MONASH University
Accident Research Centre

NATURALISTIC CYCLING STUDY:

IDENTIFYING RISK FACTORS FOR CYCLISTS IN THE AUSTRALIAN CAPITAL TERRITORY

by

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September, 2014

Report No. 322

NRMA - ACT ROAD SAFETY TRUST

Amy Gillett FOUNDATION
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MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE
REPORT DOCUMENTATION PAGE

Report No.	Date	ISBN	ISSN	Pages
322	September 2014	0-7326-2392-8	1835-4815 (online)	77

Title and sub-title:
Naturalistic cycling study: identifying risk factors for cyclists in the Australian Capital Territory

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Sponsoring Organisation(s):
This project was funded by a research grant received from the NRMA-ACT Road Safety Trust. The study was conducted and this final report was written exclusively by the named authors and has not been endorsed and is not guaranteed by the NRMA-ACT Trustees.

Abstract:

The Australian Capital Territory (ACT) has the highest cycling participation rate in Australia; however it also has one of the highest rates of cyclist serious injury. In this study, the behaviour of cyclists and their interaction with drivers was investigated to identify ways to improve cyclist safety. A naturalistic cycling study was conducted using helmet mounted video cameras with a GPS data logger. The study included an online survey and in-depth exit interviews. In total, 36 participants completed the study from September 2011 to April 2012. Participants recorded over 460 hours of video footage of their commute to and from work over a distance of almost 9,000km. In total, 91 potential conflict events were identified that involved the cyclist and another road user. The majority of the events involved the cyclist and a driver and were due to actions by the driver. Drivers turning left across the cyclist's path and unexpectedly opened vehicle doors were the most common interactions. Cyclists recorded an average speed of 22.7km/h and a maximum speed of 56km/h. Data on cyclists' speed provides new insights into how cyclists travel, particularly on-road and when interacting with other road users. Potential countermeasures and recommendations to improve safety for cyclists in the ACT are also discussed.

Key Words:
Cyclist safety, cyclist-driver interaction, naturalistic cycling study

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Preface

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Ethics Statement

Research protocols were reviewed and approved by the Monash University Human Research Ethics Committee on 23 September 2010, reference number: CF10/2057 – 2010001141.

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EXECUTIVE SUMMARY

This study investigated the experiences of cyclists in the Australian Capital Territory (ACT). The ACT has the highest rate of cycling participation of any jurisdiction in Australia and although there have been few fatality crashes in recent years; the ACT has the highest cyclist serious injuries nationally. The focus of this study was to identify safety concerns, including risks and interactions with drivers. The Safe System approach that underpins Australian road safety strategies was used to structure this study, providing a systems approach to cyclist safety that took into account: safer road users, safer roads and roadsides, safer speeds and safer vehicles.

A naturalistic cycling study was conducted with commuter cyclists to investigate their experiences across the entirety of their trip. Naturalistic methods provide the most objective record of road users' experiences and can be analysed without the potential biases and omissions that may be generated by a cyclist recalling events. Compact video cameras were mounted to participants' helmets and they recorded their trips to and from work over a four-week period. Participants also completed an online survey and in-depth exit interview. Each video camera was fitted with a GPS data logger and data points of the cyclists' locations were generated. The study was conducted from September 2011 to April 2012, during the daylight savings period.

In total, 36 participants completed the study (25 males, 11 females). Collectively the participants recorded 466 hours and 20 minutes of video footage of their trips over a period of 8,986km. The trips taken were extensive across the populated, north eastern area of the ACT and across into the border towns of Queanbeyan and Jerrabomberra in New South Wales. Cyclist routes were mapped using a GPS point density map.

No collision events were recorded. A total of 91 potentially unsafe cyclist-interactions were identified. In the majority of events (93.4%), the behaviour of the driver led to the event. The most common event type was left turn (37.3%) which involved a driver turning left across the path of the cyclist, drivers turning across cyclists' path from the adjacent direction (32.9%). Unexpectedly opened vehicle doors accounted for 17.6% of cyclist-driver interactions. In the majority of all events, a crash was avoided due to the evasive actions taken by cyclists.

