prospective crashes would be useful to further assess their utility in motorcycle safety research and evaluation.

7.5.5 Practice effects

Practice effects from repeated completion of the same questionnaires on the stability score are possible. However, these stability scores were based on completion of the same questionnaires twice only approximately four to five months apart. Therefore, practice effects, if any, can be expected to be minor.

7.6 Recommendations for research

In addition to the future research recommended in relation to the limitations noted in 7.5, future directions for research are highlighted here based on the present findings and overall limitations.

7.6.1 Replication studies

Replication of the present studies amongst novice and more experienced riders, including in other Australian states, Europe and elsewhere would facilitate understanding the sources of the limited psychometric properties of the MRBQ and MRMQ. They may be influenced by the differences between novice and experienced riders, and/or cultural and licensing policy variations. These possibilities are discussed further in 7.6.3. Understanding the sources of measurement reliability and validity would result in further development and refinement of the MRBQ and MRMQ items, and inform the utility of these measures. Riding experience was indicated as an influencing factor of the reliability of self-report exposure measures (1). It would be useful to replicate ***Study 1*** amongst more experienced riders as well as test the self-report exposure measures against an objective valid measure such as GPS to further confirm the results that hours riding in an average week provide the most reliable data. This will also further inform best practice design of self-report riding exposure questions. Further development and refinement of these measures based on replication studies will in turn warrant these self-report measures more useful in future research to understand motorcyclists' crash risks and evaluate rider safety interventions.

The perceived value of rider training was examined specifically among novice motorcyclists in ***Study 4***. Development of training programs is based on the assumption that it is lack of experience or riding skills that contribute to the higher involvement in crashes by novice motorcyclists and programs are therefore often targeted specifically at novices (40, 41). It is novice motorcyclists that are therefore directly affected by the implementation of such a program. The perceived value in ***Study 4*** was therefore derived from novice motorcyclists. However, the generalisability of the present results to the wider community is not clear. Future replication studies in other population groups would further contribute to understanding determinants of perceived value of rider training.

In addition, it would be worthwhile to replicate the present studies among younger riders with less driving experience to further examine the effects of age and driving experience. The present findings suggest possible effects of riding experience on the reliability and validity of self-report riding exposure measures and the MRBQ and MRMQ. ***Study 1*** showed the reliability of self-report riding exposure measures improved at follow-up. The results of ***Study 2*** and ***Study 3*** found lower reliabilities of the MRBQ and MRMQ scales amongst novice riders in Australia compared to what was found among more experienced riders in the UK (5, 7) and Turkey (4). Furthermore, ***Study 4*** indicated that whilst car licence year was not found to be a significant independent predictor of perceived value of rider training, rider age was a significant positive predictor. The current sample had held a car license for an average of over 17 years and was on average 36 years old. That is, the present riders were not new drivers and not young. It may be speculated that if the sample were drawn from a population of younger and less experienced drivers the reliability and validity of the present measures examined might have been worse, and the perceived value of training might have been lower.

7.6.2 Best practice self-report riding exposure question design

Of all the self-report riding exposure measures examined in ***Study 1***, riding hours in an average week was found to be most reliable and provided the greatest amount of valid data (1). More 'unknown' responses were provided to the question on riding kilometres in an average week than riding hours in an average week, probably reflecting respondents' greater confidence with providing hour estimates than kilometres. Riding exposure self-reported for the week period coincided better with that collected for the three-month period than that for the lifetime period. People are likely to estimate and remember the time it took to travel for more recent and shorter periods than earlier and longer periods (39).

Study 1 also showed that among novice riders the number of trips did not provide a reasonable functional approximation of the distance and time exposure measures used, at least when self-report is used. In practice a variable measuring number of trips would not function as a good measure of exposure to risk in road safety compared to distance or time unless distance and time are the same across all trips. For example, a single trip of 200km (or say 3 hours) would not represent the same risk as a single trip of 2km (5 minutes). Thus, exposure expressed in the units of distance or time, if measured reliably and accurately, better represents actual exposure to risk in road safety than number of trips.

The self-reported odometer question did not provide sufficiently valid and reliable data. A relatively small proportion (around 30%) of the self-reported odometer readings did not end with a “0”. As this would be unlikely for the majority, this suggests that many riders rounded their readings up or down to the nearest 10, 100, 1000, and so on even though they were asked for the exact odometer reading. Rounding up in the recall of journeys has also been indicated amongst drivers (42). In order to minimise potential guessing or rounding up of the odometer readings by the respondents, a tighter protocol that ensures adherence to reporting the exact odometer reading might be required if self-reported odometer readings are used. For example, the interviewer may directly check the respondent’s bike, or specifically request the respondent to go to the bike during the phone interview before asking them to report the exact reading.

The poor correspondence between self-report odometer and self-estimated distance in ***Study 1*** may have arisen because some participants shared their motorcycle and/or used other motorcycles for on-road riding. The odometer readings would indicate the distance travelled by the vehicle irrespective of the driver/rider and not necessarily reflect the riding distance travelled by the respondent rider. Riders who shared their motorcycles with others would have travelled less distance than the motorcycle odometer indicated. Those who rode motorcycles other than that from which the odometer was read for this study would have travelled more distance than the motorcycle odometer indicated. If vehicle is the reason for this effect, the systematically higher estimation of self-estimates relative to odometer derived distances by the present novice riders suggest that they were more likely to ride others’ motorcycle than others to rider theirs. It is plausible that novice riders would be more motivated to ride others’ non-LAMS motorcycle than others would be motivated to ride their LAMS restricted motorcycle. This is one plausible account of the present observations. Additional questions on the level of sharing their bike from which the odometer is obtained and of using more than one bike for on-road riding might help to improve the reliability of self-reported odometer measures in future studies.

It is therefore recommended that self-reported riding exposure questions are asked 1) for the current week rather than earlier and longer periods; 2) in units of time rather than distance or number of trips; and 3) as riding hours in an average week in preference to riding kilometres or self-reported odometer readings. If self-reported odometer readings are used, questions on whether the respondents share their own bike or ride more than one bike, and a built-in process to ensure respondents report the exact odometer reading on their bike are also recommended.

7.6.3 Re-designing the MRBQ and MRMQ

The present findings suggest that the MRBQ and MRMQ need further work before wider use as a valid and reliable instrument, especially for novice riders.

The low number of items for the MRBQ stunts and protective gear scales and MRMQ convenience scales might have contributed to the insufficient internal consistency of the scales. The insufficient reliability of these scales despite their demonstrated validity implies that they are powerful constructs but are poorly measured by the current MRBQ and MRMQ. Development of alternative and additional items as well as refining the wording of the relevant items in future studies is likely to be useful.

Special caution must be made in the development of additional items for the protective gear scale. For example, two original items on wearing a leather one-piece motorcycle suit and bright/fluorescent clothing are unlikely to be consistent with the rest of the protective gear use because if riders use at least one of the other pieces of gear (e.g. jacket and/or trousers; bright/fluorescent patches) they are unlikely to wear a one-piece suit or bright/fluorescent clothing as well. In order to more accurately represent riders' use of protective gear it may be more appropriate to ask whether they wear a leather one-piece motorcycle suit or jacket in one question, one-piece motorcycle suit or trousers in a separate question, and bright/fluorescent clothing or patches on their clothing in another separate question.

The original MRBQ items deleted in ***Study 2*** but in neither of the two European studies (4, 5) must be further examined in future studies to inform refinement of the MRBQ. Such examination will lead to understanding of whether the contents that were originally intended to be measured by those items add value to the MRBQ scales. It may also provide further insight into the possible causes of the inconsistencies of scale structure and constituent items amongst the three existing studies on the MRBQ (3-5). These may include but not limited to novice versus experienced riders, different traffic culture, or poor wording. For example, the item "attempt to overtake someone who you haven't noticed to be signalling a right turn" refers to a very specific overtaking situation that might be too rare for the item to bear any relevance for most riders. Whilst this item loaded on the traffic errors scale in both European studies, it might not have loaded strongly on the present errors scale because overtaking behaviours might be particularly rare for novice riders who may not be able to ride fast or be confident enough to overtake. In fact 86.7% reported they 'never' undertook this behaviour and none reported undertaking it 'nearly all the time'. "Riding between two lanes of fast moving traffic" may also be too rare for the item to bear any relevance for most novice riders. In fact, 83.9% reported they 'never' undertook this behaviour and only 0.5% reported undertaking it ‘nearly all the time’. The rarity may be caused by the fact that such ‘lane splitting’ is illegal in Victoria and can only apply to riding where multi-lane roads exist, and/or novice riders may lack the confidence to do so. This item loaded on the speed violation scale in both European studies but lane splitting is legal in the UK and Turkey and experienced riders may have more confidence to do so. Although the item “wear no motorcycle specific protective clothing” was included in the safety equipment scale in the two European studies, it is a negatively worded item, which might confuse some respondents (i.e. poorly designed item).

The lack of validity of the MRMQ might have been due to the possibility that not all riding motivations that are critical in understanding riding behaviours and crash risks were sufficiently represented in the current MRMQ. For example, none of the MRMQ scales were significant predictors of police-recorded crashes whether or not accounting for MRBQ behaviours. However, the MRBQ stunts scale was a significant predictor of police-recorded crashes while both the MRMQ pleasure and speed scales were found to be significant predictors of MRBQ stunts but not police-recorded crashes. This may suggest that there are other motivations not measured by the current MRMQ that influence stunts and police-recorded crashes. Stronger convenience motivations were related to less use of protective gear, and less use of protective gear was related to greater number of police-recorded offences. However, the convenience scale was not found to be a significant predictor of police-recorded offences. This also suggests that there may be other riding motivations not measured in the current MRMQ that influence protective gear use and traffic offences. Other motivations might include the joy of solo-riding or necessity for transitory riders who are only riding until they can afford a car, as suggested in a qualitative assessment of motorcyclists' motivations (9). There is research to suggest that riding motivations change over time (43) and it is possible that novice riders start out riding for reasons different from reasons why mature riders continue to ride. Items that identify transitory riders are likely to be particularly important to understand novice riders. Further exploratory research to identify and add to the MRMQ motivations is needed.

Aside from the possible lack of motivations reflected in the current MRMQ, another account for the present findings is that riding motivations influence crashes via avenues other than the MRBQ behaviours, such as riding locations. This account is further discussed in 7.6.10 and 7.6.12.

The MRBQ speed violation and MRMQ speed motivation scales demonstrated the strongest reliability across all scales and showed the most consistent results across studies whereas the other scales were less consistent. This may suggest that a measure of speeding behaviour and motivation can be universal whereas measures of other behaviours such as errors, protective gear use, and stunts and other motivations such as convenience must be designed in ways that account for different cultural and legal implications between different countries (e.g. lane splitting), or experience levels of the motorcyclists. It may be speculated that wearing of protective gear may be partly determined by non-rider external factors such as climate other than rider factors such as safety concern such that revealing a single underlying construct of protective gear is particularly challenging in some countries. For example, the cost of discomfort of wearing gear in hot dry summer in Australia as well as riders' concern for safety may determine protective gear use. These dual factors may be a barrier to identify a single underlying construct of protective gear use. Similarly, a measure of stunts performance may partly reflect riding skill levels as well as risky attitude amongst novice riders but more purely risky attitudes amongst experienced riders. The convenience scale in the present sample was focused on the ease of use of motorcycles. This may be a stronger motivator for riding, independent of the other factors such as fuel efficiency in the original convenience scale, amongst novice riders than experienced riders.

7.6.4 Use of MRBQ

Despite the limited reliability and validity of the current MRBQ, the measurement of errors, speeding, and stunts through an improved MRBQ is potentially useful because in practice such behaviours can be speculated to lead to a crash if they are exhibited often enough. ***Study 2*** also suggests that protective gear use is a critical construct to measure an underlying concern for safety and/or compliance with road laws. Therefore, MRBQ could be used to evaluate changes in such behaviours following implementation of programs. The inclusion of some of the items deleted in ***Study 2*** in relation to protective gear use might depend on the purpose of using the protective gear scale. If the main research question is to find the type and level of wearing of protective gear including and using the items such as a leather one-piece suit and motorcycle gloves as independent single item scales rather than as part of a composite scale would be useful. However, if the research question was to understand an underlying safety/risk concern those items in a composite scale of protective gear may be redundant.

7.6.5 Use of MRMQ

Understanding riding motivations is one critical means to inform the development of tailored methods that are more conducive to rider safety. The current MRMQ was shown to have limited reliability and validity in ***Study 3*** but with improvement it is potentially a useful tool to inform the development of tailored interventions.

Consistent with other studies (9, 44, 45), ***Study 3*** suggests motorcyclists are a heterogeneous group showing different riding patterns according to their riding motivations. For example, riding motivations seem to influence riding locations where those who have stronger pleasure motivations tend to ride on winding rural roads; those who have stronger convenience motivations tend to ride in heavy traffic and on local suburban roads but less likely on winding rural roads; those who have stronger speed motivations tend to ride on all types of roads and conditions including local suburban and winding rural roads and in heavy traffic. Furthermore all three motivations were differentially related to MRBQ behaviours, self-reported near crashes and crashes, and police-recorded offences. For example, those who had stronger speed motivations self-reported more errors, speed violations, and stunts whilst riding and near crash experiences and had more police-recorded offences; those who had stronger pleasure motivations self-reported more stunts and protective gear use and had fewer police-recorded offences; those who had stronger convenience motivations self-reported more errors and speed violations, but less use of protective gear, and more self-reported near crashes and crashes. Therefore rider safety interventions need also to be diverse with different foci to target different rider groups.

While ***Study 3*** examined the validity and reliability of the MRMQ in novice riders, the present findings suggest cluster analysis including variables of riding motivations, locations, and behaviours in future studies would also identify different target groups that may require differential interventions to maximise rider safety. Cluster analysis is a data reduction technique that creates meaningful subgroups based on combination of independent variables that maximise similarity of cases within each cluster while maximising the dissimilarity between groups (46). Subgroups of novice riders with different crash risk profile may be identified through cluster analysis, enabling more targeted interventions.

Increasing use of motorcycles leads to increasing number of deaths and injuries amongst motorcyclists (47-49). In this context, the MRMQ may be useful to identify trends in riding motivations and understand the trends in motorcycle use. This understanding may help identify measures to maximise rider safety. Similarly, novice riders may start out riding for reasons that change over time and some of them may continue to ride for different reasons. Previous research indicates that young and older riders ride for different reasons (50) and MRMQ can also be potentially useful to investigate if riding motivations change over time with experience or simply with age. This understanding may help to develop different measures that are suited to different stages of their riding career and therefore maximise their safety.

7.6.6 Testing the stability of the MRBQ and MRMQ in a shorter time interval

Stability of questionnaires can be tested for varying time intervals of weeks to months. Time intervals to test the stability of DBQ have ranged anywhere between six months and three years (51-54) and there is no evidence for the optimal time interval to measure the stability of the DBQ, let alone the relatively new measures of MRBQ and MRMQ. However, a single rule of thumb for the test-retest time interval is unlikely. Rather the decision is dependent on the construct of interest and two considerations must be made. First, the test-retest period must be sufficiently long to ensure participants are answering the questions afresh, and not simply remembering what they answered before. Second, all other things being equal the construct being measured must be expected to be stable over the time interval selected. For example, a measure of hunger is not expected to be stable from one measurement point to another because hunger is a ‘state’ rather than a ‘trait’, while attitudes to safety can be expected to be stable from one point to another all other things being equal. All other things being equal the MRBQ and MRMQ constructs were considered to be relatively stable and an interval of four to five months was considered appropriate to assess their stability as part of ***Study 2*** and ***Study 3***.

It was possible, however, that the present follow-up period of four to five months was too long for the MRBQ behaviours and MRMQ motivations to be stable amongst novice riders who might be particularly malleable to natural change in the earlier months of their riding career. This may have partly contributed to the lack of test-retest reliability scores of the MRBQ errors, stunts and protective gear scales and MRMQ convenience scale. It would be useful to test the stability of the scales for a shorter time interval but with a sufficient lapse of time in future studies.

In the context of evaluation, the stability of the construct being measured to evaluate an intervention has important implications. Testing the stability of MRBQ and MRMQ for different time intervals would further indicate the modifiability of specific behaviours and motivations, adding utility of the MRBQ and MRMQ to evaluate interventions. If the stability of the MRBQ and MRMQ vary with differing time intervals, the time interval that provides adequate and the highest stability scores may indicate the optimal follow-up period for the MRBQ and MRMQ to detect changes due to an intervention being evaluated.

7.6.7 Testing the predictive validity of the of the MRBQ in terms of at fault crashes

Crashes tend to be caused by multiple factors, not just by the individual rider (e.g. speeding behaviour by another road user with which the motorcyclist collided; existence of a tree on the roadside). The lack of validity shown by the MRBQ in ***Study 2*** may partly be explained by the fact that the MRBQ, which is a measure of the individual rider behaviour, can only predict specific crashes that were entirely or mostly due to the rider behaviour and lack the power to predict other crashes that are mainly caused by factors external to the individual rider. This point could be addressed by selecting crashes where the riders themselves were at fault and test the predictive validity of the MRBQ in terms of those crashes (e.g. see 5).

However, identifying such crashes in itself can suffer from issues of validity. The validity and reliability of self-rated responsibility for a crash has not been supported (e.g. 55). The fault attribution in police-recorded crashes may also suffer from validity problems particularly when the other party involved in the crash is dead or depending on the insurance scheme of the crash location (43, 56, 57). Future studies to improve the validity and reliability of fault attribution of crashes to examine this hypothesis are also recommended.

7.6.8 Testing validity with respect to both self-reported and police-recorded crash data

Differential predictive validity of the MRBQ and MRMQ between self-reported and police-recorded crashes was evident in ***Study 2*** and ***Study 3***. There may be several possible explanations for these differences. First, crashes of a different nature may be included in the respective crash data. For example, self-reported crashes include less serious (including low-cost property damage only) crashes than police-recorded crashes because less serious crashes are not required to be reported to police (58, 59). In the present sample 21% self-reported a crash but, of these, 38% did not involve an injury, which may have meant they were not required to be reported to police. In ***Study 2***, MRBQ errors scale was found to be a significant predictor of self-reported near crashes and crashes but not police-recorded crashes. The MRBQ stunts scale was found to be a significant predictor of police-recorded crashes but not self-reported crashes. This may imply that errors might more often than stunts result in near crashes and minor crashes (self-report) but not severe crashes (police-recorded). This account could be wrong in some circumstances because the severity of the resulting crash would depend on the error as well as the surrounding factors. However, such an overall tendency is likely in that performance of stunts is more likely to be deliberate risk taking than errors that could occur without deliberate intentions. The differences in the underlying motivations of expressed behaviours of stunts versus errors might contribute to differential risks of severe crashes. Testing of these hypotheses in future studies would be worthwhile. Similarly, the MRMQ convenience scale was found to be a significant predictor of self-reported near crashes and crashes but no MRMQ scales were significant predictors of police-recorded crashes. This may imply that convenience motivations may influence near crashes and minor crashes, but non-rider factors may influence severe crashes. These results suggest self-reported and police-recorded crashes are likely to provide complementary evidence for validity.

Second, respondents may misreport crashes in self-reports due to either social desirability bias or recall error. Testing the validity of self-report measures with respect to measures from sources other than self-report can negate the possible consistency motif bias where an artificial positive relationship is created due to respondents' tendency to try to maintain consistency in their responses (60, 61). These together highlight the importance of testing validity of self-report measures used in road safety research with respect to both self-reported and police-recorded crashes.

7.6.9 Examination of the validity and reliability of self-report riding exposure measures in relation to riding purposes, locations, and experience

The greater reliability of riding exposure found in ***Study 1*** amongst commuting and rural riders compared to recreational and metropolitan riders respectively and at the second interview compared to the first suggests that factors such as riding purposes, geographical locations, and riding experience can contribute to measurement reliability. The relationship between reliability and geographical locations were examined based on the participants' postcodes. Whilst postcodes of the riders' residence were not a perfect measure, they were the best possible proxy measure for their riding locations of all the available data. Use of a direct measure of riding locations to test the relationship in future studies would be useful. Further research to understand the extent and determinants of measurement reliability in self-report riding exposure measures, particularly in relation to riding purposes, locations, and experience, may help to further improve self-report riding exposure measures and to ensure their appropriate use in future motorcycle crash risk analyses.

7.6.10 Examination of riding behaviours and riding motivations by riding locations

The observed relationships of the MRBQ and MRMQ with police-recorded offences may be influenced by the likelihood of being caught determined by riding locations. Police enforcement is not everywhere at all times and people can speed and make other road rule violations without being caught. Therefore, the actual frequency of speeding self-reported in the MRBQ may not necessarily correspond with police-recorded offences. For example, in Australia, drivers in major urban centres were much more likely than those in other locations to have offences that were detected by speed cameras (62).

Similarly, as observed in the present significant positive relationship with riding on winding rural roads and non-significant relationships with riding on local suburban roads and in heavy traffic, those who ride for pleasure motivations might more often ride on the less busy rural roads, which may be less exposed to enforcement. On the other hand, as observed in the significant positive relationships with riding in heavy traffic, and on local suburban and winding rural roads, those who ride for speed motivations might more often ride on all types of roads in general and be more exposed to enforcement.

Riding locations may also influence self-reported behaviours measured by the MRBQ errors scale. Those who ride in heavy traffic and on local suburban roads and less on winding rural roads might more often recognise their own errors. For example, if their riding was one metre off where it should be, riders may be less likely to recognise it as an error on a rural road that is wide and where they may be the only road user than on an urban road that is narrow and more congested, where they may more likely to notice greater conflict with other vehicles or pedestrians.

Future research to more closely examine the relationships of MRBQ and MRMQ with riding locations may help to confirm these speculations. Understanding these relationships may also allow more targeted and effective enforcement to prevent behaviours that can lead to crash involvements.

7.6.11 Examination of riding behaviours and riding motivations by different types of motorcycles

There are a variety of motivations that influence both riding patterns and type of vehicle chosen. Riders may identify with a particular type of motorcycle which to a large degree reflects their riding motivations and their subsequent patterns of riding. Differences in the levels of protective gear use by different motorcycle types have been reported with particularly low wearing rate by scooter riders (63, 64). The present studies excluded scooter and moped riders. Future research on the variability of riding motivations and behaviours with the types of motorcycles including scooters and mopeds would provide more confidence to the generalisability of the present results or inform the need for policy variations.

7.6.12 Theoretical framework of motorcycle crash risks based on empirical research

Crashes and police-recorded offences tend to be determined by multiple factors including situational factors as discussed above. A traffic offence will not be recorded unless enforcement exists at the time of offending and the chance of riders being caught tends to be very low. Crashes may only occur when all possible risk factors including road designs are at play and riding motivations or riding behaviours singly cannot cause a crash. Any one measure such as the MRMQ or MRBQ will fall short as they only address some of the determinants of crashes and offences. Therefore, a theoretical framework of motorcycle crash risks must incorporate multiple elements and not solely riding behaviours or motivations.

The fact that the convenience motivations remained a significant predictor of self-reported near crashes and both pleasure and speed motivations remained significant predictors of traffic offencesoffences even after accounting for the MRBQ behaviours also suggests that riding motivations can influence crashes and traffic offences via riding behaviours or other non-rider factors not represented in the MRBQ. These factors may include riding locations as discussed above. These together imply that more research is required to develop a comprehensive theoretical model to understand motorcycle crash risks. In particular more research is required to develop theoretical models to understand how convenience motivations influence near crashes, and how pleasure and speed motivations influence traffic offences via factors not measured by the MRBQ.

Incorporation of riding motivations in theoretical models to understand motorcyclists is particularly important because motorcyclists are often found to cite affective motivations such as enjoyment as a key element for riding (9, 44, 45). The importance of affective motivations was further supported by the validity and reliability demonstrated by the pleasure and speed scales of the MRMQ. ***Study 3*** findings also suggest riding motivation is a critical determinant of rider behaviour and motorcycle crash risks, and support the need for behavioural theories like the Theory of Planned Behaviour (TPB) to incorporate motivational constructs. TPB posits behaviours are determined by intentions underpinned by cognitions, subjective norms, and perceived behavioural control (65). Although this theory is widely applied to car drivers (e.g. 66, 67), it has been applied less to motorcyclists (68). It has also been criticised for focusing on purely cognitive processes and lacking consideration of affective determinants of behaviour (e.g. 69, 70). Adding motivational variables in TPB may improve the applicability of TPB in motorcyclists.

7.6.13 Further examination of determinants of training valuation

The low goodness of fit (R-square=.233) of the overall regression model in ***Study 4*** may suggest that other determinants of perceived value, such as attitudes to risks, were missing from the present analysis. Further research to explore other determinants would determine this.

7.6.14 Evaluation of measures to align perceived value and effectiveness

Study 4 showed that perceived value is modifiable with age, near crash experiences, and participation in training as key determinants. This modifiability of perceived value may imply that it may be possible to manipulate some determinants of perceived value in order to align perceived value with actual effectiveness of interventions, thus allowing more appropriate resource allocation. Future research to find effective ways to align the perceived value with effectiveness evidence is worthwhile. Potential options to explore and evaluate may include community education on evidence on training effectiveness as well as alternative measures that have demonstrated effectiveness in reducing crash risks. The CV methods applied in ***Study 4*** may be employed to quantify effects of such options intended to reduce the perceived value of training, thereby evaluating measures to modify perceived value.

7.6.15 Randomisation of the bidding order when using the bidding format to elicit WTP in CV surveys

The bidding format in CV surveys commonly suffers from starting point bias (71, 72) and its effect seems pervasive whether the product provision is framed in a public or private setting (22). Starting-point bias was found to be a powerful influence on individual valuations in ***Study 4***, confirming the importance of the randomization of the bid presentation in order to obtain a balanced overall mean perceived value when using the bidding format to elicit willingness to pay values.

7.7 Recommendations for policy and practice

Recommendations for policy and practice can be made based on the body of work presented in this thesis.

7.7.1 Continued focus on development and evaluation of interventions for speeding

The MRBQ speed violations scale demonstrated good reliability and showed the most consistent results amongst the three studies whereas other scales were less consistent (3-5). This may suggest that speeding is a universal issue and emphasises the need for continued focus on development and evaluation of interventions for speeding.

The effect of MRMQ speed motivations on MRBQ speed violations and stunts was the strongest across the MRMQ motivations and across the MRBQ behaviours. Further, speed motivations had one of the strongest effects on police-recorded offences. These indicate speed motivations have a pervasive effect on many forms of risk taking. These findings as well as the ability of the speed motivation scale to predict near crashes highlight the importance of interventions to reduce the overall attraction of risk taking especially amongst novice riders who are particularly motivated by the speed aspect of riding. They also highlight the utility of the MRMQ speed scale to evaluate the effects of interventions in terms of those central road safety outcomes amongst riders.

The stability shown by the MRBQ speed violations and MRMQ speed motivation scales suggests that speeding behaviour and motivation are particularly consistent over time. This has implications for interventions and policy. Measures that have more immediate deterrence effects such as mix of covert and overt speed enforcement (73); point-to-point speed cameras (74); Intelligent Speed Adaptation, a technology that automatically alerts drivers if they exceed the speed limit (75); and increased enforcement density and/or penalty size as well as their announcements (76) may be more effective in reducing speeding behaviours than measures that aim to induce changes in speeding behaviours in the longer-term such as via training.

7.7.2 Legislation, enforcement, and education

The present findings have legislation, enforcement, and education implications.

Of all the MRBQ scales, only the protective gear scale demonstrated some content validity and predictive validity with respect to police-recorded offences. Those who self-reported to use protective gear more frequently were less likely to have a recorded helmet and drink riding/driving offences. This parallels with the finding that drink riders were half as likely to wear a helmet as non-drink riders (77). More frequent use of protective gear was also associated with fewer police-recorded offences. These findings together suggest that protective gear use including helmets may reflect riders' underlying concern for safety and/or compliance with road laws, and increased use would be beneficial. The effectiveness of behaviour change with the introduction of legislation and enforcement has been shown amongst car drivers, especially in relation to seatbelts, drink-driving, red-light violations, and speeding (e.g. 78-83). It may also be of value to consider introduction of mandated use of protective clothing to promote increased use. Community education on conspicuous and protective clothing may also facilitate increased use of protective gear, as shown amongst metropolitan riders in Victoria, Australia (63).

The different associations of riding behaviours and motivations with police-recorded offences found in the present studies suggest riders may choose to perform risky behaviours in locations and at times of perceived low likelihood of being caught. This implies that managing the perceived risk of being caught is critical in reducing risky riding behaviours in general. Unpredictable and visible enforcement are key elements to increase perceived risk of being caught as suggested by the effectiveness of the combination of overt and covert mobile enforcement (73). Drivers who have a high perceived risk of being caught are also found to be more accepting of enforcement and are more likely to report safer driving behaviours (84).

7.7.3 Use of CV surveys as a way to inform implementation strategies and facilitate appropriate resource allocation in road safety

Study 4 demonstrated CV as an appropriate tool to quantify the value novice motorcyclists place on rider training and to understand the determinants of its perceived value. The finding that perceived value is modifiable has broader implications for road safety where, aside from scientific evidence, community demand and therefore politics play a powerful role in road safety decisions. Specifically, understanding the determinants of perceived value via CV surveys on road safety measures such as speed camera and bicycle helmet legislation where the mismatch between robust scientific evidence and lack of community demand is observed (85-87) can be useful to inform implementation strategies. The use of CV is recommended for policy makers to address perceived value of various road safety interventions and therefore facilitate appropriate resource allocation in road safety.

7.7.4 Seek value of rider training from well-informed individuals in cost-benefit analysis

The introduction and adoption of safety enhancing programs impose an increasing burden on household and government budgets. A cost-benefit analysis is one of the bases for the justification of additional spending on and the prioritisation between different policy measures targeted at road safety improvement (19, 88). The most empirically established method to measure people's WTP is the CV survey, in which individuals of a representative sample of the population at risk are directly asked to value in monetary terms a hypothetical reduction in risks of their own and possibly other people's (19, 88). The WTP values derived from CV surveys of reducing road mortality risk is usually one of the dominating components of the benefit expressed in benefit-cost ratios of transport investments and policies (89).

In the case of rider training user perceived value is reduced by the participation in the training and with increasing near crash experiences. This suggests that the traditional *ex ante* approach (that is, obtaining values from those who have not experienced the training or near crashes) to cost-benefit studies may lead to inflated benefit calculations of training, and those who have little or no knowledge of the effectiveness of training ought to have little weight in the decision making process. It is recommended that cost-benefit analysis is based on benefit values derived from well-informed individuals so that resources are allocated appropriately.

7.8 Conclusions

Whilst the present research was based on Victorian novice motorcyclists, many practical implications arise from the body of research presented in this thesis for other jurisdictions and internationally. Each chapter has built on the preceding one, providing a picture of the contributing elements to best practice research in motorcycle safety. Specifically, in ***Study 1*** a comprehensive set of statistical analyses were performed to test the validity and reliability of various forms of self-report riding exposure measures. Practical recommendations for best practice design of self-report riding exposure questions were provided based on the present findings. In ***Study 2*** and ***Study 3*** a comprehensive psychometric assessment of the MRBQ and MRMQ was achieved. Specifically, previously untested psychometric properties of stability, content validity, and predictive validity in terms of police-recorded offences and crashes as well as previously assessed factor structure, internal consistency, and predictive validity in terms of self-reported crashes were examined. These two studies were the first to examine the applicability of MRBQ and MRMQ amongst novice riders, and indicated that MRBQ and MRMQ are premature as they currently stand, at least amongst Australian novice riders. Further work is required before their wider use and recommendations for the re-design and use of the MRBQ and MRMQ were provided in the present thesis. In ***Study 4*** a methodologically rigorous CV survey research was implemented, demonstrating the utility of CV in measuring, understanding, and therefore addressing the perceived value of rider training amongst novice motorcyclists. ***Study 4*** is the first to empirically quantify the perceived value of rider training and analyse the determinants through a well-designed CV survey. The four studies highlight that the appropriateness of self-report is dependent on not only the nature of the phenomenon under study but also the extent to which the factors that contribute to measurement reliability are taken into account in the design of self-report measures. Self-report data must also be able to contribute to better understanding of the causal relationships between behaviours, motivations, and attitudes, and crashes, injuries, and fatalities in order to bear relevance in road safety. Empirically informed question design can warrant self-report to be a valuable tool in motorcycle safety research. This thesis demonstrates the value of assessing the reliability, validity, and utility of self-report measures in providing results that contribute to best practice motorcycle safety research, policy and practice.

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Appendices

Eight appendices are included in this thesis:

1. *VicRide* evaluation trial invitation letter and information leaflet
2. Web recruitment script
3. Phone recruitment script
4. Baseline phone interview script
5. Follow-up phone interview script
6. Ethics approval
7. Journal confirmation of manuscripts in press and submitted
8. Authorship statements

EACH APPENDIX FOLLOWS OVERPAGE.

Appendix 1: *VicRide* evaluation trial invitation letter and information booklet

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vicroads.vic.gov.au

JOIN IN THE FREE VICRIDE

Congratulations on gaining your motorcycle licence. Now you have passed the test, I would like to invite you to participate in a world first trial VicRoads is offering to riders.

The opportunity is a free, four hour on-road coaching session involving a variety of city and country riding, with an experienced coach who will provide guidance and feedback. Coaches are experienced rider trainers who have a high level of motorcycle riding safety awareness and skill.

What's in it for you?
For participating in the trial, you will receive:

- a free on road coaching program
- a $90 gift voucher to thank you for your participation.

You may also be eligible for an additional gift voucher worth $50.

Why are we doing this?
Since 2002 there had been a reduction of 31% in motorcyclist fatalities in Victoria, compared to an increase of 19% for the rest of Australia. However, in the first half of 2010, there was a sharp increase in the number of riders being killed on our roads.

This innovative trial will demonstrate whether coaching can be effective in improving motorcyclist safety. But to do this, we need your help. This is your opportunity to participate in an initiative that could benefit all riders.

How can you participate in the program?
The enclosed booklet contains more information about the program.

To sign up to participate visit: http://monash.edu/miri/research/participate-in-our-research.html using the code LBK. You may be contacted by telephone about participating in the program. If you do not wish to be contacted, please email vicride@george.org.au or phone 1800 105 945.

When you participate in the trial you will be randomly selected to either participate in the ride now or in 12 months time.

I urge you to take the time to find out more about this innovative program.

Yours sincerely

James Holgate
Director - Road User Safety

State Government Victoria

TRIAL OF VICRIDE: ON-ROAD COACHING

Information Booklet

VicRide: on-road coaching

Introduction

VicRoads is offering motorcycle riders an opportunity to be involved in a trial of an on-road coaching program. The trial involves completion of a four hour on-road ride and three 30 minute telephone interviews over 12 months.

When you complete the trial you will receive a $90 gift voucher or cash payment.

This booklet explains the trial in more detail and provides key information about the trial to help you determine whether you would like to join.

This booklet contains:

The trial was supported by the former Victorian Motorcycle Advisory Council and is being funded by the Motorcycle Safety Levy.

You may have received this booklet in the mail or from your training provider.

You can sign up online at **monash.edu/miri/research/participate-in-our-research.html**

You may also be contacted by telephone about joining the trial.

If you don't want to be contacted, please email **vicride@george.org.au** or phone **1800 101 522**.

"I didn't feel judged for riding ability or any lack thereof. I felt safe and not pushed to exceed skill/comfort level. The rural sections of the journey were very enjoyable."

Explanatory Statement

Development and evaluation of a large-scale trial of the *Vicride: on-road coaching* program for motorcyclists.

What is VicRide?

You are invited to participate in a trial of the *VicRide: on-road coaching* program. Not enough is known about the effectiveness of training for motorcycle riders. The aim of VicRide is to improve the training of motorcycle riders and determine how effective the program is at improving safety for motorcycle riders.

The *VicRide: on-road coaching* program has been developed for Victorian motorcycle riders. Small groups of riders are accompanied by an experienced rider trainer (the coach) who will provide advice and feedback on your riding style. The ride, including discussions, will last for about four hours and incorporate both rural and urban riding.