Cyclists' speed was recorded across the entire cohort. Average travel speed was recorded at 22.7km/h with the maximum recorded speed of 56km/h. Speed was a factor in the cyclist-driver events, in almost two thirds of events (64.8%) the cyclist braked to avoid a potential collision. Events when the cyclists needed to brake heavily typically involved the driver cutting across the cyclists' path without adequate indication of their intention to turn.

Event characteristics in the ACT were compared to a previous naturalistic cycling study conducted in Melbourne. In both cities, the majority of events were triggered by driver behaviour (ACT: 93.4%; Melb: 87.0%). There were similarities related to time of day and events occurring in relation to an intersection. However, there were also many differences. Considerably more cyclist-vehicle door incidences occurred in the ACT whereas Melbourne events tended to have higher severity (more crash and near-crash events) and a higher number of events per participant were identified in Melbourne.

As a result of this study, the following recommendations are made to the NRMA-ACT Road Safety Trust. Background and study findings that support each recommendation are detailed in the report.

Recommendations to the NRMA-ACT Road Safety Trust:

Safer road users

To support an *It's a two-way street* communication campaign in the ACT to raise awareness about safe cycling and driving behaviours.

To support action to amend legislation to specify the minimum passing distance a driver must allow when overtaking a cyclist.

To support behaviour change experts to develop an effective campaign to target aggressive driving behaviour and reduce on-road bullying.

To support the establishment of a crash surveillance system that allows the community to register crash events that are not reported to the police or a hospital to establish a more comprehensive understanding of cyclist safety and changes over time.

To support research into the role the media and online forums play in the public discussion and perception of road users. In addition, to examine the correlation between public discussion and risk to road user safety and how any such risk may be ameliorated.

To support targeted police blitzes on key driver behaviours that impact cyclist safety including publicity about the blitz and that the aim is to improve safety for cyclists by targeting driver behaviour.

To support greater consistency of cycling infrastructure and line markings, particularly at intersections across the ACT.

To support education and awareness campaigns that provide clear instructions to all road users about sharing the road.

Safer roads and roadsides

To support the implementation of continued and increased bike lanes with greater connectivity along cycling routes. In particular, improved connectivity, especially at points where the road narrows and the bike lane discontinues, a safe connected option is needed at these points.

To support a review of intersections where cyclists report they are not recognised by the infrastructure that triggers a signal change.

To support a trial to permit cyclists to turn left at all signalised intersections and across the 'top' of T intersections.

To support increased implementation of Austroads guidelines to prioritise safe cyclist travel.

To support the (re)surfacing of all roadways with the same quality road surface material that is used in vehicular lane in the bicycle lane.

To support the introduction of a glass return scheme, as in South Australia, that provided people with a small payment per glass bottle returned to a central depot. It was suggested that this would result in fewer broken glass bottles on the road and bike paths.

To support programs that encourage key stakeholders, particularly road designers, to regularly cycle in the ACT to better understand the challenges and gaps for cyclists.

Safer speeds

To support a review of posted speed zones in the ACT with consideration to reducing the speed in areas of high cyclist and pedestrian activity.

To support education for drivers to promote a more accurate understanding of cyclists' speed and the distance required to turn in front of a cyclist safely.

To support further analysis of cyclist speed data to profile the impact of cyclist travel speed on interactions with other road users in on- and off-road locations.

Safer vehicles

To support increased education for bus drivers that focuses on: safe interactions with cyclists, safe overtaking, actual time 'delays' caused by waiting for cyclists, minimising leapfrogging. International examples of driver training, for example truck driver awareness in the UK could be adapted for Australian bus drivers.

To support education/awareness campaigns targeting safe cycling behaviour when interacting with buses that includes: minimising leapfrogging, reminder of the law about giving way to buses.

To support targeted education campaigns to drivers that are considered to be of concern to drivers may improve driver behaviour and reduce the level of tension between cyclists and drivers.

To support a trial of adult cyclists' use of footpaths in all states where it is currently not permitted.

To support the addition of mandatory driving skills related to interacting with cyclists and cycling infrastructure and knowledge of cyclist-related road rules in driver licence training and testing.

We note that the NRMA-ACT Road Safety Trust have already publicly included many of these recommendations in their submission to the ACT Legislative Assembly's Inquiry into Vulnerable Road Users, 22 August 2013.

1. INTRODUCTION

Australians are rediscovering cycling. Regular riding improves health and physical fitness,[1, 2] and is a convenient form of transport that can reduce urban traffic congestion.[3] These benefits are recognised by all levels of Australian government in public policy and cycling strategies.[4, 5] Cycling reduces dependence on vehicles which improves the health of individuals, reduces vehicle congestion on the roads, requires cheaper infrastructure than vehicles and contributes to achieving environmental targets for reduced vehicle emissions.[5]

Nationally, the number of people riding their bikes for exercise, recreation and sport is increasing. Different approaches to counting cyclists have resulted in a wide variance in the number of people cycling in Australia. According to the annual report *Participation in Exercise, Recreation and Sport* (ERASS), from 2001 to 2010 the number of people who rode a bike in the previous year increased by 46 per cent (see Figure 1).

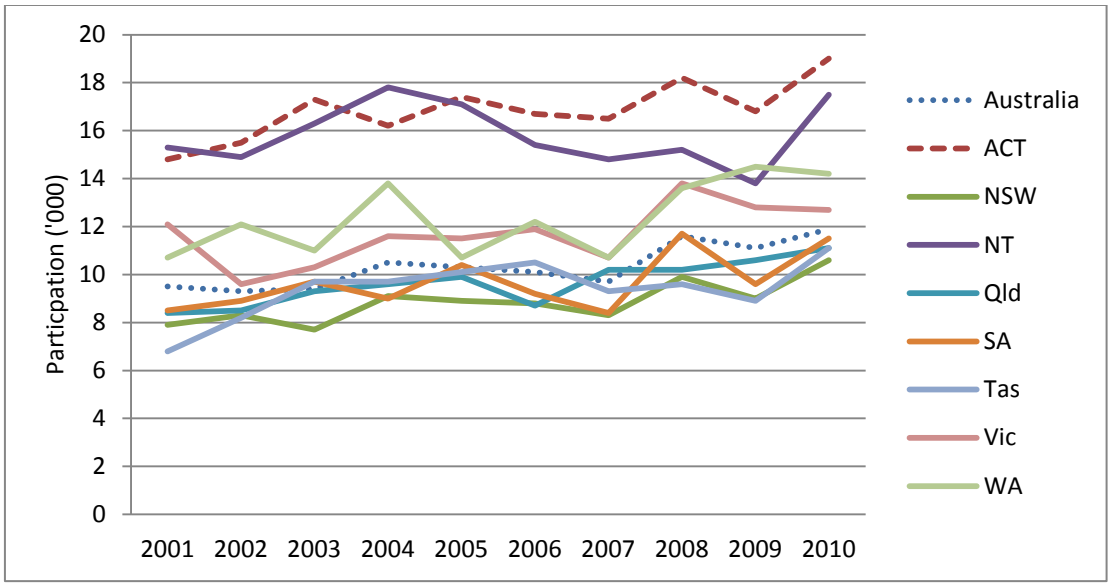

Figure 1 Proportion of population who cycle in Australia by jurisdiction (2001-2010)[6-15]

A snapshot study in 2011, *Australian Cycling Participation*[16] reported that 17.8 per cent of Australians, approximately 4 million people had ridden a bike in the previous week and 39.6 per cent of Australians, approximately 8.3 million people had ridden a bike in the previous year. This study is the basis for the National Australian Cycling Strategy target to double cycling participation in Australia by 2016.