Who is conducting the research?

The research is being conducted by Christine Mulvihill, a Research Fellow at the Monash University Accident Research Centre (MUARC); Mr Mark Collins, National Manager of Honda Australia Rider Training; Dr Mark Symmons (Research Fellow, MUARC); Associate Professor Rebecca Ivers and colleagues at the George Institute for Global Health (affiliated with the University of Sydney) and employees from the Survey Research Centre (SRC).

The coaches delivering the on-road coaching program are experienced rider trainers with a high level of motorcycle riding safety awareness and skill. The coaches have been employed from motorcycle training providers across Victoria.

How did the researchers obtain your contact details?

The researchers obtained your contact details in one of two ways:

→ VicRoads gave your name and telephone number (as listed on the VicRoads Registration and Licensing Database) to the George Institute for Global Health and the Survey Research Centre.

→ You provided your details in a consent form and gave it to a motorcycle training provider. The training provider gave this form to the George Institute for Global Health and the Survey Research Centre. The training provider has been subcontracted to collect your contact details on behalf of Monash University Accident Research Centre.

The Survey Research Centre will telephone rider candidates to determine if they can participate in the trial, and conduct telephone interviews with the riders who are eligible and consent to participate.

Who can participate?

To participate you must:

→ hold a Victorian probationary or restricted motorcycle licence
→ have ridden at least 500 km on-road over a minimum of 12 rides (since obtaining your learner permit)
→ be in the first year since you gained your motorcycle licence (i.e. on a LAMS restriction)
→ ride your own motorcycle (minimum 125 cc, no scooters).
→ complete the on-road ride within six weeks of completing your first interview with the Survey Research Centre (if you get assigned to the Ride Group – see 3, following page).

How will you be rewarded for your time?

To reward you for your time, you will be given:

→ a free high visibility vest on completion of the on-road ride
→ a $50 voucher/cash payment if you are randomly assigned to the Ride Group and complete the on-road ride within six weeks of completion of the first telephone interview
→ a $90 voucher/cash payment after completing the third telephone interview.

VicRoads will send you a letter by mail to enable you to collect the $90 voucher/cash payment from any Australia Post retail outlet. If you are eligible (i.e. you are randomly assigned to the RIDE group and complete the on-road ride within 6 weeks of the date you complete the baseline interview), HART or VicRoads will also send you a letter by mail to enable you to collect a $50 voucher/cash payment.

MONASH University Accident Research Centre
THE GEORGE INSTITUTE for Global Health
THE UNIVERSITY OF SYDNEY

Where is the trial being conducted?

The trial is being conducted at four locations in Victoria: Somerton, Kilsyth, Bendigo, and Cranbourne.

What you have to do

1. Check your eligibility and consent to participate

At the time of consenting, you will be asked a number of questions to determine your eligibility to participate in the trial.

If you are eligible and consent to participate, you will be asked to provide us your contact details and licence number.

2. Participate in three telephone interviews

You will be asked to complete three telephone interviews over a 12 month period.

In each interview, one of our research staff will ask about your riding and driving experience and training, risk perception and rider skills.

After about three months and again after 12 months we will call you to conduct another interview. Each interview will take about 30 minutes.

This information will be used to evaluate the impact of the program on safety.

3. Complete the four hour ride

At the end of the first interview you will be randomly allocated into either the Ride Group (immediate on-road ride), or the Delayed Ride Group.

Ride Group

If you are allocated to the Ride Group you will be invited to take part in the ride immediately. You must complete the ride within six weeks of the date of your first interview. If you do this you will be rewarded with a $50 voucher. The $50 voucher is in addition to the $90 voucher/cash payment you will receive at the end of the study.

Delayed Ride Group

If you are in the Delayed Ride Group you will be invited to take part in the ride in about 12 months time, after you have completed all three interviews.

4. On-road ride

Booking in for the ride

If you are allocated to the Ride Group, you will be provided with details on how to contact HART to book in to do the ride. HART will also contact you. Sessions are run on weekends and weekdays.

On the day

When you turn up for the ride please ensure you have your current motorcycle probationary or restricted licence with you.

HART will check that you are:

→ wearing full protective clothing. This includes an AS/NZS1698 helmet (preferably with eye protection), motorcycle jacket and gloves, boots that protect ankles, and heavy jeans (leather, textile or kevlar jeans preferred).

→ riding a motorcycle which is in good mechanical condition and has plenty of tread on the tyres

→ riding a motorcycle appropriate for your class of licence.You will be asked to read and sign HART's 'Exclusion of Liability and Indemnity' form.

You will be asked to read and sign HART's 'Exclusion of Liability and Indemnity' form.

Before the commencement of the ride you will be required to complete an initial short ride to demonstrate that you can ride a motorcycle safely.

You will not be able to continue with the ride if you do not meet the above safety checks.

The ride

The ride will be guided by an experienced coach who will work with you to build on your knowledge and experience to improve your riding style. The ride involves regular stops along the way to enable regular discussion between the coach and riders. Each rider will get opportunities to lead the group as well as to follow the coach and observe the other riders.

5. Other data we will collect about you

If you consent to participate in the research, we will use your licence number to collect your rider and driver history from VicRoads. This will include licensing details, crash history, demerit points and riding and driving offences. This information will be given to the George Institute for Global Health by VicRoads to evaluate the impact of the program on safety. For full details of the VicRoads' privacy statement, please see the included document 'Protecting Your Privacy'.

The George Institute for Global Health will collect information from the Transport Accident Commission (TAC), about the treatment cost, type and severity of any motorcycle related injuries you have. This information will also be used by the George Institute for Global Health to evaluate the impact of the program on safety.

The George Institute and Monash University will provide your name and address to VicRoads for the purpose of sending out your payment letter(s).

6. Withdrawing from the research

Participating in the trial is voluntary. You are free to withdraw from it at any time up until you have completed your third interview.

Your decision to participate or not in this research or to withdraw from it will not be used by the coach or anyone else to influence your performance in any licence testing or training at HART or at any other motorcycle rider training and test facility.

Privacy and confidentiality

Any and all personal information you give us will be treated in strict confidence. Personal information includes any information that could be used to identify you.

At the conclusion of the study, all identifying information will be removed from the data.

A report will be written about the trial and sent to VicRoads and the data may be used to write a scientific journal or conference paper. All reports and papers arising from the trial will be published in summary form and it will not be possible to identify any individual from the reports or papers. Your responses to interview questions will not be provided to VicRoads or the TAC.

Inconvenience, discomfort and risks

Motorcycling is an inherently risky activity because of the lack of protection afforded by a motorcycle in the event of a crash. By taking part in the VicRide on-road coaching program you will be exposed to the same road safety risks that you and other motorcyclists face any time they ride on the road.

There will be regular rest stops and breaks for discussion, however you may experience fatigue. You should let the coach know if you are experiencing any difficulty at any time.

Data storage

Storage of the de-identified data will adhere to the regulations of Monash University and the University of Sydney and kept on University premises on password protected computer databases and in locked filing cabinets for seven years. After seven years all data will be destroyed.

Results

If you would like to be informed of the research findings, please check The George Institute's website **thegeorgeinstitute.org** after September 2014.

"I liked getting experience on new rides with supervision and feedback."

Participant Consent Form

To participate in the trial you will be required to provide your informed consent.

If you are eligible and consent online, the consent form below will be presented to you before you enter your contact details.

If you are eligible and agree to participate over the phone, the researcher will read you a summary of the text below and ask you to provide verbal consent to participate. If you consent to participate the researcher will conduct your first telephone interview.

I agree to take part in the Monash University Accident Research Centre and The George Institute for Global Health research project specified in the Explanatory Statement . I have read the Explanatory Statement and I understand what is required of me as a participant. I understand that agreeing to take part means that:

I will provide my contact details and my licence number and describe my riding experiences since being licensed.

I will be participating in three telephone interviews conducted by the research team, which will ask questions about me, my riding and driving experiences, risk perception and riding skills, and my opinions about the on-road ride program.

I will take part in a four-hour on-road ride in which I will ride my own motorcycle and allow my coach and others in my riding group to provide me with verbal feedback on my riding. I agree to follow all instructions of the coach.

The research team at The George Institute for Global Health will have access to my:

→ Traffic crash details (provided by VicRoads)

→ Personal information including my licensing details and driving and motorcycle riding records (provided by VicRoads)

→ Information about treatment type, cost of treatment and type of injury for any motorcycle related injuries I may have during the 12 month evaluation period that are compensated by the Transport Accident Commission.

VicRoads will provide my traffic crash details and my personal information to The George Institute. I consent to VicRoads providing this information to The George Institute. The research team will pass on my name and address to VicRoads only for the purposes of posting out the letter that allows me to collect my $90 voucher/cash payment and/or the $50 voucher (if applicable). I consent to the research team passing on this information to VicRoads.

VicRoads is committed to protecting your privacy. For full details of its privacy statement, please see enclosed Privacy Policy or go to **vicroads.vic.gov.au/Home/Options/Privacy**

Monash University is subject to the Information Privacy Act 2000 (Victoria) and is committed to protecting your privacy. For full details of its Privacy Statement please go to **monash.edu.au/legals/privacy.html**

The George Institute for Global Health is affiliated with the University of Sydney, and its data collection and use is consistent with the Privacy Policy of the University of Sydney. Full details of the University of Sydney Privacy Policy can be found at **usyd.edu.au/senate/policies/Privacy.pdf**.

I understand that any information I provide will be kept confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project. My information and data will be securely stored. Following the conclusion of the project the data will be de-identified and stored for seven years as per Monash University and the University of Sydney requirements. After the storage period the data will be destroyed.

I understand that I can access a transcript of data concerning me for my approval before it is included in the write up of the research.

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw my data at any stage of the project up until completion of my third telephone interview. My withdrawal from this research will not result in me being penalised or disadvantaged.

MONASH University
Accident Research Centre

THE GEORGE INSTITUTE
for Global Health

THE UNIVERSITY OF SYDNEY

VicRoads Privacy Policy

Protecting Your Privacy

VicRoads is committed to protecting your privacy. We are required by law to protect personal, health and other confidential information such as information relating to your driver licence and vehicle registration. This statement summarises VicRoads policies for the management of personal, health and other confidential information.

- We cannot collect, use or disclose information of a personal nature, health information or information that is commercially sensitive, except to the extent set out in the Road Safety Act 1986, the Information Privacy Act 2000, and the Health Records Act 2001. Our staff are trained in their obligations under these Acts.
- We will only collect information about you, that is necessary for us to perform our functions. We will always try to do so in a fair, lawful and nonintrusive way. Wherever possible, we will collect information directly from you rather than from third parties. We will do our best to tell you if we collect information about you from a third party.
- When we collect information from you we will tell you why we are collecting it, any law that requires it to be collected, the organisations or type of organisations to whom we would usually disclose it, the consequences for you if the information is not provided to us and will inform you of your rights to have access to the information.
- We are prohibited from using or disclosing personal or commercially sensitive information obtained under the *Road Safety Act*, such as driver licence or vehicle registration information, except for purposes permitted by the Act. We are also prohibited from using or disclosing health information except in limited circumstances set out in the *Health Records Act*. For example, we are allowed to use information about you:
  - for the purposes of driver licensing and vehicle registration
  - for law enforcement purposes, including legal proceedings, prosecutions, investigations and enforcement of judgements and court orders (the information may also be disclosed to appropriate organisations or personnel for the same reasons)
  - for public safety purposes.
- Other examples of permitted use include disclosure of the information to:
  - other State government or Territory road or traffic authorities for the purposes of exchanging vehicle and driver information
  - the manufacturer or supplier of vehicles in connection with vehicle safety recalls
  - the Transport Accident Commission
- Aside from where the law specifically allows us to use or disclose personal or health information, we will not do so, without your consent, for purposes which are unrelated to the purposes for which we collected the information.
- We do everything we can to make sure that the information we hold about you is accurate, complete and up to date. We are required under the Public Records Act to hold some records for extended periods. We will not keep information longer than we need to. From time to time we check our databases to ensure that the information we hold is accurate and up to date.
- Access to our computer systems is controlled and monitored. Our staff and authorised external users only have access to systems that their duties require. We have comprehensive auditing procedures to prevent and detect fraud. Our computer systems uniquely identify individual users to ensure that access is appropriately authorised. Transactions involving information of a personal nature that can be audited are traceable to an individual VicRoads officer.
- Our Internet privacy policy is contained on our website privacy statement located at **vicroads.vic.gov.au**
- An individual or organisation (such as an enforcement agency), seeking access to personal, health and other confidential information held by VicRoads has to sign a confidentiality agreement. When entering into an agreement, the recipient agrees that the information will only be used and disclosed in accordance with the terms and conditions outlined in the agreement. However, if you authorise us in writing to release the personal information to another individual or organisation, then a confidentiality agreement is not required.
- If you ask us, we will generally give you access to information we hold about you. However, there are some exceptions to this. For example, we do not have to give you access to personal information we hold about you where doing so would pose a serious and imminent threat to life or health, would unreasonably impact on the privacy of others or where the information would otherwise be exempt from disclosure by law. We do not have to give you access to health information that is supplied to us in confidence in some circumstances.
- We may from time to time transfer personal, health or other confidential information about you to organisations in other States and Territories. We are permitted to exchange registration and licensing information with other State and Territory road authorities, and for some other purposes that are set out in the Road Safety Act. In other cases, we will only do this where you consent, where we believe that the recipient organisation is subject to binding privacy obligations that are substantially similar to the ones under which we operate, or where it is in your interests for us to do so.
- We thoroughly investigate any suspected infringements of privacy. Our anti-fraud unit develops fraud prevention strategies to identify procedural and systems weaknesses and develops and delivers anti-fraud and corruption awareness programs. Disciplinary action is taken in cases where investigations of suspected infringements of privacy are proven.
- If you:
  - want to have access to personal or health information we hold about you
  - want to know more about what sort of information we hold, for what purposes and how we deal with that information
  - have concerns that we may have infringed your privacy rights, you should contact:

    The Information Privacy Co-ordinator
    Level 5, 60 Denmark Street
    Kew Victoria 3101
    Telephone: 13 11 71

"Learnt some new skills from an experienced instructor."

Researcher contact details

To contact the researchers about any aspect of this study:

For enquiries related to the on-road trial:

Christine Mulvihill
Monash University Accident Research Centre
Christine.Mulvihill@muarc.monash.edu.au
Tel: +61 3 9905 4367
Fax: +61 3 9905 1809

OR

For enquiries related to the evaluation of the on-road trial:

Associate Professor Rebecca Ivers
The George Institute for Global Health
rivers@george.org.au
Tel: +61 2 9657 0361
Fax: +61 2 9657 0301

If you have a complaint concerning the manner in which this research is being conducted, please contact:

For concerns related to the on-road trial:

Executive Officer
Monash University Human Research Ethics Committee (MUHREC)
Building 3e Room 111
Research Office
Monash University
VIC 3800
Tel: +61 3 9905 2052
Fax: +61 3 9905 1420
muhrec@adm.monash.edu.au

OR

For concerns related to the evaluation of the on-road trial:

Manager
Human Ethics Administration
University of Sydney
NSW 2050
Tel: +61 2 8627 8176
Fax: + 61 2 8627 8177
ro.humanethics@sydney.edu.au

"I consider it real training and not just learning how to operate a bike."

Authorised and published by VicRoads - 60 Denmark Street, Kew, Victoria, 3101 VRPIN02763 12.11

MONASH University Accident Research Centre
THE GEORGE INSTITUTE for Global Health
vicroads
State Government Victoria

Appendix 2: Web recruitment script

VicRide: on-road coaching

1. VicRide: on-road coaching program

You've learnt to ride
You've passed the test
Now take the next step

Enrol in the *VicRide: on-road coaching* program and take a 4 hour on-road coached ride with two other recently licensed riders and an experienced rider trainer who will give you feedback on your riding style.

The program is being delivered as part of a research project to understand the impact of the *VicRide: on-road coaching* program on motorcyclist safety.

Because it is a research project, there are a couple of important things you need to know before continuing:

- Half of the participating riders will take part in the coached on-road ride 1-6 weeks after enrolling (the Ride Group). The other half of the group will take part in this ride at the end of the study in about 12 months time (the Delayed Ride Group).
- If you agree to take part, you will be allocated to one of these groups randomly by computer. This means you cannot choose whether to take part in the ride immediately or at the end of the 12 months.
- Riders in both groups will be interviewed about their riding experience at three stages over the 12 months.
- Riders in the Delayed Ride Group are really important to the study. By comparing their progress to that of the group who take part in the on-road ride immediately, we will be able to determine whether any differences are due to the program or just general riding experience.
- Riders in both groups will receive a $90 gift card and a free high visibility vest to compensate for their time.

The on-road ride will take place at one of four locations: Somerton, Kilsyth, Cranbourne or Bendigo. In order to take part in the on-road ride, you must:

- ride your own motorcycle (minimum of 125cc, no scooters)
- be in the first year since you gained your motorcycle licence (i.e. on a LAMS restriction)
- ensure your motorcycle is in good mechanical condition and has plenty of tread on the tyres.
- hold a probationary or restricted Victorian motorcycle licence (if you hold a learner permit you need to wait until you have gained your motorcycle licence before you can take part)
- have ridden at least 500 km on-road over a minimum of 12 rides since obtaining your learner permit
- have mastered basic motorcycle riding skills.

On the day of your ride the coach will ask you to briefly demonstrate your riding in order to check that you are appropriately experienced and eligible to participate in the ride. If you passed your motorcycle licence test and haven't had a long non-riding break since then, you should be eligible for the program. Riders who are unable to demonstrate basic riding skills on the day of the ride will not be permitted to continue. If appropriate, these riders are welcome to participate another time providing they meet the eligibility criteria at that time.

Please proceed to the next screen to find out if you are eligible to participate.

VicRide: on-road coaching

2. Participation

Please answer the following eleven questions below to determine if you are eligible to take part.