In order to reach such ambitious targets, it is essential to continue to improve the safety of cyclists to ensure increased participation rates are achieved without concurrent cyclist trauma. In the Australian Capital Territory, the rate of cycling participation is close to the highest in Australia and doubling the current rates of cycling means an increase of weekly (2011: 21.9% to 2016: 43.8%) and yearly (2011: 46.3% to 2016: 87.6%) proportions of cyclists. However, the *Australian Cycling Participation* report does not measure cycling travel that is the number of trips a cyclist takes, the distance travelled or the purpose of the trip. These are significant limitations and make it difficult to compare the data to other existing reports of cycling participation in Australia and internationally. On face value, a doubling of cycling participation in the ACT using the report figures would result in levels that match, or potentially exceed, the current rates of cycling participation in European countries like Denmark and the Netherlands.[17]

This study focused on the experiences of cycling in the ACT and importantly, the findings provide insights and recommendations about how cyclist safety can be improved. Since 1999, the ACT has had the lowest number of cyclist fatalities of any Australian state or territory.[18] It may be that the experiences of cyclists in the ACT will have national significance for cyclist safety. A naturalistic cycling study was conducted in the ACT. The study design was originally developed by the authors (M Johnson, J Charlton, J Oxley) in Melbourne.[19] This study builds on the original study design and benefits from advancements in video camera technology.

A safe cycling environment is fundamental to achieving participation targets as well as benefits for individual bike riders and the community.[20, 21] This study investigated the experiences of cyclists travelling on the roads in the Australian Capital Territory with a focus on their interactions with other road users.

1.1. AUSTRALIAN CAPITAL TERRITORY (ACT)

The Australian Capital Territory (ACT) has an area of 2,351 square kilometres[22] and a population of 365,600 (2011).[23] The population of the ACT is concentrated in the north eastern region of the territory. The remainder of the territory is primarily dedicated to national parks (see Figure 2, sourced from ABS, 2014).[24]

There is an extensive cycling network in the populated north eastern area of the ACT which includes both on-road, off-road and shared path facilities. The ACT is also one of the few jurisdictions that permit adult cyclists to ride on the footpath.

Figure 2 Map of the Australian Capital Territory

Publicly available policy documents from the ACT clearly identify plans to encourage and promote cycling. The ACT Sustainable Transport Plan clearly identified targets for cycle trips to work. The plan outlines targets of cycling trips as a proportion of all trips to work with an aim of 5 per cent by 2010 and 7 per cent by 2026.[25] Cycling benefits are also promoted in the Canberra Bicycle 2000 Bike Plan.[26]

Despite the extensive cycling network in the Australian Capital Territory, there are still risks for cyclists, particularly when travelling on the road. Over the last decade, from 2002 to 2011, there were 4 cyclist fatalities in the ACT, equal to the Northern Territory and the lowest number of cyclist fatalities. Initially this bodes well for cyclist safety, given the concurrent increase in cycling participation; however, this is undermined by the significant increase in cyclist serious injury crashes. The age-standardised population rate of cyclist serious injury in the ACT (31 per 100,000) was the highest of all Australian jurisdictions and significantly higher than the national rate (23 per 100,000).[27] It is possible that the higher serious injury rate is a function of high exposure given the cycling participation rate in the ACT.[28]

Cyclist crashes involving a motor vehicle result in the most serious cyclist injury outcomes.[29-31] The majority of cyclist fatality (86%)[32] involved a motor vehicle. However there is inconsistency in our understanding of motor vehicle involved in non-fatal crashes. The proportion of cyclist serious injury crashes involving vehicle varies depending on the data source. Analyses of hospital data has

reported that cyclist-vehicle crashes account for from a third (33.3%)[27] to almost half of hospital reported crashes (45%).[33] While in police reported cyclist serious injury crashes almost all crashes involved a motor vehicle (95%).[33] A cyclist has a 3.6 times greater risk of serious injury in a collision with a vehicle when compared to other non-vehicle cyclist crash types.[34] To better understand how crashes can be avoided, it is important to understand how crashes occurred. Little is known about the behaviours of cyclists and drivers and the characteristics of collisions and near-collisions involving cyclists.[35]

The purpose of this study was to better understand cyclist and driver interactions to identify countermeasures that could contribute to a safer environment for cyclists. The focus of cyclist safety in the Australian Capital Territory (ACT) was instigated by the high participation rate of cycling and high serious injury rate of cyclists in the territory. The concurrent increases seem to contradict the safety in numbers theory that presumes that an increase in the number of people cycling will create a safer environment for cyclists and a subsequent reduction in individual exposure to fatality and serious injury crashes.[36] By identifying key factors that contribute to cyclist-driver interactions, particularly collisions and near-collisions it was anticipated that insights could be gained to improve cyclist safety.