1. Will you ride your own motorcycle (no scooters allowed) for the on-road ride?

- Yes
- No

2. Is your motorcycle LAMS approved with an engine capacity of 125cc or greater?

- Yes
- No

3. Is your motorcycle in good mechanical condition with plenty of tread on the tyres?

- Yes
- No

4. Do you hold a probationary or restricted motorcycle licence to ride in Victoria?

- Yes
- No

5. Have you been on your probationary/restricted motorcycle licence for one year or less?

- Yes
- No

6. Since obtaining your motorcycle learner permit have you ridden at least 500 kms on public roads?

- Yes
- No

7. Since obtaining your motorcycle learner permit have you ridden at least 12 separate rides on public roads?

- Yes
- No

8. Are you able to accelerate up to and maintain the posted speed limit on all public roads when safe to do so?

- Yes
- No

9. Are you able to maintain speed limits of between 40-70 km/h on metropolitan public roads when safe to do so?

- ◯ Yes
- ◯ No

10. Are you able to maintain speed limits of between 80-100 km/h on rural public roads when safe to do so?

- ◯ Yes
- ◯ No

11. If you are assigned to the Ride Group are you able to complete the on-road ride no later than six weeks after enrolling?

- ◯ Yes
- ◯ No

Please click on 'Next' to proceed to the next screen

3. Explanatory Statement

VicRide: on-road coaching

You are now entering a secure site: all parts of the website where your personal information is entered are protected.
Use only the 'Previous' and 'Next' buttons at the bottom of each screen.
DO NOT use any of the browser buttons as your information may be lost.
Please read the explanatory statement below carefully which explains the research and what we will ask you to do.

DEVELOPMENT AND EVALUATION OF A LARGE-SCALE TRIAL OF THE
VICRIDE ON-ROAD COACHING
PROGRAM FOR MOTORCYCLISTS

EXPLANATORY STATEMENT

What is VicRide?
You are being invited to participate in a trial of the *VicRide: on-road coaching* program. Not enough is known about the effectiveness of training for motorcycle riders. The aim of *VicRide* is to improve the training of motorcycle riders and determine how effective the program is at improving safety for riders.

The *VicRide: on-road coaching* program has been developed for Victorian motorcycle riders. Small groups of riders are accompanied by an experienced rider trainer (the coach) who will provide advice and feedback on your riding style. The ride, including discussions, will last about four hours and incorporate both urban and rural riding.

Who is conducting the research?
The research is being conducted by Christine Mulvihill, a Research Fellow at the Monash University Accident Research Centre (MUARC); Mr Mark Collins, National Manager of Honda Australia Rider Training (HART), Dr Mark Symmons, Research Fellow, MUARC, Associate Professor Rebecca Ivers and colleagues from The George Institute for Global Health (affiliated with the University of Sydney) and employees from the Survey Research Centre (SRC).

The coaches delivering the on-road coaching program are experienced rider trainers with a high level of motorcycle riding safety awareness and skill. The coaches have been employed from motorcycle training providers across Victoria.

Who can participate?
To participate you must:
• hold a Victorian probationary or restricted motorcycle licence
• have ridden at least 500 km on-road over a minimum of 12 rides (since obtaining your learner permit)
• be in the first year since you gained your motorcycle licence (i.e. on a LAMS restriction)
• ride your own motorcycle (minimum 125 cc, no scooters).
• ensure your motorcycle is in good mechanical condition with plenty of tread on the tyres
• complete the on-road ride within six weeks of completing your first interview (if you get assigned to the Ride Group - see 2 below)

How will you be rewarded for your time?
To compensate for your time, you will be given:
• a free high visibility vest on completion of the on-road ride
• a $50 voucher if you are randomly assigned to the ride group and complete the on-road ride within six weeks of completion of the first interview.
• a $90 voucher after completion of the third interview.

Where is the trial being conducted?
The trial will take place at one of four locations in Victoria: Somerton, Kilsyth, Bendigo and Cranbourne.

What do I have to do?

1: Check your eligibility and consent to participate
On the next screen you will be asked to enter your contact details and licence number and answer some questions about your riding experiences. We will use this information to determine whether you fit the profile of riders we are recruiting and to contact you to participate.

2: Participate in three telephone interviews
You will be asked to complete three telephone interviews over a 12 month period.
In each interview one of our research staff will ask about your riding and driving experience and training, risk perception and rider skills. After about three months and again after 12 months we will call you to conduct another interview. Each interview will take about 30 minutes.

This information will be used to evaluate the impact of the program on safety.

3: Completing the four hour ride

At the end of the first interview you will be randomly allocated by computer into either the Ride Group (immediate on-road ride), or the Delayed Ride Group.

Ride Group

If you are in the Ride Group you will be invited to take part in the ride immediately. You must be prepared to complete the ride within six weeks of the date of completion of your first telephone interview. If you do this then you will be rewarded with a $50 gift voucher. The $50 voucher is in addition to the $90 voucher/cash payment you will receive at the end of the study.

Delayed Ride Group

If you are in the Delayed Ride Group you will be invited to take part in the program in about 12 months time, after you have completed all three interviews.

4: On road ride

Booking in for the ride

If you are allocated to the Ride Group, you will be provided with details on how to contact HART to book in to do the ride. HART will also attempt to contact you. Sessions are run on weekends and weekdays.

On the day

When you turn up for the ride please ensure you have your current motorcycle probationary or restricted licence with you.

HART will check that you are:

- wearing full protective clothing. This includes an AS/NZS1698 helmet (preferably with eye protection), motorcycle jacket and gloves, boots that protect ankles, and heavy jeans (leather, textile or kevlar jeans preferred)
- riding a motorcycle which is in good mechanical condition and has plenty of tread on the tyres
- riding a motorcycle appropriate for your class of licence.

You will be asked to read and sign HART’s ‘Exclusion of Liability and Indemnity’ form.

At the commencement of the ride you will be required to complete an initial short ride to demonstrate that you can ride a motorcycle safely.

You will not be able to continue with the ride if you do not meet the above safety checks.

The ride

The ride will be guided by an experienced coach who will work with you to build on your knowledge and experience to improve your riding style. The ride involves regular stops along the way to enable regular discussion between the coach and riders. Each rider will get opportunities to lead the group as well as to follow the coach and observe the other riders.

4. Explanatory Statement continued

5: Other data we will collect about you

If you consent to participate in the research, we will use your licence number to collect your rider and driver history from VicRoads. This will include licensing details, crash history, demerit points and riding and driving offences. This information will be given to the George Institute for Global Health by VicRoads, the funding body for this research, to evaluate the impact of the program on safety. For full details of the VicRoads' privacy statement, please go to www.vicroads.vic.gov.au/Home/Options/Privacy.

The George Institute for Global Health will also collect information from the Transport Accident Commission (TAC), about the treatment cost, type and severity of any motorcycle related injuries you have. This information will also be used by the George Institute for Global Health to evaluate the impact of the program on safety.
The George Institute and Monash University will provide your name and address to VicRoads for the purpose of sending out your voucher/cash payment.

6: Withdrawing from the research

Participating in this research is voluntary and you are free to withdraw from it at any time up until you have completed your third telephone interview.

Your decision to participate or not in this research or to withdraw from it will not be used by the coach or anyone else to influence your performance in any licence testing or training at HART or at any other motorcycle rider training and test facility.

Privacy and confidentiality

Any and all personal information you give us will be treated in strict confidence. Personal information includes any information that could be used to identify you.

At the conclusion of the study, all identifying information will be stripped out of the data.

A report will be written about the trial and sent to VicRoads and the data may be used to write a scientific journal or conference paper. All reports and papers arising from the trial will be published in summary form and it will not be possible to identify any individual from the reports or papers. Your responses to interview questions will not be provided to VicRoads or the TAC.

Inconvenience/discomfort/risks

Motorcycling is an inherently risky activity because of the lack of protection afforded by the motorcycle in the event of a crash. By taking part in the *VicRide: on-road coaching* program you will be exposed to the same road safety risks that you and other motorcyclists face any time they ride on the road.

There will be regular rest stops and breaks for discussion, however you may experience fatigue. You should let the coach know if you are experiencing any difficulty at any time.

Data storage

Storage of the de-identified data will adhere to the regulations of Monash University and the University of Sydney and kept on University premises on password protected computer databases and in locked filing cabinets for seven years. After the seven years all data will be destroyed.

Results

If you would like to be informed of the research findings, please check The George Institute for Global Health's website www.thegeorgeinstitute.org after September 2014.

If you agree to take part in the study please read the consent form on the next page, click to tick the 'yes' button and click next. You will then be taken to another page to supply your contact details. Before doing so you are encouraged to print out this page for your own records.

To contact the researchers about any aspect of this study:

For enquiries related to the on-road trial:
Christine Mulvihill
Christine.Mulvihill@muarc.monash.edu.au
Tel: +61 3 9905 4367 Fax: +61 3 9905 1809

For enquiries related to the evaluation of the on-road trial:
Associate Professor Rebecca Ivers
rivers@george.org.au
Tel: +61 2 9657 0361 Fax: +61 2 9657 0301

If you have a complaint concerning the manner in which this research (CF09/3653-2009001972) is being conducted, please contact:

For concerns related to the on-road trial:
Executive Officer
Monash University Human Research Ethics Committee (MUHREC)
Building 3e Room 111
Research Office
Monash University VIC 3800
Tel: +61 3 9905 2052 Fax: +61 3 9905 1420
muhrec@adm.monash.edu.au

OR

For concerns related to the evaluation of the on-road trial:
Manager
Human Ethics Administration
University of Sydney
NSW 2050
Tel: +61 2 8627 8176 Fax: + 61 2 8627 8177
ro.humanethics@sydney.edu.au

Thank you.
Christine Mulvihill and Rebecca Ivers

5. Participant Consent Form

DEVELOPMENT AND EVALUATION OF A LARGE-SCALE TRIAL OF THE

VICRIDE ON-ROAD COACHING

PROGRAM FOR MOTORCYCLISTS

PARTICIPANT CONSENT FORM

I agree to take part in the Monash University and The George Institute for Global Health research project specified above. I have read the Explanatory Statement and I understand what is required of me as a participant. I understand that agreeing to take part means that:

On the next screen I will enter my contact details and my licence number and describe my riding experiences since being licensed.

I will be participating in three telephone interviews conducted by the research team, which will ask questions about me, my riding and driving experiences, risk perception and riding skills, and my opinions about the on-road ride program.

I will take part in a four-hour on-road ride in which I will ride my own motorcycle and allow my coach and others in my riding group to provide me with verbal feedback on my riding. I agree to follow all instructions of the coach.

The research team at The George Institute for Global Health will have access to my:

- Traffic crash details (provided by VicRoads)
- Personal information including my licensing details and driving and motorcycle riding records (provided by VicRoads)
- Information about treatment type, cost of treatment and type of injury for any motorcycle related injuries I may have during the 12 month evaluation period that are compensated by the Transport Accident Commission.

VicRoads will provide my traffic crash details and my personal information to The George Institute for Global Health. I consent to VicRoads providing this information to The George Institute for Global Health. The research team will pass on my name and address to VicRoads for the purposes of posting out a letter that allows me to collect my $90 voucher/cash payment and or the $50 voucher (if applicable). I consent to the research team passing on this information to VicRoads.

VicRoads is committed to protecting your privacy. For full details of its privacy statement, please go to www.vicroads.vic.gov.au/Home/Options/Privacy

Monash University is subject to the Information Privacy Act 2000 (Victoria) and is committed to protecting your privacy. For full details of its Privacy Statement please go to www.monash.edu.au/legals/privacy.html

The George Institute for Global Health is affiliated with the University of Sydney, and its data collection and use is consistent with the Privacy Policy of the University of Sydney. Full details of the University of Sydney Privacy Policy can be found at www.usyd.edu.au/senate/policies/Privacy.pdf.

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project. My information and data will be securely stored. Following the conclusion of the project the data will be de-identified and stored for seven years as per Monash University and the University of Sydney requirements. After the storage period the data will be destroyed.

I understand that I can access a transcript of data concerning me for my approval before it is included in the write up of the research.

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw my data at any stage of the project up until completion of my third telephone interview. My withdrawal from this research will not result in me being penalised or disadvantaged.

1. I agree to participate in the research project specified above

- ◯ Yes
- ◯ No

Please click on 'Next' to proceed to the next screen.

6. Confirmation of eligibility

Please answer the following two questions to confirm your eligibility to take part.

1. About how many kilometres do you think you have ridden since getting your motorcycle learner permit?

- ◯ 0-500
- ◯ 501-1000
- ◯ 1001-2000
- ◯ 2001-3000
- ◯ 3000+

2. About how many trips do you think you have ridden since getting your motorcycle learner permit?

- ◯ 0-11
- ◯ 12 or more

7. Contact details

1. Please complete the following contact details:

First name: [ ]

Surname: [ ]

Home Address: [ ]

City/Town: [ ]

State: [ ]

2. Post code:

[ ]

3. Postal address (if different from the residential address you provided above)

Postal Address: [ ]

City/Town: [ ]

State: [ ]

4. Post code:

[ ]

5. What is your gender?

- ○ Male
- ○ Female

6. Date of birth:

	DD		MM		YYYY
Date of Birth	[ ]	/	[ ]	/	[ ]

7. Please provide up to three telephone numbers (no spaces) so that we can contact you to conduct the baseline telephone interview. For home and work numbers please ensure you enter 03 followed by eight digits. For mobile numbers please ensure you enter ten digits.

Home [ ]

Work [ ]

Mobile [ ]

In the two questions below, please make as many selections as suit your timetable for weekdays and/or weekends.

8. From this list, please select the best day/s and time/s for us to telephone you for the baseline interview on weekdays and/or weekends.
Please select all that apply on weekdays and weekends

- ☐ Monday 12 midday - 2:00pm
- ☐ Monday 2:00pm - 4.00pm
- ☐ Wednesday 2.00pm - 4.00pm
- ☐ Wednesday 4.00pm - 6.00pm
- ☐ Friday 4.00pm - 6.00pm
- ☐ Friday 6.00pm-8.00pm

- [ ] Monday 4.00pm - 6:00pm
- [ ] Monday 6.00pm - 8.00pm
- [ ] Monday 8.00pm - 9.00pm
- [ ] Tuesday 12 midday - 2.00pm
- [ ] Tuesday 2.00pm - 4.00pm
- [ ] Tuesday 4.00pm - 6.00pm
- [ ] Tuesday 6.00pm - 8.00pm
- [ ] Tuesday 8.00pm - 9.00pm
- [ ] Wednesday 12 midday - 2.00pm
- [ ] Wednesday 6.00pm - 8.00pm
- [ ] Wednesday 8.00pm - 9.00pm
- [ ] Thursday 12 midday - 2.00pm
- [ ] Thursday 2.00pm - 4.00pm
- [ ] Thursday 4.00pm - 6.00pm
- [ ] Thursday 6.00pm-8.00pm
- [ ] Thursday 8.00pm - 9.00pm
- [ ] Friday 12 midday - 2.00pm
- [ ] Friday 2.00pm - 4.00pm
- [ ] Friday 8.00pm - 9.00pm
- [ ] Saturday: 1.00pm-3:00pm
- [ ] Saturday: 3:00pm-5:00pm
- [ ] Saturday: 5.00pm-7.00pm
- [ ] Sunday: 1.00pm-3:00pm
- [ ] Sunday 3:00pm-5:00pm
- [ ] Sunday: 5.00pm-7.00pm

9. Please enter your licence number (this can be found on the top right hand side of your Victorian car/motorcycle licence). If you have passed your motorcycle licence test but not yet received your licence in the mail, please enter the number on your learner permit:

10. Please indicate when you got your motorcycle probationary/restricted licence. Month and year are required.

	Month	Year
Received motorcycle probationary/restricted licence:		

11. Program code.

If you received a flyer about this program in the mail, please enter the code from the letter you received:

We will ask you to provide us with your motorcycle odometer reading when we telephone you for the initial telephone interview. Please check the odometer reading on the day you would like us to telephone you for the interview and be ready to read it out to us.

Thank you for taking the time to complete this survey.

If you meet the eligibility criteria for this study, a researcher will telephone you soon to take part in the initial interview.

Please click on 'next' to be taken to the final page.

8. Not eligible

Unfortunately you are not eligible to participate in the *VicRide: on-road coaching* program.

You may be ineligible for one or more of the following reasons:

- **• You are not able to ride your own motorcycle for the on-road ride;**
- **• You own a scooter and not a motorcycle;**
- **• Your motorcycle is not LAMS approved with an engine capacity of 125cc or greater;**
- **• Your motorcycle is not in good mechanical condition with plenty of tread on the tyres;**
- **• You do not yet have your probationary or restricted motorcycle licence;**
- **• You have been on your probationary or restricted motorcycle licence for more than one year;**
- **• You have less than 500 kilometres of on-road riding experience since obtaining your learner permit;**
- **• You have ridden less than 12 separate on-road rides since obtaining your learner permit;**
- **• You are unable to maintain the posted speed limits of 40-70 km/h on metropolitan public roads and or 80-100 km/h on rural public roads when safe to do so.**
- **• You indicated that if you are assigned to the Ride Group you would be unable to complete the on-road ride within six weeks of enrolling.**

If applicable you are welcome to try again later once you have met all of the eligibility criteria.

Please click on 'Next' to proceed to the next screen.

9. Do not consent

You have indicated that you DO NOT agree to participate in this research project.

Please briefly state your reason in the box below. If this is incorrect and you agree to participate please click on 'Previous' and return to the survey

Please click on 'Next' to proceed to the next screen.

1. (max 100 characters)

10. Thank you

Please press the 'submit' button to save your information and exit this survey

We wish you all the very best with your riding.

Appendix 3: Phone recruitment script

The VicRide Evaluation Trial

Phone Recruitment Script for the SRC

BACKGROUND

A letter and information booklet (containing explanatory statement, consent form and VicRoads privacy policy) were sent to ALL newly licensed riders one to two months after they obtained their licence.

An information package containing the letter sent to riders inviting them to participate in the study, as well as an information booklet containing the Explanatory Statement, Consent Form and VicRoads Privacy Policy were provided to the SRC so that the interviewers were prepared to answer questions about the study and go over the main parts of the study with those riders who have any questions.

Instructions were given to interviewers that at any point in the interview people can opt out of the study. Any time that occurs reasons were to be recorded and provided to the George Institute as part of the monthly Running Call Results.

PREAMBLE

"Hello, my name is _____________, and I'm calling you from the Survey Research Centre. We've been engaged by VicRoads to call you about a trial of an on-road coaching program for motorcycle riders and we're calling to see if you would be interested to participate. Are you interested?"

[**Screen out no answers – No data provided**. Only a tally of number of calls]

(If yes, start **INTERVIEW**)

Phone recruitment interview

"Now that you have gained your motorcycle licence you are invited to participate in a trial of an on-road coaching program. The trial involves the completion of a 4 hour on-road coaching session and three 30 minute telephone interviews over 12 months. The trial is being conducted to find out whether the ride is an effective way to improve rider safety. The program is being offered for free and you will receive a $90 gift voucher when you complete the trial. This offer is limited to 2,400 riders in Victoria.

Half the riders who join the trial will have the opportunity to do the coached ride immediately after the first interview, and half in 12 months time.

You will be asked to undertake the on-road ride at one of five locations on a weekday or on a weekend. The rides are located in Somerton, Kilsyth, Warragul, Bendigo and Cranbourne.

Before we begin, I want to assure you of confidentiality for any answers you may give, and let you know that this survey may be listened to by a supervisor for training and quality control purposes."

"You may have received a letter and information booklet about this study in the mail. The booklet contained information about the trial including an explanatory statement, consent form and the VicRoads privacy policy.

Q1n. Is that right?"

☐ **Yes** ☐ **No**

(If Yes) – "We will treat your information on the basis of what is in these documents. Do you agree to continue on that basis?" (If yes, Go to **+** If no, go to ^^)

^^(If no) **–** "If you think you are likely to be interested to participate then we can email you the documents and give you some time to read them and then we can call you back in a week or two. Would you like to do that?"" (If yes) "Can I get your email address?" (**Q1nR** If no, ask for and record reasons, screen out and never call back)

(If yes, record details. If they don't have emails record mail address)

a) Full Name:

b) Email Address:

c) Mail address (only if no email):

"Thank you very much for your time today. I'll call back in a week or two. Bye"

[Outcome: Interview Complete

Data up to this point will be provided for this lot

ACTION only for those with email/mail address provided: The George Institute will email the riders the information. If only mail then the names and address will be sent to VicRoads for mailing. No further action will be taken if no email/mail address in the data.]

+ Q2n. "Have you by any chance been on the website to sign up to participate in the study?"

□ **Yes** □ **No**

(If Yes) – "That's great. We will be calling you back shortly to do the interview."

[Outcome: Interview Complete

Data up to this point will be provided for this lot]

(If No, go to eligibility questions**^**)

^Eligibility questions

Q3n. "Now I'd like to check to make sure that you are eligible for the study."

- **1. Do you have your own motorcycle with a minimum engine capacity of 125cc and NOT a scooter ?**

○ Yes

○ No

- **2. Since obtaining your motorcycle learner permit have you ridden at least 12 separate rides on public roads?**

○ Yes

○ No

- **3. Since obtaining your motorcycle learner permit have you ridden at least 500 kms on public roads?**

○ Yes

○ No

- **4. Have you been on your probationary/restricted motorcycle licence for one year or less?**

○ Yes

○ No

- **5. Are you able to accelerate up to and maintain the posted speed limit on all public roads when safe to do so?**

○ Yes

○ No

- **6. Are you able to maintain speed limits of between 40-70 km/h on metropolitan public roads when safe to do so?**

○ Yes

○ No

- **7. Are you able to maintain speed limits of between 80-100 km/h on rural public roads when safe to do so?**

○ Yes

○ No

- **8. Do you hold a probationary or restricted motorcycle licence to ride in Victoria?**

◉ Yes

○ No

(As soon as they say no to a question -)

“I’m sorry but you are not eligible to participate in the study. Thank you for your time.”

[Interviewers: If they ask questions at this point, you could answer them based on the information package, or refer them to MUARC. “You can call MUARC for your questions. The number is 03 9905 4367.”]

[Outcome: Interview Complete

Data up to this point will be provided for this lot]

(If ‘yes’ to ALL the 8 questions)

“Congratulations, you are eligible to participate in this study. I will now invite you to consent to participate in the study.

Q4. Can I confirm with you that you have read the Explanatory Statement and Consent Form and understand what is required of you as a participant?”

☐ **Yes** ☐ **No**

*(If yes, skip to Statement of Verbal Consent #**)***

(If no, read the main points from the Explanatory Statement and confirm that they understand the requirements. Answer questions based on the information package.)

Explanatory Statement:

“The aim of the research project is to measure the effectiveness of the program.

The project involves:

1. Doing three telephone interviews over 12 months. After the first interview today you will be randomly allocated by computer into either the Ride Group (immediate on-road ride), or the Delayed Ride Group. If you are in the Ride group you must be

prepared to complete the ride within four weeks of the date of completion of the baseline interview. If you are in the Delayed Ride Group you will be invited to take part in the ride in about 12 months time, after you have completed all three interviews.

2. Participation in the *VicRide on-road coaching* program is at one of five locations on either a weekday or a weekend. When you book in for the on-road ride, HART will ask you to pay a $50 deposit. This payment is required as a commitment from you to participate in the ride. You will lose your $50 if you book in but do not participate on the day.
3. When you turn up on the day of your ride, the coach will check that you are wearing full protective clothing and riding a motorcycle which is in good mechanical condition, has plenty of tread on the tyres, and is appropriate for your class of licence. You will be asked to read, and agree to sign HART's 'Exclusion of Liability and Indemnity' form. You will also be required to complete an initial short ride to demonstrate that you have mastered basic riding skills. You will not be able to continue with the ride if you do not meet these criteria.

We have gone through the main points of the study. Remember, your participation is voluntary and if you change your mind you can withdraw from the study later."

 # Verbal Consent

"Great! Now I need to have your consent to participate in this study. Is it all right with you that I read out the key points about being involved in this study and that you reply by stating 'yes' or 'no' to participating in the study when I prompt you?"

Statement of verbal consent

I, Full name, understand that agreeing to take part means that:

I will provide my name, date of birth, gender, contact details, and my licence number.

I will be participating in three telephone interviews conducted by the research team, which will ask questions about me, my riding and driving experiences, risk perception and riding skills, and my opinions about the on-road ride program.

I will take part in a four-hour on-road ride in which I will ride my own motorcycle and allow my coach and others in my riding group to provide me with verbal feedback on my riding. I agree to follow all instructions of the coach.

The research team at The George Institute will have access to my:

- Traffic crash details (provided by VicRoads)
- Personal information including my licensing details and driving and motorcycle riding records (provided by VicRoads)
- Information about treatment type, cost of treatment and type of injury for any motorcycle related injuries I may have during the 12 month evaluation period that are compensated by the Transport Accident Commission.

VicRoads will provide my traffic crash details and my personal information to The George Institute. **I** consent to VicRoads providing this information to The George Institute.

VicRoads, The George Institute for Global Health and the Monash University Accident Research Centre respect and are committed to protecting your privacy. For full details of the VicRoads privacy policy please refer to the booklet that has been mailed to you.

I understand that any information **I** provide will be kept confidential, and that no information that could lead to identification of any individual will be disclosed in any reports on the project.

I understand that my data will be securely stored and that following the conclusion of the project the data will be de-identified and stored for seven years as per Monash University and the University of Sydney requirements.

I understand I will lose my $50 deposit if I book in but do not participate on the day of my ride.

Q5. "Do you understand these aspects of being involved in the study?"

□ Yes □ No

Q6. "Remembering that you can withdraw from the study at any time, do you consent to being involved in the study?"

□ Yes □ No

(If no to Consent) **Q7. "**Do you mind telling me why you don't want to consent to participate in the study?"

Record reasons ______________________________

"Thank you for your time."

[Interview Complete

Data up to this point will be provided for this lot]

(If yes to Consent) "Thank you very much for that. Now I would like to get your details."

NQ1. What is your full name?

____

NQ2. Please provide me with your licence number (this can be found on the top right hand side of your Victorian car/motorcycle licence). If you have passed your motorcycle licence test but not yet received your licence in the mail, please give me the number on your learner permit:

[ ]

NQ3. Please indicate when you obtained your motorcycle probationary/restricted licence.
a) Month: _____________________________

b) Year:_______________________

NQ4. What is your date of birth and gender?

a) *DOB (dd/mm/yy):* ____ / ____ / ____

b) *Gender:* ***M / F***

Now we are ready to begin the interview.

Would you have time (about 30 minutes) now, or we could schedule a time in the next couple of days, to do a telephone interview.

Are you available to do the interview now?

□ Yes □ No

(If no) What would be the best time to call back and do the interview?

Date: ____ / ____ / ____ *Time* ________________

Is this the best phone number to call you on or is there another one? ____________

[Interview Complete
Data up to this point will be provided for this lot]

(If yes start the normal baseline interview questions)

Appendix 4: Baseline phone interview script

Hello, my name is _____________. I'm calling from The George Institute at the University of Sydney about the **VicRide Program,** in which I understand you have agreed to take part? Is that right? Yes/ No (*If Yes, continue,)*

(*If No*)

I am sorry to have contacted you in that case but your name and phone number were provided to me by Monash University who are recruiting people into this study. According to our records you consented to join this study which is about a motorcycle VicRide program. If you did not provide these details via the study website someone else must have done so on your behalf and we will have to investigate the matter. I will refer the matter to the chief investigator Associate Professor Rebecca Ivers to follow up. She will call you back on this number or you can call her on 02 9657 0361.

(If Yes)

The study involves three telephone interviews as well as taking part in the VicRide.

Today I am calling about the first telephone interview, which covers questions about you, such as your rider training and riding experiences.

At the end of the interview you will be allocated by computer into one of two groups. Riders in Group One will attend the VicRide as soon as possible: those riders in Group Two have the opportunity to do the ride in 12 months time. The computer uses a random numbers program to decide which group you are in, and this process is not affected by your answers in the interview we are about to do.

Both groups will be interviewed again in about 3 months and then in 12 months. After the last interview riders in Group 2 will be able to attend the VicRide.

Is that all clear?

Would you have time (about 30 minutes) now to do this first interview, or can we schedule a time in the next week that I can call you back?

(*Able do the interview now?* ☐ Yes ☐ No (*If No*)

What would be the best time to call back and do the interview?

Date: ____ / ____ / ____ *Time* _______________

*Is this the best phone number to call you on or is there another one? (*Record other number*)*

____

(If participant refuses to join the study)

OK, that's fine, no problem, but could you just tell me the main reason you do not want to participate, because that's important information for us? ………………………………….

RECORD RE-CONTACT TYPE

1. ☐ Definitely don't call back

2. ☐ Possible conversion

(*Once ready to do the interview, enter Date interview conducted ___________mm______yyyy*)

There are no right or wrong answers to these questions. We just want to know about your experiences as a rider. Please answer all the questions honestly.

Q1. What type of motorcycle licence do you have and when did you obtain it? Just the month and year will do. (*Do not read – prompt if needed. Only the current licence information is required.)*

1. Learner license	***date: ___________mm___yyyy*** **(read script)**	
2. Probationary	***date: ___________mm___yyyy***	
3. Restricted motorcycle licence	***date: ___________mm___yyyy***	
4. Full license	**date: _______________mm_____yyyy *(read script)***	

[***If 1 or 4 read script***] *I'm sorry but this study and the coaching program is only available to probationary or restricted licence holders. You should have been told this at the point of registration, so there has been some mistake. Unfortunately you are not eligible for the study. If you wish to discuss it with the program organisers, you can call 1-800 XXXXXX. Thank you for your willingness to take part, but we cannot proceed with the interview. Good bye.*

Q2. How long were you on your Learner permit before obtaining your riders licence? ______total months.

(Note: do not allow ranges, if rider says 2-3 months, ask whether that is closer to 2 or to 3).

Q3. What motorcycle do you ride most frequently on public roads (not including off-road)? Please tell me its:

Make _______________Model_________________and engine capacity _______CC

Q4. What type of motorcycle is this – for example a sports bike? (*Do not read – use the list to prompt if needed)*

1. Sports (including Super sports /super motard)
2. Cruiser
3. Standard (including Naked)
4. Touring (jncluding Sports tourer)
5. Adventure/ adventure tourer/ dual sport
6. Off road - Trail/ enduro/ mx
7. Scooter ***(read script)***
8. Other Please specify ____________________________________
9. Don't know

*[**If 7, read script**] I'm sorry but the coaching program is not designed for scooter riders. Unfortunately you are not eligible for the study. You should have been told this at the point of registration, so there has been some mistake. If you wish to discuss it with the program organisers, you can call 1-800 XXXXXX. Thank you for your willingness to take part, but we cannot proceed with the interview. Good bye.*

Q5. Is this a LAMS approved motorcycle? (*Learner Approved Motorcycle Scheme*)

1. No
2. Yes
3. Don't know

Q6. Do you always ride the same motorcycle for your on-road riding?

1. No (skip to Q8)
2. Yes

Q7. What is the current kilometres reading on your motorcycle?__________________ Total kilometres (need exact reading or best estimate if they have checked it recently)

☐ Don't know *[IF they don't know the reading say " Can you check it within the next 24 hours and email it to odo@george.org.au or SMS it to 0404171748 together with your name?]*

(We will need a weekly update on those who respond "Don't know", so we can call them if they haven't contacted us)

THE NEXT FEW QUESTIONS ARE ABOUT YOUR RIDING BACKGROUND AND EXPERIENCE.

Q8. How many kilometres have you ridden on-road in total since you have been riding?

________________Total km ("best estimate" is OK)
(Note: if they give a range, ask "Would that be closer to X or Y?, I have to give a single number.")

Q9. In an average week, about how many kilometres do you ride on-road? _________________km (*Do not allow ranges*)

Q10. In an average week, how many hours would you spend riding on-road? ____________hours

Q11. Thinking now about the riding you have done in the last month, how many separate trips on-road have you ridden over the past month: (Note: count to and from a destination as 2 separate trips, record "0" if no trips of this kind)

1. Commuting to work or study? _____ # trips
2. Riding for work as a part of your job? _____# trips
3. Riding for recreation (on-road riding)? _____# trips
4. Riding as a form of general transport, e.g. visiting, shopping etc? ____# trips
5. Other types of trips, Please specify:
   Other 1: type of trip_____________ # of this type of trip _____# trips
   Other 2: type of trip_____________ # of this type of trip _____# trips
   Other 3: type of trip_____________ # of this type of trip _____# trips

Q12. I am going to list some types of riding conditions. Thinking just about the past month, please tell me how many times you have ridden under each condition. A single ride can be counted for each of a number of conditions, for example if it was dark and raining, it counts once for dark and once for raining. If you are not sure, give your best estimate. How many times over the past month did you ride:

1. When it was dark	________***# times***
2. When it was raining	________***# times***
3. On local suburban roads	________***# times***
4. In heavy traffic	________***# times***
5. On high speed roads zoned 100 km/h or more	________***# times***
6. On winding rural roads	________***# times***
7. In the company of at least one other rider	________***# times***

Q13. Do you ride all year round? (*Read responses and tick one*)

1. Yes, all year round
2. No, mostly October to March (ie Summer)
3. No, mostly April to September (ie Winter)
4. Other (please describe)……………

Q14. Have you ever ridden a motorcycle OFF road, that is, on private land or in forests/ bush or farmland?

1. No (*Skip to Q16*)
2. Yes

Q15. (*If yes*) How frequently do you ride off-road? (*Do not read – prompt if needed)*

1. I used to ride off road but not any more
2. I have ridden off-road only a couple of times
3. 1-5 times a year
4. 6-11 times a year
5. Monthly
6. Weekly

Q16. Did you have any on-road riding experience on public roads before you obtained your Learner permit (this time)?

1. No (Never ridden before obtaining Learner permit)(*Skip to Q18*)
2. Yes

Q17. (*If yes*) How many times did you ride on-road before obtaining your Learners' permit?

1. 1-3 times
2. 4-10 times
3. >10 times

Q18. Have you attended any formal rider training or coaching courses?

1. No (Skip to Q21)
2. Yes

Q19. (If yes) Which of the following types of training have you undertaken? (*Read list.)*

1. A Pre-learners' course (*before they have the Learner Permit*) ☐ Yes ☐ No
2. Learner courses: (*before the motorcycle licence test*) ☐ Yes ☐ No
3. Post-licence course: (*A course for riders who have passed the motorcycle licence test*) ☐ Yes ☐ No
4. Advanced rider skills course ☐ Yes ☐ No
5. Off-road / dirt riding course ☐ Yes ☐ No
6. Motorcycle club rider training sessions ☐ Yes ☐ No
7. Other course. Please provide details___________________________________

*(If none to **all** of the above, skip to Q 21)*

Q20. How many of these courses were within the last 12 months? (*Do NOT read list – Only those recorded as "yes" will appear on the list below. Record a number next to all types, 0,1, 2 etc*.)

1. A Pre-learners' course (before they have the Learner Permit) _______#
2. Learner courses: (before the motorcycle licence test) _______#
3. Post-licence course: (a course for riders who have passed the motorcycle licence test)_______#
4. Advanced rider skills course _______#
5. Off-road / dirt riding course _______#
6. Motorcycle club rider training sessions _______#
7. Other course. Please provide details if "other"___________________________________

Q21. Have you been on any practice rides with a more experienced rider to improve your riding?

1. No (*Skip TO Q23*)
2. Yes

Q22. (If Yes) How many within the last 12 months? _______#

Q23. Do you belong to a motorcycle club or organized ride group?

1. No
2. Yes

Q24. I am going to read a series of statements, please say how much you agree or disagree with the statement. The options are: Strongly agree, Agree, Neither agree or disagree, then Disagree and Strongly disagree. How much you agree or disagree with the following statements: Accidents involving motorcycles are often caused by:

	Strongly agree	**Agree**	**Neither**	**Disagree**	**Strongly disagree**
a. Drivers pulling out in front of motorcyclists.	1	2	3	4	5
b. Drivers not noticing motorcyclists.	1	2	3	4	5
c. Motorcyclists going too fast	1	2	3	4	5
d. Car drivers going too fast.	1	2	3	4	5
e. Motorcyclists not looking far enough ahead.	1	2	3	4	5

f. Car drivers not looking properly.	1	2	3	4	5
g. Motorcycles being relatively less stable in an emergency situation.	1	2	3	4	5

Q25. Thinking just about riders your age and gender and with the same level of riding experience, how much more likely or unlikely do you think it is that YOU will be involved in a motorcycle crash in the next 12 months?: The options are: Much less likely, Less likely, Just as likely, More likely and Much more likely.