Naturalistic methods have been used to better understand the experiences of road users, driver and passenger behaviours and crashes.[37-41] Helmet mounted cameras have been used to investigate the experiences of cyclists while mountain bike riding[42] and city cycling.[43]

The Safe System approach was used to structure this study. This theoretical model identifies four main tenets to road safety: safer road users, safer roads and roadsides; safer vehicles, and; safer speeds.[44] An overview of the study is provided below using these four components.

1.2. SAFE SYSTEM APPROACH

The Safe System approach is an important paradigm shift for cyclists, away from the road user approach of individual responsibility that assumes the road environment is perfect and it is only due to user error that collisions occur.[45] The Safe System approach recognises that a *system* approach is needed to understand events on the road and identify solutions to reduce road trauma. The approach takes a holistic approach and considers the behaviour of the road user, as well as the road environment and how the physical road design can impact and influence behaviour. Speed and the vehicles are also considered in a broad view of the road environment.

1.2.1. Safer road users

Alert and compliant road users are the description used for safer road users. Much of the previous research into risk factors associated with collisions between on-road cyclists and drivers has focused on post-event data including: official records,[32, 46] self-reported questionnaires[34, 47] and fixed point observations of a single site.[48-50] Extensive analysis of hospital data has provided insight into the severity and types of injuries sustained and the cost of cyclist injuries.

However, cyclist crashes are notoriously underreported,[51] estimates suggest that as few as 1 in 30 of all cyclist crashes are reported.[52] As a result, research based on police-reported or hospital injury database crashes is unlikely to be representative of all cyclist crash types. In addition, there are limitations in using post-event data to understand pre-crash factors[53] and the data is subject to reporting biases and errors. Many questions remain about adult cyclists, their behaviour when interacting with drivers, how drivers interact with cyclists and the on-road space afforded to riders.

An Australian review of police and coronial reports for 222 cyclist fatalities found that in over 60% of collisions a major contributing factor was that cyclists and drivers did not see each other.[32] Numerous studies have sought to investigate the looking behaviour of drivers: driver hazard perception,[54] at intersections and the role of speed reducing countermeasures[55, 56] and detecting

approaching motorcyclists.[57] Investigations of visual scanning strategies have found many drivers looked-but-failed-to-see cyclists,[58] and that drivers look to cyclists' faces to assess intended behaviour rather than their hand/arm.[59, 60]

Cyclist visual scanning research has reported that head checks are an important indicator of intended behaviour. Räsänen and colleagues conducted video observations in a study of yield behaviour at intersections following a change in Finnish legislation regarding vehicle priority. An analysis of the head movements of 2,112 cyclists reported an association between more frequent head movements with greater caution.[61] Cyclists' looking behaviour and cyclist and driver behaviour pre- and post-interaction were all considered as part of this study.

A study of ACT cyclists was conducted by de Rome et al (2011) of cyclists (n=313) who presented to hospital in the ACT. Crash locations were mapped and almost a third (30.3%) were riding in traffic (n=79) or in bicycle lanes (n=16). Characteristics of the on-road crashes included: collision with another road user (50.5%); commuter cyclists (49.5%); riding alone (67.3%), and; experienced cyclists who rode 100km or more per week (63.2%).[28] Studies with people who have presented to hospital provide valuable insights into crash circumstances. However, findings provide limited and potentially biased accounts in terms of insights into pre-crash factors.[62] Events happen quickly and often critical details are not recorded or recalled or are unseen.

To date, little research has investigated the on-road pre-event contributing crash characteristics for cyclists in the ACT. Arguably the best way to understand cycling crashes and the behaviours and circumstances that lead to these events is to observe cyclist-driver interactions in a naturalistic context.