	Much less likely 1	Less likely 2	Just as likely 3	More likely 4	Much more likely 5

Q26. Again, compared to other riders your age, gender and level of riding experience, how much better or worse do you think you are at each of the following? The options are: Much better, Better, About the same, Worse or Much worse.

	Much better	**Better**	**About the same**	**Worse**	**Much worse**
a. Controlling the motorcycle (i.e. your vehicle control skills)	1	2	3	4	5
b. Spotting hazards	1	2	3	4	5
c. Getting out of hazardous situations safely	1	2	3	4	5
d. Avoiding hazardous situations	1	2	3	4	5

Q27. The options for the next set of statements are about frequency: Never, Hardly ever, Occasionally, Quite often, Frequently and All the time. When riding how often do you wear:

	Never	**Hardly ever**	**Occasionally**	**Quite often**	**Frequently**	**All the time**
a. A leather one-piece motorcycle suit	1	2	3	4	5	6
b. A motorcycle protective jacket (leather or non-leather)	1	2	3	4	5	6
c. Motorcycle protective trousers (leather or non-leather)	1	2	3	4	5	6
d. Body armour / impact protectors (eg for elbow, shoulder or knees)	1	2	3	4	5	6
e. Motorcycle boots	1	2	3	4	5	6
f. Motorcycle gloves	1	2	3	4	5	6
g. Bright/fluorescent clothing	1	2	3	4	5	6
h. Bright/fluorescent stripes/ patches on your clothing	1	2	3	4	5	6

	Never	Hardly ever	Occasionally	Quite often	Frequently	All the time
i. A fully fastened helmet	1	2	3	4	5	6

Q28. When riding how often:	Never	Hardly ever	Occasionally	Quite often	Frequently	All the time
a. Do you use daytime running lights or headlights-on in daylight.	1	2	3	4	5	6
b. Do you wear no motorcycle specific protective clothing?	1	2	3	4	5	6
c. Do you have trouble with your visor or goggles fogging up	1	2	3	4	5	6

Q29. When riding how often do each of the following things happen to you? The options are: Never, Hardly ever, Occasionally, Quite often, Frequently and Nearly all the time. When riding how often do each of the following things happen to you?

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
a. Queuing to turn left on a main road, you pay such close attention to the main traffic that you nearly hit the vehicle in front.	1	2	3	4	5	6
b. Fail to notice that pedestrians are crossing when turning into a side street from a main road.	1	2	3	4	5	6
c. Exceed the speed limit on a residential road.	1	2	3	4	5	6
d. Miss a ‘Give Way’ or ‘Stop’ signs and almost crash with another vehicle.	1	2	3	4	5	6
e. Attempt to overtake someone who you haven’t noticed to be signalling a right turn.	1	2	3	4	5	6
f. Race away from the traffic lights with the intention of beating the driver/rider next to you.	1	2	3	4	5	6
g. Ride so close to the vehicle in front that it would be difficult to stop in an emergency.	1	2	3	4	5	6
h. Exceed the speed limit on a motorway.	1	2	3	4	5	6

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
i. Ride between two lanes of fast moving traffic.	1	2	3	4	5	6
j. Ride so fast into a corner that you scare yourself	1	2	3	4	5	6
k. Exceed the speed limit on a country/ rural road.	1	2	3	4	5	6
l. Ride when you suspect that you might be over the legal limit for alcohol.	1	2	3	4	5	6
m. When riding at the same speed as other traffic, you find it difficult to stop in time when a traffic light has turned against you.	1	2	3	4	5	6

Q30. When riding, how often do each of the following things happen to you?

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
a. Distracted or pre-occupied, you suddenly realise that the vehicle in front has slowed, and you have to brake hard to avoid a collision.	1	2	3	4	5	6
b. Pull onto a main road in front of a vehicle you haven't noticed or whose speed you misjudged.	1	2	3	4	5	6
c. Disregard the speed limit late at night or in the early hours of the morning.	1	2	3	4	5	6
d. Not notice a pedestrian waiting at a crossing where the lights have just turned red.	1	2	3	4	5	6
e. Not notice someone stepping out from behind a parked vehicle until it is nearly too late.	1	2	3	4	5	6
f. Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping	1	2	3	4	5	6
g. Get involved in racing other riders or drivers.	1	2	3	4	5	6
h. Attempt or done a wheelie	1	2	3	4	5	6
i. Unintentionally had your wheels spin	1	2	3	4	5	6

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
j. Intentionally do a wheel spin	1	2	3	4	5	6
k. Pull away too quickly and your front wheel lifted off the road.	1	2	3	4	5	6
l. Open up the throttle and just go for it on a country road.	1	2	3	4	5	6
m. Another driver deliberately annoys you or puts you at risk.	1	2	3	4	5	6

Q31. When riding how often do each of the following things happen to you?

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
a. Ride so fast into a corner that you feel like you might lose control.	1	2	3	4	5	6
b. Needed to change gears when going around a corner.	1	2	3	4	5	6
c. Skid on a wet road or manhole cover, road marking etc	1	2	3	4	5	6
d. Run wide when going around a corner	1	2	3	4	5	6
e. Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble)	1	2	3	4	5	6
f. Needed to brake or back-off when going round a bend.	1	2	3	4	5	6

Q32. How much do you agree or disagree with the following statements? The options are to: Strongly agree, Agree, Neither agree or disagree, then Disagree and Strongly disagree.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
a. It is important to me that my motorcycle is economic in fuel consumption	1	2	3	4	5
b. It is important to me that my motorcycle is stable and easy to control	1	2	3	4	5
c. One of the best things about riding a motorcycle is that it is easy to park	1	2	3	4	5

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
d. A motorcycle is only a means of getting from A to B	1	2	3	4	5
e. One of the best things about riding a motorcycle is that you can get through traffic jams more easily	1	2	3	4	5
f. One of the best things about my motorcycle is that it is easy to manoeuvre in traffic	1	2	3	4	5
g. Motorcycle riding is exciting	1	2	3	4	5
h. Riding a motorcycle makes me feel good	1	2	3	4	5
i. When riding, it is a good feeling when you overtake others.					
j. When riding a motorcycle, I feel a sense of freedom	1	2	3	4	5
k. I prefer to ride slowly	1	2	3	4	5
l. It is important to me that my motorcycle has a high top speed	1	2	3	4	5
m. It is important to me that my motorcycle has fast acceleration.	1	2	3	4	5
n. When I am with my friends, we often talk about motorcycles	1	2	3	4	5
o. I enjoy riding my motorcycle at high speeds	1	2	3	4	5
p. I like to corner at high speed	1	2	3	4	5
q. I enjoy going on long motorcycle rides	1	2	3	4	5
r. Riding a motorcycle is a good social activity	1	2	3	4	5
s. When riding a motorcycle, I often feel as if I am at one with the machine	1	2	3	4	5
t. Motorcycling is safe as long as you know what you are doing	1	2	3	4	5
u. I think that 100 km/h on a rural road is too slow.	1	2	3	4	5
v. Without motorcycles, my life would be less interesting	1	2	3	4	5
w. Without a certain level of thrill, motorcycle riding would be boring	1	2	3	4	5
x. It is fun to ride a motorcycle	1	2	3	4	5

Q33. How much do you agree or disagree with the following statements? The options are to: Strongly agree, Agree, Neutral, then Disagree and Strongly disagree.

	Strongly agree	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*
a. Riding quickly on winding roads is a sign of a good rider.	*1*	*2*	*3*	*4*	*5*
b. Obeying all speed limits and traffic laws is a sign of a good rider.	*1*	*2*	*3*	*4*	*5*
c. You are a better rider if you obey all speed limits and traffic laws, even if you do not ride quickly around winding roads.	*1*	*2*	*3*	*4*	*5*
d. It doesn't matter if I break a few road traffic laws.	*1*	*2*	*3*	*4*	*5*
e. I get a real thrill out of riding fast.	*1*	*2*	*3*	*4*	*5*
f. I find it difficult to obey all the road traffic laws while riding.	*1*	*2*	*3*	*4*	*5*
g. It's okay for me to go faster than the speed limit as long as I ride carefully.	*1*	*2*	*3*	*4*	*5*
h. I can break a few road traffic laws and still stay safe on the road.	*1*	*2*	*3*	*4*	*5*
i. I don't want to take risks when I'm riding.	*1*	*2*	*3*	*4*	*5*

Q34. Over the last 3 months, how many near misses or close calls have you had while riding on a public road? By this I mean incidents when you almost had an accident but didn't.

Number ___________ (*If none, skip to Q36)*

Q35. Thinking about the most serious close call or near miss in the past 3 months, how much were you responsible for what happened – with 0% being "I was not at all responsible"; 50% being "I was half responsible" , 100% being "I was fully responsible"? (*THEY MAY ASSIGN ANY VALUE FROM 0 TO 100%)*

[Note: riders may apportion responsibility for the incident to another road user, to a vehicle or features of the road.]

__________%

Q36. Over the last 12 months, have you had any sort of motorcycle crash (including minor spills and offs)? That is where you collided with someone or something, dropped or came off while riding your motorcycle on a public road? (Don't include dropping or knocking it over while parked)

1. *None (*Skip to Q.41*)*
2. *If Yes, how many crashes____________(Number)*

(NOTE If they have had more than one crash in the past 12 months, ask them to answer in relation to the one that was the most serious.)

Q37. Were you or anyone else injured? (*Tick all that apply*)

1. No (*Skip to Q39)*
2. Yes – rider
3. Yes someone else (*skip to Q41*)

Q38. What type of medical treatment did you receive? (*Do not read, use as prompt if needed*)

1. Was not injured
2. I had only minor cuts and bruises and did not need medical treatment
3. I went to a local GP or medical centre
4. Treated at the scene by Ambulance
5. Treated at hospital but not admitted
6. Admitted to hospital.

Q39. How much were you responsible for the crash? With 0% being "I was not at all responsible" 50% being "I was half responsible" , 100% being "I was fully responsible"? (*They may assign a value from 0 to 100%) [Note: riders may apportion responsibility for the crash to another road user, to a vehicle or features of the road.]*

__________%

Q40. How much experience had you had riding that motorcycle before the crash? (Read list, tick only 1 response)

1. **None** (You had never ridden that motorcycle before)
2. Less than 100 km
3. Between 101-1,000km
4. Between 1,001-5,000km
5. More than 5,000km

Q41. Do you have a driver's licence?

1. Yes
2. No (if No - Ask: Which of the following apply (tick only one)
    a. You never had one (skip to Q44)
    b. It was cancelled/disqualified (skip to Q43)
    c. You let it lapse (didn't renew it) (skip to Q43)

Q42. What kind of driver's licence do you have? (Do not Read – prompt if needed)

1. . A Learner permit

2. . A P1 Probationary Licence (Red)

3. A P2 Probationary Licence (Green)

4.. An unrestricted (full) licence

Q43. How many years driving experience do you have as a provisional or fully licensed driver? ________________Years (*Do not allow ranges, take to the nearest whole year)*

Finally, I would like to ask a few brief questions about yourself.

Q44. Into which occupational group do you belong? Are you ...(*Read out and tick one only*)

1. Working full time – more than 20 hours per week
2. Working (part time – less than 20 hours per week
3. School student
4. Tertiary or other student
5. Full time home duties or not seeking work
6. Retired/Pensioner
7. Unemployed

8. (Don't know)

Q45. What is your household's annual gross income in terms of the range it falls into? (*Read list. Note: If single – but living in shared household – only count their personal income. Income includes: wages/salary, income derived from self-employment, government benefits/pensions, other income– such as investments, scholarships, etc)*

2. Less than $30,000
3. $30,001-$50,000
4. $50,001-$100,000
5. $100,001 - $150,000
6. More than *$150,000*
7. *Don't know*
8. *Not answered*

What is the highest level of education you have so far reached? (*Do not read out – prompt if needed)*

1. *Still attending school*
2. *Year 11 or less (did not complete VCE or equivalent)*
3. *Completed VCE (Year 12 or equivalent)*
4. *Trade or other Certificate – or wo*rking towards this
5. Tertiary Degree or Diploma or working towards this
6. Other (Specify) ___________________

[*RECONTACTING DETAILS – Baseline and 3 month survey only*]

That is the end of the questions – but in case this phone number changes before we need to contact you again for the next part of the study, could we have your mobile number (if not currently speaking on a mobile)

Mobile __________________________________

and an email address ____________________________

As it is important that we can find you for the next interview, could you also give me the name and contact details of a family member or friend that does not live in the same household as you, so that if you move or change phone numbers we can ask them for your details?

*Name of alternate contact 1:*_________________________

Phone number: _____________________________

*Relationship;*____________________________________

*Name of alternate contact 2:*_____________________

Phone number: __________________________

*Relationship:*_________________________________

Please let this/these people know that you have supplied their details, so that they are not surprised if we call them.

That is the end of the interview, now we can find out to which group you have been assigned. assigned.

(*Pull up their Group number and tell the participant)*

So – it seems you have been allocated to the (program or delayed program) group

☐ VicRide ☐ Delayed VicRide

For you, the next step in the study is:

A. (VicRide. Read script:)

Scheduling a time and place to do the on-road VicRide Program.

Do you have a pen and paper? I'll give you a code and a phone number to call. The code is (*READ OUT THE CODE THEY HAVE BEEN ASSIGNED*) and the number is 1-800 XXXXXX . You will have to call 1800 – XXXXXX and give them your code (REPEAT CODE) to book in for your VicRide. We will also email these details to you but that will take about a week. Don't worry if you lose them, you will just have to wait for the email before you can schedule the time for your VicRide.

I will now pass on your details to ___________ who is booking the on-road VicRide Program. If they don't hear from you on the 1800 number, they will call you to arrange your VicRide.

Thank you once again for your time today.

B. (*Delayed VicRide - Read Script*)

You have been assigned to the delayed program group. This means that you will be doing the VicRide in 12 months time after you have completed all three interviews. You will be interviewed again in 3 months and then 12 months. The questions each time will cover much the same areas as today in terms of your riding experience. You will also receive a payment of $90 after you have completed the 12 month interview. Your role in the study is really important as we need to monitor some riders experience over time before they do the VicRide so we can see how well it works. We will also send you an email in a week's time confirming these details.

Thank you once again for your time today.

Appendix 5: Follow-up phone interview script

Hello, my name is ____________, and I'm calling from The George Institute at the University of Sydney about the **VicRide Program**. I am calling to do, or arrange a time to do, the second interview that is part of the study as you may recall.

Would you have time (about 30 minutes) now to do this second survey, or can we schedule a time in the next week that I can call you back ?

Are you available to do the interview now?

☐ Yes ☐ No OR

What would be the best time to call back and do the interview?

Date: ____ / ____ / ____ *Time* _______________

Is this the best phone number to call you on or is there another one? ___________

If participant refuses to continue with the study:

Interviewer: OK, that's fine, no problem, but could you just tell me the main reason you do not want to participate, because that's important information for us?

…………………………………

RECORD RE-CONTACT TYPE

1. Definitely don't call back

2. Possible conversion

(*Once ready to do the interview, enter Date interview conducted ___________mm______yyyy*)

There are no right or wrong answers to these questions. We just want to know about your experiences as a rider. Please answer all the questions as accurately and honestly as possible.

Q46. Q6. Do you always ride the same motorcycle for your on-road riding?

3. No (skip to Q4)
4. Yes

Q47. NQ1. Is this the same motorcycle that you were riding three months ago when you joined the study?

1. No (skip to Q4)
2. Yes

Q48. Q7. What is the current kilometres reading on your motorcycle?___________________ Total kilometres (need exact reading or best estimate if they have checked it recently)

☐ Don't know *[IF they don't know the reading say "Can you check it within the next 24 hours and email it to odo@george.org.au or SMS it to 0404171748 together with your name?]*

(As with the baseline interview we will need a weekly update on those who respond "Don't know")

THE NEXT FEW QUESTIONS ARE ABOUT YOUR RIDING BACKGROUND AND EXPERIENCE.

Q49. Q8_2. How many kilometres have you ridden on-road in total in the last 3 months?

________________Total km ("best estimate" is OK)
(Note: if they give a range, ask "Would that be closer to X or Y?, I have to give a single number.")

Q50. Q9. In an average week, about how many kilometres do you ride on-road?
_________________km
(*Do not allow ranges*)

Q51. Q10. In an average week, how many hours would you spend riding on-road?
____________hours

Q52. Q11. Thinking now about the riding you have done in the **last month**, how many separate trips on-road have you ridden over the past month: (Note: count to and from a destination as 2 separate trips, record "0" if no trips of this kind. It would be good to clarify again if the respondent give you odd numbers (unless they took another means of transport on their return trip).)

6. Commuting to work or study? _____ # trips
7. Riding for work as a part of your job? _____# trips
8. Riding for recreation (on-road riding)? _____# trips
9. Riding as a form of general transport, e.g. visiting, shopping etc? ____# trips
10. Other types of trips, Please specify:
    Other 1: type of trip_____________ # of this type of trip _____# trips
    Other 2: type of trip_____________ # of this type of trip _____# trips
    Other 3: type of trip_____________ # of this type of trip _____# trips

Q53. Q12. I am going to list some types of riding conditions. Thinking just about the past month, please tell me how many times you have ridden under each condition. A single ride can be counted for each of a number of conditions, for example if it was dark and raining, it counts once for dark and once for raining. If you are not sure, give your best estimate. How many times over the past month did you ride:

1. *When it was dark* _______***# times***
2. *When it was raining* _______***# times***
3. *On local suburban roads* _______***# times***
4. *In heavy traffic* _______***# times***
5. *On high speed roads zoned 100 km/h or more* _______***# times***
6. *On winding rural roads* _______***# times***
7. *In the company of at least one other rider* _______***# times***

Q54. Q18. Have you attended any formal rider training or coaching courses in the last three months?. Please don't include the VicRide program if you have done this.