Naturalistic driving and cycling studies have provided detailed data on road users in their 'natural environment'.[35, 38, 41, 63] In these studies, there is no attempt to control the road user or road environment, rather, road users are studied *in situ* through video recordings of trips. Naturalistic studies minimise or eliminate errors related to official reports[64] and recall bias.[65, 66] When investigating cyclists, naturalistic methods generates data that does not rely on the cyclists' memory or their subjective recall of events which can vary dramatically, influenced by the cyclists' skill level or previous cycling experiences.[43]

The benefits of passive, in situ recording are that it eliminates the need for participants to recall their experiences, thus removing recall bias. Researchers are not reliant on participants' memory of events, this is important as the riders may not remember, nor have been fully cognisant, of all occurrences along their trip.[43] The video footage creates a record to be used to systematically compare the experiences of participants. In addition, GPS data loggers provide an accurate, objective measurement of cyclist travel speeds.[67]

One potential bias from this method is behavioural bias from the participants and other cyclists or drivers who observed the camera. However, in a naturalistic cycling study in Melbourne, Johnson et al[35] found that some cautious behaviour was noted for cyclists, this was only evident for some cyclists at the beginning of the study and cyclists' behaviour reverted to 'normal' after a few trips. Participants reported that most cyclists did not appear to notice the camera or if they did they thought it was a light. None of the participants were approached by drivers about the camera and it may be assumed that drivers were not aware they were being filmed. One unexpected outcome was reported by a female participant who said having the camera gave her confidence in traffic. Being able to record a driver's behaviour and their licence plate details just by looking at them, particularly drivers' whose behaviour she felt was threatening, gave her a sense of protection.

Looking behaviour, both cyclist and driver as well as pre- and post-interaction were considered as part of this study.

1.2.2. Safer roads and roadsides

Beyond road user behaviours, it is important to consider how the road network and the environment may contribute to crash and injury risk.[45] The actions of cyclists and drivers on the road are facilitated and shaped by the design of the road.[68] In the ACT, there are extensive on-road and off-road facilities for cyclists and these facilities are actively reviewed to monitor and improve connectivity, lighting, personal safety and land use.[69] Characteristics of the road environment have been included in this study.

1.2.3. Safer vehicles

There is great potential for safer vehicles to improve the safety of on-road cyclists. Cyclist safety benefits can be realised from a less aggressive vehicle fleet, as vehicle mass and design are significant factors in the severity of injuries sustained by a cyclist in a collision.[46, 70] For example, a cyclist struck by a van or four wheel drive vehicle with a high front profile is much more likely to sustain serious head injuries than when struck by the bonnet (hood) of a passenger vehicle.[46] Vehicle type was included in the analyses in this study.

Safer vehicles in terms of the *bicycle* may also be a contributing factor in some cyclist crashes. In a recent study of cyclists who had crashed and presented to hospitals in Melbourne (Sandringham, The Alfred), bicycle mechanical failure was the contributing factor in 9 per cent of all crashes.[62] Although bicycle mechanical failure was not reported to be a contributing factor in any of the events in this study, it is important to consider all vehicles.

1.2.4. Safer speeds

Safer speeds typically refer to the speed of the vehicle and the posted speed limit, with slower speeds being synonymous with safer speeds. It is well established that a non-occupant road user, including cyclists and pedestrians, are unlikely to survive a collision with a motor vehicle when the driver is travelling in excess of 40km/h.[71] Lowering speed limits is an effective system change, likely to yield positive results for all road users including cyclists, particularly in resident areas.[72]

The other safer speed component in cyclist crashes is the travel speed of cyclists. However, little research has been conducted on cyclist travel speed and no research was found that investigated cyclist speed in relation to collisions or near-collision events. It is likely that cyclists will generally travel within the posted speed limit, so safe speed for cyclists differs from the measurements for drivers. It is also likely that safe speeds will vary depending on the individual cyclist and their bike handling skills. The road environment and other road users may also contribute to what is considered a safe travel speed for cyclists. In this study, cyclist speed was investigated including the travel speeds over all cyclist trips and the speed profile in relation to a collision or near-collision event.

The overall aim of the study was to gain an in-depth understanding of the behaviour of cyclists as they ride in various traffic environments in the ACT. Three specific objectives were to:

1 understand how adult ACT cyclists used on-road and off-road paths, interact with other road users

2 identify the key risk factors for ACT cyclists and compare these to risks identified for Melbourne cyclists

3 make recommendations to improve cyclist safety that address how crashes and near-crashes involving cyclists and drivers can be avoided

The remainder of this report is presented in four sections: study design; results; discussion and recommendation and conclusion.

2. STUDY DESIGN

A naturalistic study of commuter cyclists was conducted in the Australian Capital Territory (ACT). The method used was developed and refined in previous research conducted in Melbourne at Monash University Accident Research Centre (MUARC)[1]. The research protocols for this study were approved by the Monash University Human Research Ethics Committee.

Data collection was conducted from September 2011 to April 2012, during the daylight savings period. The initial start date for the study was September 2010, however, this was delayed as the GPS plug-in module for the compact video camera was delayed by the importers and was not available until 2011. The study had three components: 1) video recordings of cyclists' commuter trips using helmet mounted cameras; 2) in-depth, semi-structured exit interviews of participants' experiences and attitudes, and; 3) an online survey. Each of the three study components are described in more detail below.

2.1. VIDEO RECORDINGS

A compact video camera with a GPS data logger was fitted to each participant's helmet. Participants were required to record 12 hours of footage of their trips to and from work over a four-week period. The requirement of 12 hours of footage was based on the Melbourne naturalistic cycling study[35] which showed that this was sufficient time to provide a range of cyclist experiences that was representative of typical trips. It also gave participants opportunity to become accustomed to being filmed and minimise any behavioural bias. Camera mounting options including the handlebars, under the seat or on the cyclists' body were extensively pilot tested in the Melbourne naturalistic cycling study and the helmet mount was preferred option. The helmet mounted option captured the cyclists' head movement and the broader environment, all important factors in the event of a crash or near-crash event.[19, 73]

2.1.1. Compact video camera

The compact video cameras used were the Oregon Scientific ATC9K Action Camera. Each camera was fitted with a 32GB micro memory card with capacity to record approximately 17 hours and 30 minutes and was powered by a rechargeable lithium ion battery with capacity to record approximately 2 hours of data per charge. The footage was recorded in HD at 720p, 30 frames per second (1280 x 720). A display screen at the rear of the camera indicated the recording time remaining on the camera and the battery charge. Participants recharged the battery as required.

Compared to previous models, this camera model had improved aperture that captured footage at lower ambient light levels and recorded clear footage at dawn and dusk and other low light periods. While this advancement increased the low light time that could be recorded, there were still some exclusions. When there was insufficient ambient light, the video footage would be mainly black without any details of the road environment or the experiences of the cyclist. Even with the spotlight effect created by the cyclist's front bike light, the reflected light was insufficient for meaningful analysis of the footage. Video footage recorded at such low light or dark times was excluded from the analysis.

As participants often commuted in the before dawn-dawn or dusk-after dusk periods, capturing footage at low light times was important to record their entire trip. Further, capturing pre-dawn rides was particularly important given the reported time distribution of cyclist crashes shows a peak crash time of 6am to 10am.[46]

[1] The Melbourne study was undertaken as part of M Johnson's PhD research, funded by the Amy Gillett Foundation and the Monash University Accident Research Foundation.

The data was downloaded by the researcher (M Johnson) at the end of each participant's study involvement. Participants were instructed not to review, download or copy the footage during the study to minimise potential subsequent behavioural bias.

2.1.2. GPS data logger

An off-the-shelf compact video camera was used in this study. While numerous cameras were available, this camera was the only unit that included an integrated data logger that synchronised the video footage with GPS data output. The GPS recorded data at one second intervals and logged the participants' latitude, longitude, altitude, speed and acceleration on three axes (x, y, z). The GPS data logger included an accelerometer which could be used to calculate speed in addition to the change in location expressed by the latitude and longitude values.

2.2. EXIT INTERVIEWS

At the end of the 4-week period, the researcher met again with the participants to collect the cameras and a semi-structured interview was conducted with each participant. Questions included details of the participants' experiences during the study, their general riding experiences and suggestions for improving cyclist safety.

2.3. ONLINE SURVEY

Participants also completed a survey about their driving/cycling experiences, provided weekly updates, cycling safety and general topics including helmets, headphones and registration. A full version of the survey used is included as Appendix A.