3. No (Skip to Q11)
4. Yes

Q55. NQ2. (If yes) Please tell me the name of the program, the institution that provided the program, and the duration of the program for all the formal rider programs you have participated in.

Name of program	**Institution**	**Duration in hours**

Q56. Q21. Have you been on any practice rides with a more experienced rider to improve your riding? Again, please don't count the VicRide program if you have done this.

3. No (*Skip TO Q13*)
4. Yes

Q57. Q22_2(If Yes) How many within the last 3 months? _______#

Q58. Q24. I am going to read a series of statements, please say how much you agree or disagree with the statement. The options are: Strongly agree, Agree, Neither agree or disagree, then Disagree and Strongly disagree. How much do you agree or disagree with the following statements:
Accidents involving motorcycles are often caused by:

	Strongly agree	**Agree**	**Neither**	**Disagree**	**Strongly disagree**
h. Drivers pulling out in front of motorcyclists.	1	2	3	4	5
i. Drivers not noticing motorcyclists.	1	2	3	4	5
j. Motorcyclists going too fast	1	2	3	4	5
k. Car drivers going too fast.	1	2	3	4	5
l. Motorcyclists not looking far enough ahead.	1	2	3	4	5
m. Car drivers not looking properly.	1	2	3	4	5
n. Motorcycles being relatively less stable in an emergency situation.	1	2	3	4	5

Q59. Q25. Thinking just about riders your age and gender and with the same level of riding experience, how much more likely or unlikely do you think it is that YOU will be involved in a motorcycle crash in the next 12 months?: The options are: Much less likely, Less likely, Just as likely, More likely and Much more likely.

	Much less likely 1	Less likely 2	Just as likely 3	More likely 4	Much more likely 5

Q60. Q26. Again, compared to other riders your age, gender and level of riding experience, how much better or worse do you think you are at each of the following? The options are: Much better, Better, About the same, Worse or Much worse.

	Much better	**Better**	**About the same**	**Worse**	**Much worse**
e. Controlling the motorcycle (i.e. your vehicle control skills)	1	2	3	4	5
f. Spotting hazards	1	2	3	4	5
g. Getting out of hazardous situations safely	1	2	3	4	5
h. Avoiding hazardous situations	1	2	3	4	5

Q61. Q27. The options for the next set of statements are about frequency: Never, Hardly ever, Occasionally, Quite often, Frequently and All the time. When riding how often do you wear:

	Never	**Hardly ever**	**Occasionally**	**Quite often**	**Frequently**	**All the time**
j. A leather one-piece motorcycle suit	1	2	3	4	5	6
k. A motorcycle protective jacket (leather or non-leather)	1	2	3	4	5	6
l. Motorcycle protective trousers (leather or non-leather)	1	2	3	4	5	6
m. Body armour / impact protectors (eg for elbow, shoulder or knees)	1	2	3	4	5	6
n. Motorcycle boots	1	2	3	4	5	6
o. Motorcycle gloves	1	2	3	4	5	6
p. Bright/fluorescent clothing	1	2	3	4	5	6
q. Bright/fluorescent stripes/ patches on your clothing	1	2	3	4	5	6
r. A fully fastened helmet	1	2	3	4	5	6

Q62. Q28. When riding how often:	**Never**	**Hardly ever**	**Occasionally**	**Quite often**	**Frequently**	**All the time**
d. Do you use daytime running lights or headlights-on in daylight.	1	2	3	4	5	6
e. Do you ride with no motorcycle specific protective clothing?	1	2	3	4	5	6
f. Do you have trouble with your visor or goggles fogging up	1	2	3	4	5	6

Q63. Q29. When riding how often do each of the following things happen to you? [Instructions to interviewers: Prompt with the response options if required]

	Never	**Hardly ever**	**Occasionally**	**Quite often**	**Frequently**	**Nearly all the time**
n. Queuing to turn left on a main road, you pay such close attention to the main traffic that you nearly hit the vehicle in front.	1	2	3	4	5	6
o. Fail to notice that pedestrians are crossing when turning into a side street from a main road.	1	2	3	4	5	6
p. Exceed the speed limit on a residential road.	1	2	3	4	5	6
q. Miss a 'Give Way' or 'Stop' signs and almost crash with another vehicle.	1	2	3	4	5	6
r. Attempt to overtake someone who you haven't noticed to be signalling a right turn.	1	2	3	4	5	6
s. Race away from the traffic lights with the intention of beating the driver/rider next to you.	1	2	3	4	5	6
t. Ride so close to the vehicle in front that it would be difficult to stop in an emergency.	1	2	3	4	5	6
u. Exceed the speed limit on a motorway.	1	2	3	4	5	6
v. Ride between two lanes of fast moving traffic.	1	2	3	4	5	6
w. Ride so fast into a corner that you scare yourself	1	2	3	4	5	6
x. Exceed the speed limit on a country/ rural road.	1	2	3	4	5	6
y. Ride when you suspect that you might be over the legal limit for alcohol.	1	2	3	4	5	6

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
z. When riding at the same speed as other traffic, you find it difficult to stop in time when a traffic light has turned against you.	1	2	3	4	5	6

Q64. Q30. When riding, how often do each of the following things happen to you?

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
n. Distracted or pre-occupied, you suddenly realise that the vehicle in front has slowed, and you have to brake hard to avoid a collision.	1	2	3	4	5	6
o. Pull onto a main road in front of a vehicle you haven't noticed or whose speed you misjudged.	1	2	3	4	5	6
p. Disregard the speed limit late at night or in the early hours of the morning.	1	2	3	4	5	6
q. Not notice a pedestrian waiting at a crossing where the lights have just turned red.	1	2	3	4	5	6
r. Not notice someone stepping out from behind a parked vehicle until it is nearly too late.	1	2	3	4	5	6
s. Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping	1	2	3	4	5	6
t. Get involved in racing other riders or drivers.	1	2	3	4	5	6
u. Attempt or done a wheelie	1	2	3	4	5	6
v. Unintentionally had your wheels spin	1	2	3	4	5	6
w. Intentionally do a wheel spin	1	2	3	4	5	6
x. Pull away too quickly and your front wheel lifted off the road.	1	2	3	4	5	6
y. Open up the throttle and just go for it on a country road.	1	2	3	4	5	6

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
z. Another driver deliberately annoys you or puts you at risk.	1	2	3	4	5	6

Q65. Q31. When riding how often do each of the following things happen to you?

	Never	Hardly ever	Occasionally	Quite often	Frequently	Nearly all the time
g. Ride so fast into a corner that you feel like you might lose control.	1	2	3	4	5	6
h. Needed to change gears when going around a corner.	1	2	3	4	5	6
i. Skid on a wet road or manhole cover, road marking etc	1	2	3	4	5	6
j. Run wide when going around a corner	1	2	3	4	5	6
k. Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble)	1	2	3	4	5	6
l. Needed to brake or back-off when going round a bend.	1	2	3	4	5	6

Q66. Q32. How much do you agree or disagree with the following statements? The options are to: Strongly agree, Agree, Neither agree or disagree, then Disagree and Strongly disagree.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
y. It is important to me that my motorcycle is economic in fuel consumption	1	2	3	4	5
z. It is important to me that my motorcycle is stable and easy to control	1	2	3	4	5
aa. One of the best things about riding a motorcycle is that it is easy to park	1	2	3	4	5
bb. A motorcycle is only a means of getting from A to B	1	2	3	4	5
cc. One of the best things about riding a motorcycle is that you can get through traffic jams more easily	1	2	3	4	5
dd. One of the best things about my motorcycle is that it is easy to manoeuvre in traffic	1	2	3	4	5

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
ee. Motorcycle riding is exciting	1	2	3	4	5
ff. Riding a motorcycle makes me feel good	1	2	3	4	5
gg. When riding, it is a good feeling when you overtake others.					
hh. When riding a motorcycle, I feel a sense of freedom	1	2	3	4	5
ii. I prefer to ride slowly	1	2	3	4	5
jj. It is important to me that my motorcycle has a high top speed	1	2	3	4	5
kk. It is important to me that my motorcycle has fast acceleration.	1	2	3	4	5
ll. When I am with my friends, we often talk about motorcycles	1	2	3	4	5
mm. I enjoy riding my motorcycle at high speeds	1	2	3	4	5
nn. I like to corner at high speed	1	2	3	4	5
oo. I enjoy going on long motorcycle rides	1	2	3	4	5
pp. Riding a motorcycle is a good social activity	1	2	3	4	5
qq. When riding a motorcycle, I often feel as if I am at one with the machine	1	2	3	4	5
rr. Motorcycling is safe as long as you know what you are doing	1	2	3	4	5
ss. I think that 100 km/h on a rural road is too slow.	1	2	3	4	5
tt. Without motorcycles, my life would be less interesting	1	2	3	4	5
uu. Without a certain level of thrill, motorcycle riding would be boring	1	2	3	4	5
vv. It is fun to ride a motorcycle	1	2	3	4	5

Q67. Q33. How much do you agree or disagree with the following statements? [Instructions to interviewers: Prompt with the response options if required]

	Strongly agree	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*

j. Riding quickly on winding roads is a sign of a good rider.	*1*	*2*	*3*	*4*	*5*
k. Obeying all speed limits and traffic laws is a sign of a good rider.	*1*	*2*	*3*	*4*	*5*
l. You are a better rider if you obey all speed limits and traffic laws, even if you do not ride quickly around winding roads.	*1*	*2*	*3*	*4*	*5*
m. It doesn't matter if I break a few road traffic laws.	*1*	*2*	*3*	*4*	*5*
n. I get a real thrill out of riding fast.	*1*	*2*	*3*	*4*	*5*
o. I find it difficult to obey all the road traffic laws while riding.	*1*	*2*	*3*	*4*	*5*
p. It's okay for me to go faster than the speed limit as long as I ride carefully.	*1*	*2*	*3*	*4*	*5*
q. I can break a few road traffic laws and still stay safe on the road.	*1*	*2*	*3*	*4*	*5*
r. I don't want to take risks when I'm riding.	*1*	*2*	*3*	*4*	*5*

Q68. Q34. Over the **last 3 months**, how many near misses or close calls have you had while riding on a public road? By this I mean incidents when you almost had an accident but didn't.

Number ___________ (*If none, skip to Q26)*

Q69. Q35. Thinking about the most serious close call or near miss in the past 3 months, how much were you responsible for what happened – with 0% being "I was not at all responsible"; 50% being "I was half responsible", 100% being "I was fully responsible"? (*THEY MAY ASSIGN ANY VALUE FROM 0 TO 100%)*

[Note: riders may apportion responsibility for the incident to another road user, to a vehicle or features of the road.]

__________%

Q70. Q36. Over the last 3 months, have you had any sort of motorcycle crash (including minor spills and offs)? That is where you collided with someone or something, dropped or came off while riding your motorcycle on a public road? (Don't include dropping or knocking it over while parked)

3. *None (*Skip to Q.28*)*
4. *If Yes, how many crashes____________ (Number)*

(NOTE If they have had more than one crash in the past 3 months, ask them to answer in relation to the one that was the most serious.)

Q71. Q37. Were you or anyone else injured? (*Tick all that apply*)

4. No
5. Yes – rider
6. Yes someone else

[Instructions for programming: After Q26, for control skip to Q36. For cases go to Q27.]

Q72. NQ3. **[Instructions for programming: Cases only]** Finally I would like to ask you about the VicRide program. Just to confirm, you have completed the VicRide course recently. Is that right?

1. No (*Go to NQ4)*
2. Yes (*skip to NQ5*)

Q73. NQ4. (if no) As I understand you registered to do the course. What stopped you from doing the course?

[Instructions for programming: skip to NQ14]

Q74. NQ5. (if yes) Before I ask you questions about the VicRide course you completed some weeks ago, can I ask you a few questions to help you remember about the course? Do you remember the name of your Coach? I understand you went on rides with a few other riders and your Coach. You had discussion times with them as well and the Coach gave you some feedback on your rides. Is that right?

(**Instruction to interviewers: The aim here is to establish rapport with the rider and help him/her remember and answer the following questions about the VicRide course. Unless it is a refusal to participate type response, what responses they give or whether it's right or wrong does not matter.**)

Q75. NQ6. Thinking about the VicRide course, can you tell me how strongly you agree or disagree with the following? Your answer can be strongly agree, agree, disagree or strongly disagree.

	Stronly Agree 4	**Agree 3**	**Disagree 2**	**Strongly Disagree 1**	**DK 0**
a) I got what I wanted out of the course					
b) I found the course useful overall					
c) I found the coach's feedback helpful					
d) I found the discussions helpful					
e) I found the rides helpful					
f) The course has helped me to ride more safely					
g) The location of the course was suitable for me					
h) The booking process was smooth					
i) The participant handbook was useful					
j) I would recommend this course to other new riders					
k) The time required to complete the course including the preparation time was suitable for me					
l) I was satisfied with the style of coaching					
m) I found the coach credible					
n) The course enabled me to improve on the aspects I wanted to improve in my riding					
o) There was enough new information provided in the course.					

p) The program was pitched at the right level for my riding experience.					

Q76. NQ9. What would you like to have seen done differently?

Q77. NQ10. What did you like about the Course?

Q78. NQ11. Do you feel the Course was….

1. ☐ Too long 2. ☐ About the right length or 3. ☐ Too short?

Q79. NQ12. Do you feel that the speed of the rides was ….

1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
Much too fast	A bit too fast	About right	A bit too slow	or Much too slow?

Q80. NQ13.Do you feel the Course employs the right balance of discussion and on-road riding? [Instructions to the interviewers: Read out the first three prompts]

1. ☐ Not enough discussion and too much on-road riding
2. ☐ About the right balance
3. ☐ Too much discussion and not enough on-road riding
4. ☐DK

Q81. NQ14.

As you know, you are taking part in this trial of the VicRide coaching program to see whether it helps make newly licensed riders safer. I'm now going to present you a scenario and I'd like you to answer the following questions keeping in mind the context described to you.

[Instructions for programming: Control only] I would like to remind you though as you are participating in the trial you will still be doing the course for free after the third interview.

In the past five years in Victoria, around 1050 riders have been killed or seriously injured every year in motorcycle crashes. The VicRide on-road coaching program was developed to reduce motorcycle related deaths and injuries.

The course:

- Takes about 4 to 5 hours of your time to complete, and
- Involves rides on road with an accredited and experienced riding coach and one or two other newly licensed riders, as well as

- discussions with the group about the rides covering basic theory.

The VicRide course is delivered through professional training providers like HART, Honda Australia Rider Training, but it is managed and coordinated by VicRoads to ensure safety standards are met.

The coaching course is being offered to newly licensed Victorian riders and it's your choice to participate or not, but the course has to be paid for by each rider (separate from the licence fee).

We expect that when all the Victorian riders complete the VicRide course, motorcycle related deaths and serious injuries will be reduced by 52 people per year.

(**Programming instruction**: Random allocation of 2 formats (2 different ordering of the questions. Each rider is asked one of the 2 formats randomly within the intervention and control group respectively. Hence there will be 4 screens randomly allocated to the total sample of 2000-2400.)

ORDER: increasing order and decreasing order. For decreasing order, stop when the rider says 'yes' and ask Q37 for that value. For increasing order, stop when the rider says 'no' an ask Q37 for the last value they said 'yes' to.)

10. ☐ Would you pay $500 or more to participate in the program? (If 'yes', tick ***and ask item 8***. This is the respondent's maximum willingness to pay. If 'no', ask next item.)
11. ☐ Would you pay $300? (If 'yes', tick and go to NQ15.This is the respondent's maximum willingness to pay. If 'no', ask next item.)
12. ☐ Would you pay $200? (If 'yes', tick and go to NQ15. This is the respondent's maximum willingness to pay. If 'no', ask next item.)
13. ☐ Would you pay $150? (If 'yes', tick and go to NQ15. This is the respondent's maximum willingness to pay. If 'no', ask next item.)
14. ☐ Would you pay $100? (If 'yes', tick and go to NQ15. This is the respondent's maximum willingness to pay. If 'no', ask next item.)
15. ☐ Would you pay $50? (If 'yes', tick and go to NQ15. This is the respondent's maximum willingness to pay. If 'no', ask next item.)
16. ☐ Would you pay $25? (If 'yes', tick and go to NQ15. This is the respondent's maximum willingness to pay. If 'no', ask item 8.)
17. ☐ How much would you pay? (please record value, and go to NQ15. This is the respondent's maximum willingness to pay.)
18. ☐ Don't know (If 'yes' tick and go to NQ15.)

10. ☐ Would you pay $25 to participate in the program? (If 'yes', tick and ask item 6. If 'no', ***ask item 8***")
11. ☐ Would you pay $50? (If 'yes' tick and ask next item. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

5. ☐ Would you pay $100? (If 'yes' tick and ask next item. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

7. ☐ Would you pay $150? (If 'yes' tick and ask next item. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

3. ☐ Would you pay $200? (If 'yes' tick and ask next item. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

9. ☐ Would you pay $300? (If 'yes' tick and ask next item. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

1. ☐ Would you pay $500 or more? (If 'yes' tick ***and ask item 8***. If 'no' go to NQ15. The previous value they said 'yes' to is the respondent's maximum willingness to pay.)

11. ☐ How much would you pay? (please record value, and go to NQ15. This is the respondent's maximum willingness to pay.)

12. ☐ Don't know (If 'yes' tick and go to NQ15.)

Q82. NQ15. How certain are you with your choice on how much you would pay for the program, on a scale from 1 to 10 where 1 is not certain at all and 10 is very certain?

Q83. NQ16. What is the main reason for your choice to pay (just ask for the maximum value they said yes to in NQ14: $25, $50, $100, $150, $200, $300, $500, or the respondent's own reported value)? ***For DK answers*** Why is that?

(**Instruction to interviewers: Please record the most appropriate category that best fits the rider's answer. Ask this question for DK answers too. If you are not sure what category it fits then write the response in text.**)

12) Reduction in crash risk is not important to me.

13) That's not enough crash reduction for me.

14) That's how much the course is worth to me.

15) It's something Government should pay, not me.

16) I don't believe such a course will make a difference to crash risk

17) I want to learn more riding skills and this is a good way to do it

18) I value safety

19) I just don't have a lot of spare cash

20) I want to finish the interview as quickly as possible.

21) Other (please specify) [**Interviewers – please record in text**]

22) I don't know.

Q84. NQ17. What would be most likely to attract you to doing a course like the VicRide course if it were offered to you and you weren't in this trial? [**Interviewers – please record in text**]

[*RECONTACTING DETAILS*]

"That is the end of the questions – We are calling you in 9 months time for the last interview. When that is done you will receive your $90 gift voucher from VicRoads. Would this number still be the best number to call you on?"

If No, record number (or if they know they won't be around find out if there is a date close to that they would be or if they would be contactable at all)

____

Refused – LAST RESORT

"Have you moved house, changed mobile or email addresses?"

If Yes, Record new contact details that are applicable:

Email address ____________________________

Home number: ______________________________

Mobile: ______________________________

Work number: ______________________________

"That is the end of the interview.

Thank you once again for your time today."

Appendix 6: Ethics Approval

2009/ 23699

Address for correspondence:
OFFICE OF ETHICS ADMINISTRATION
LEVEL 6
JANE FOSS RUSSELL BUILDING – G02
THE UNIVERSITY OF SYDNEY NSW 2006

ETHICS OFFICE
20 JAN 2010
DATE RECEIVED

UNIVERSITY OF SYDNEY
HREC
22 FEB 2010
APPROVED

APPROVED
2/2/10

THE UNIVERSITY OF SYDNEY
HUMAN RESEARCH ETHICS COMMITTEE
REQUEST FOR MODIFICATION

1. **Principal Investigator:** A/Prof Rebecca Ivers

   Department: The George Institute, Conjoint A/Prof, School of Public Health, University of Sydney

   Address: The George Institute, PO Box M201 Missenden Road NSW 2050

2. **Project Title:** Evaluation of a large-scale trial of an on-road assisted ride program for newly licensed motorcycle riders

3. **HREC Approval No.:** 12-2009/12467

4. **Names of Students/Co-Investigators:** Dr Teresa Senserrick, Dr Jane Elkington, Dr Soufiane Boufous, Ms Liz de Rome, Dr Maria Ali

5. **Project Description:**
   Please provide a one paragraph lay summary of your original project

The study involves the evaluation of a motorcycle rider training program in a large scale randomised control trial. Monash University Accident Research Centre (MUARC) is responsible for recruiting and consenting participants and delivering the program to 2000 riders; the investigators on this application are responsible for the evaluation of the program, including three surveys and data linkage to crash and licensing information.

6. **Any previously approved minor amendments?** ☐ Yes ✓No
   If YES, please briefly outline

7. **Nature of and reasons for amendment(s)**
   Please provide details of the changes you propose to make to the project and explain why they are necessary. Please justify any increase in sample size.

Addition of a pilot test of the interview protocol. The funding body has requested that the telephone interview protocol for study subjects (approved 8th December, 2009 – see Attachment C – Baseline survey) be pilot tested with a group of motorcycle riders who will not be involved in the trial. This will ensure that the language and content of the questions is appropriate for this group of subjects.

It is proposed that the pilot testing be undertaken in two steps:
1) In-depth interviews with a small number of riders sourced in consultation with motorcycle riders clubs in Sydney. These interviews will be conducted face to face or by phone by a member of the evaluation team and aim to identify issues with working of questions, length of interview and riders perceptions of questions and measures used. Riders would be surveyed until there is a "saturation" effect; that is, no major additional changes are required. Given that

2009/23699

Address for correspondence:
OFFICE OF ETHICS ADMINISTRATION
LEVEL 6
JANE FOSS RUSSELL BUILDING – G02
THE UNIVERSITY OF SYDNEY NSW 2006

APPROVED
22/2/10

THE UNIVERSITY OF SYDNEY
HUMAN RESEARCH ETHICS COMMITTEE
REQUEST FOR MODIFICATION

1. **Principal Investigator:** A/Prof Rebecca Ivers

   Department: The George Institute, Conjoint A/Prof, School of Public Health, University of Sydney

   Address: The George Institute, PO Box M201 Missenden Road NSW 2050

2. **Project Title:** Evaluation of a large-scale trial of an on-road assisted ride program for newly licensed motorcycle riders

3. **HREC Approval No.:** 12-2009/12467

4. **Names of Students/Co-Investigators:** Dr Teresa Senserrick, Dr Jane Elkington, Dr Soufiane Boufous, Ms Liz de Rome, Dr Maria Ali

5. **Project Description:**
   Please provide a one paragraph lay summary of your original project

The study involves the evaluation of a motorcycle rider training program in a large scale randomised control trial. Monash University Accident Research Centre (MUARC) is responsible for recruiting and consenting participants and delivering the program to 2000 riders; the investigators on this application are responsible for the evaluation of the program, including three surveys and data linkage to crash and licensing information.

6. **Any previously approved minor amendments?** ☒ Yes ☐ No
   If YES, please briefly outline

An amendment (not yet approved) has been submitted to pilot test the baseline participant questionnaire for riders, using motorcycle riders recruited from clubs in NSW.

7. **Nature of and reasons for amendment(s)**
   Please provide details of the changes you propose to make to the project and explain why they are necessary. Please justify any increase in sample size.

<u>Two amendments are requested.</u>

1. As noted above, an amendment (not yet approved) has been submitted to pilot test the questionnaire for program participants with motorcycle riders in NSW. We are now seeking approval to extend the pilot test to include riders from both NSW and Victoria, rather than just from NSW as previously outlined.

2. <u>Additional surveys of coaches delivering program</u>

Up to 50 motorcycle coaches will be recruited by Monash University to deliver the assisted ride program

2009/2365

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

ETHICS OFFICE
21 MAY 2010
DATE RECEIVED

APPROVED 26/5/2010

Human Ethics Certificate of Approval for VicRoads

Date: **3 March 2010**

Project Number: **CF09/3653 - 2009001972**

Project Title: **Develop and conduct a large-scale trial of an on-road Assisted Ride Program for motorcyclists**

Chief Investigator: **Ms Christine Mulvihill**

Approved: **From: 3 March 2010** **To: 3 March 2015**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Ben Canny

Professor Ben Canny
Chair, MUHREC

cc: Mr Mark Collins, Dr Mark Anthony Symmons, Assoc Prof Rebecca Ivers

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
Telephone +61 3 9905 5490 Facsimile +61 3 9905 3831
Email muhrec@adm.monash.edu.au www.monash.edu/research/ethics/human/index/html
ABN 12 377 614 012 CRICOS Provider #00008C

2009/23699 (P)

ETHICS OFFICE
27 SEP 2010
DATE RECEIVED

Patricia Engelmann

From:	Chika Sakashita [csakashita@georgeinstitute.org.au]
Sent:	Monday, 27 September 2010 11:54 AM
To:	Patricia Engelmann
Cc:	Rebecca Ivers; Jane Elkington; Liz de Rome; Soufiane Boufous; ~~Maria Ali~~
Subject:	FW: MUHREC Amendment CF09/3653 – 2009001972: Develop and conduct a large-scale trial of an on-road Assisted Ride Program for motorcyclists
Attachments:	Revised web recr exp statement for ethics Sep 9 2010_1.doc; Att 1 Current Recruitment method.doc; Att 2 Information sheet for training providers 8 Sep 10_CM.DOCX; Att 3 CONSENT TO BE CONTACTED FORM.DOC; Att 4 letter for riders.doc; Att 5 VICRIDE Booklet 9 Sep 2010 v2.doc; Att 6 SRC Script for recruiting riders DRAFT 2 Sep 10.docx; Att 7 VicRoads Booklet Letter_2 Sep 2010.doc

Dear Patricia

This email is in relation to the project Ref No **12467; Title: Evaluation of a large-scale trial of an on-road assisted ride program for newly licensed motorcycle riders**.

The recruitment for this trial had been previously approved by Monash University Ethics (MUHREC), and the approval letter from MUHREC was forwarded to you fyi on 21/5/10. Additional recruitment methods were proposed to help improve the recruitment rate and MUHREC approval has been granted for this too on 24/9/10. I am forwarding their approval notification below on behalf of A/Prof Rebecca Ivers. I have just in case also attached all the documents that were sent to MUHREC fyi.

Thank you.
Chika

APPROVED
21/10/10

CHIKA SAKASHITA
Project Manager, Injury Division

The George Institute for Global Health | AUSTRALIA
Level 7, 341 George St | Sydney NSW 2000 Australia
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THE GEORGE INSTITUTE
for Global Health

From: Christine Mulvihill [mailto:Christine.Mulvihill@monash.edu]
Sent: Monday, 27 September 2010 10:06 AM
To: Chika Sakashita
Subject: Fw: MUHREC Amendment CF09/3653 – 2009001972: Develop and conduct a large-scale trial of an on-road Assisted Ride Program for motorcyclists

----- Forwarded by Christine Mulvihill/Muarc/Staff/Monash on 27/09/2010 10:02 AM -----

From:	MRO Human Ethics Team/Adm/Staff/Monash
To	Christine Mulvihill/Muarc/Staff/Monash@Monash
Cc:	mcollins@hondampe.com.au, Mark.Symmons@monash.edu, rivers@george.org.au
Date	24/09/2010 02:24 PM
Subject	MUHREC Amendment CF09/3653 – 2009001972: Develop and conduct a large-scale trial of an on-road Assisted Ride Program for motorcyclists

Appendix 7: Journal confirmation of manuscripts in press and submitted

Dear Chika Sakashita
Your article listed below is currently in production with Taylor & Francis.

Journal: GCPI Traffic Injury Prevention
Manuscript ID: 837576
Manuscript Title: The use of self-report exposure measures amongst novice motorcyclists: appropriateness and best practice recommendations
By: Sakashita; Senserrick; Boufous; deRome; Elkington; Ivers

Elsevier Editorial System(tm) for Transportation Research Part F: Traffic Psychology and Behaviour
Manuscript Draft
Manuscript Number: TRF-D-12-00159R1
Title: The Motorcycle Rider Behavior Questionnaire: Psychometric properties and application amongst novice riders in Australia
Article Type: Full Length Article
Section/Category: Regular Issue
Keywords: Motorcycle Rider Behaviour Questionnaire; validity; reliability; motorcycle crash; traffic offence
Corresponding Author: Ms. Chika Sakashita,
Corresponding Author's Institution: The George Institute for Global Health, University of Sydney
First Author: Chika Sakashita
Order of Authors: Chika Sakashita; Teresa Senserrick; Serigne Lo; Soufiane Boufous; Liz de Rome; Rebecca Ivers
Manuscript Region of Origin: AUSTRALIA
Abstract: The Motorcycle Rider Behavior Questionnaire (MRBQ) was developed to measure behavioural factors influencing motorcyclists' crash risk including errors and violations as well as the use of motorcycle safety equipment via self-report. The aims of the present study were to 1) examine the previously examined psychometric properties of the MRBQ including the factor structure, internal consistency, and predictive validity in terms of self-reported crashes amongst experienced riders in the UK and Turkey; 2) examine the psychometric properties of the MRBQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes; and 3) assess the applicability of the MRBQ to a population of novice riders in Australia, to whom the MRBQ has not been applied to date. Novice riders (N=1305) in the state of Victoria, Australia participated in the present study. Confirmatory factor analyses showed that the present data did not fit with the previously found factor models in experienced riders in the UK and Turkey. Principal axis factoring was performed to respecify the MRBQ factor model amongst novice riders and revealed four scales: errors; speed violations; stunts; and protective gear. The insufficient internal consistency, stability, content and predictive validity demonstrated by the MRBQ in the present study and some inconsistencies amongst the three MRBQ studies suggest that the development and refinement of the MRBQ items are required before wider use of the MRBQ instrument, especially amongst novice riders. Possible causes of the limited reliability and validity of the current MRBQ are discussed to inform further development and refinement of the items, thereby making the MRBQ more useful in future research to understand and evaluate riders' behaviors.

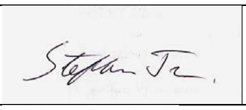
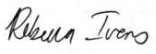
Elsevier Editorial System(tm) for Transportation Research Part F: Traffic Psychology and Behaviour
Manuscript Draft
Manuscript Number: TRF-D-12-00196R1
Title: The Motorcycle Rider Motivation Questionnaire: Psychometric properties and application for novice riders in Australia
Article Type: Full Length Article
Section/Category: Regular Issue
Keywords: Motorcycle Rider Motivation Questionnaire; validity; reliability; motorcycle crash; traffic offence
Corresponding Author: Ms. Chika Sakashita,
Corresponding Author's Institution: The George Institute for Global Health, University of Sydney
First Author: Chika Sakashita
Order of Authors: Chika Sakashita; Teresa Senserrick; Soufiane Boufous; Liz de Rome; Rebecca Ivers
Manuscript Region of Origin: AUSTRALIA
Abstract: The Motorcycle Rider Motivation Questionnaire (MRMQ) is the first structured questionnaire to be developed to systematically assess the reasons for riding. The aims of the present study were to 1) examine the previously examined psychometric properties of the MRMQ including the factor structure internal consistency, and predictive validity in terms of riding behaviours as measured by the Motorcycle Rider Behaviour Questionnaire (MRBQ), 2) examine the psychometric properties of the MRMQ not yet examined, including its stability, content validity, and predictive validity in terms of police-recorded crashes and offences as well as self-reported near crashes and crashes, and 3) assess the applicability of the MRMQ amongst novice riders in Australia, a population to whom the MRMQ, developed using a sample of UK riders, has not been applied to date. The present findings showed some similarities but also differences with respect to the previously found item constituents of each scale, internal consistency and predictive validity of the MRMQ in terms of MRBQ behaviours. Confirmatory factor analysis showed that the previously found structure was not a good fit ($\chi2 = 1661.10$; df=246; $p<.001$; RMSEA =.066), and a new structure was explored. Principal component analysis identified a 20-item MRMQ with three scales, namely pleasure, speed, and convenience to be most appropriate in the present sample. The pleasure and speed scales showed acceptable internal consistency and stability ($\alpha=.75$; r=.75-.76), but the convenience scale had alpha and stability scores just below the acceptable cut-off of 0.7. Although the size of the correlations was not large, all the three scales demonstrated results that would be expected with good content validity. All the three scales showed predictive validity in one way or another but differently in relation to the MRBQ behaviours, self-reported near crashes and crashes, and police-recorded offences. The present findings and the inconsistencies between the two MRMQ studies suggest that the current MRMQ as it stands is limited and further development and refinement of the MRMQ items are required before its wider use, especially with respect to the convenience construct and amongst novice riders. However, the predictive validity of the MRMQ in terms of the MRBQ paralleled observations in other studies, and the practical implications of the present findings overall are discussed.

Appendix 8: Authorship statements

Paper 1

Sakashita C, Jan S, Ivers R. The application of contingent valuation surveys to obtain willingness to pay data in road safety research: methodological review and recommendations. Australasian Road Safety Research Policing and Education Conference; 2012 4–6 October 2012; Wellington, New Zealand. Accesion number:01481706. Available from http://trid.trb.org/view.aspx?id=1250827

CS conceived and designed the study, conducted the review and critical analyses of the literature, wrote the first draft of the manuscript and the first draft of the response to reviewers' comments, and was responsible for finalisng the paper for submission. All authors provided input in preparing the final draft for submission and responding to reviewers' comments.

Author name	Signature	Date
Chika Sakashita		28/8/2013
Stephen Jan		28/8/2013
Rebecca Ivers		28/8/2013

Paper 2

Sakashita C, Senserrick T, Boufous S, de Rome L, Elkington J, Ivers R. The use of self-report exposure measures amongst novice motorcyclists: appropriateness and implications. Traffic Injury Prevention. 2013. In Press.

CS conceived and designed the study, conducted all statistical analyses, wrote the first draft of the manuscript and the first draft of the response to reviewers' comments, and was responsible for finalising the manuscript for journal submission. All authors provided input in the design of the survey, and the final draft for submission. TS and RI also provided input in responding to reviewers' comments.

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Paper 3

Sakashita C, Senserrick T, Lo S, Boufous S, De Rome L, Ivers R. The Motorcycle Rider Behavior Questionnaire: Psychometric properties and application amongst novice riders in Australia. Transportation Research Part F: Traffic Psychology and Behaviour. Under review.

CS conceived and designed the study, conducted all statistical analyses, wrote the first draft of the manuscript and the first draft of the response to reviewers' comments, and was responsible for finalising the manuscript for journal submission. CS, TS, SB, LdR, and RI provided input in the design of the survey. SL provided guidance in statistical analyses and the interpretation of the results. All authors provided input in the final draft for submission, and in responding to reviewers' comments.

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Paper 4

Sakashita C, Senserrick T, Boufous S, De Rome L, Ivers R. The Motorcycle Rider Motivational Questionnaire: Psychometric properties and application for newly licensed riders in Australia. Transportation Research Part F: Traffic Psychology and Behaviour. Under review.

CS conceived and designed the study, conducted all statistical analyses, wrote the first draft of the manuscript and the first draft of the response to reviewers' comments, and was responsible for finalising the manuscript for journal submission. All authors provided input in the design of the survey, and the final draft for submission. TS and RI also provided input in responding to reviewers' comments.

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Paper 5

Sakashita C, Jan S, Senserrick T, Lo S, Ivers R. Perceived value of a motorcycle training program: the influence of crash history and experience of the training. Traffic Injury Prevention. 2013. DOI: 10.1080/15389588.2013.828346. Available from http://www.tandfonline.com/eprint/Sr8FntbsA2x5I3MYDAHq/full

CS conceived and designed the survey and the study, conducted all statistical analyses, wrote the first draft of the manuscript and the first draft of the response to reviewers' comments, and was responsible for finalising the manuscript for journal submission. SJ, TS, and RI provided input in the design of the survey. SJ and SL provided guidance in statistical analyses and the interpretation of the results. All authors provided input in the final draft for submission, and in responding to reviewers' comments.

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