2.4. PARTICIPANTS

The participant inclusion criteria were: over 18 years; regularly cycle commuted to and from work; travelled at least half the trip on the road, and; able to film 12 hours of footage over a 4-week period. While participants travelled the majority of their trips on the road, most also rode on off-road bike paths, shared paths and on the footpath. All non-electric bicycle types were accepted, excluding recumbent bicycles. Block-recruitment was used, with 8 participants completing the study at one time over the study period a total of 36 participants completed the study.

A convenience sample was used and participants were recruited using various methods. Participants from previous cyclist safety research at MUARC who had indicated they were interested in further research were invited to participate. Pedal Power, a community organisation and the primary cycling advocacy group in the ACT, included an announcement of the study and recruitment details in their newsletter that was forwarded to their membership. Also, the study and recruitment details were discussed in interviews with local media including 666 ABC Canberra radio.

2.4.1. Study induction

All study inductions were conducted by a researcher (M Johnson) at participants' home or work location. The induction included instruction on operation of the camera, the camera was attached to the helmet and each participant rode a short test ride to correctly position the camera which was then secured. The camera position varied depending on bicycle type, helmet design and the participant's position on the bicycle.

Participants then recorded their trips to and from work and provide a weekly email update during the study period to allow monitoring of the participants' progress and troubleshoot any problems or concerns.

2.5. DATA ANALYSIS

The data analysis included a descriptive summary of the participants and the details of their trips, including total time recorded, total distance recorded, speed and the routes are mapped. All

identified near-collisions were analysed. Details of the data analysis process of the video data, GPS data, exit interviews and surveys are included below.

2.5.1. Video data

All video footage was manually reviewed to identify the cyclist-driver interactions. In naturalistic driving studies, crash or near-crash events are typically identified by trigger points often marked by rapid acceleration or braking.[38, 40] However, cyclist-driver interactions often happen at low speed or without notable differentiation in travel speed. These subtleties of cyclist interactions are essential to understanding how cyclists interact with other road users. It is imporatnt to understand how crasehs are avoided, as well as how they actually occur, to ensure that the safe practices that are helpeing to avoid crahses are known and enoucraged, but also to identifiy the unsafe proactices and elements of the road network that need to be imporved to assist with cyclsit safety. As a result, automated analysis of footage to identify events, particularly near-collisions was not used.

While deceleration is a trigger in naturalistic driving footage as braking is a behaviour closely correlated with a crash or near-crash event. To automate the analysis of naturalistic cycling footage using an algorithm to identify incidents of rapid deceleration would fail to identify critical events that occurred at low speed. Similarly, incidents that involved the cyclist taking evasive actions to avoid a crash, for example swerving may not require significant braking and an automated analysis is likely to miss such an event. Therefore to identify the cyclist-driver interactions, all video footage was manually reviewed.

Cyclist-driver interactions that were potentially unsafe, near-collision or crash related were identified and all factors from the event were coded using the modified 100-car data dictionary[19]. Modifications replaced the subject driver with cyclist, added cyclist specific factors and characteristics of the Australian road environment.[19, 38] For full details of how the dictionary was modified see Johnson et al.[19]

The modified data dictionary included three levels of event severity: collision, near-collision and incident. A *collision* involved contact between the cyclist and another road user with kinetic energy transference. A *near-collision* required rapid, evasive manoeuvring from the cyclist and/or the other road user to avoid a collision, for example sudden braking or swerving. An *incident* required some crash avoidance, but was less sudden than the near-collision event and included close vehicle proximity which results when drivers did not allow sufficient space when overtaking cyclists.

In addition, all cyclist-driver interactions were coded using the VicRoads Definitions for Classifying Accidents (DCA).[74] This additional classification allows direct comparison with events from the Melbourne naturalistic cycling study. Full list of DCA codes is included as Appendix B.

All trips were reviewed including time spent riding on off-road bike paths, shared paths and footpaths. Some footage recorded in the dark or with insufficient light was excluded as details of the cyclist and other road users were not visible. No major cycling facility roadworks (e.g. bike lanes) were implemented during the study period on the routes ridden by participants so any before-after analysis of cycling facilities was not possible.

The footage was reviewed using InterVideo WinDVD 5 viewing software. Aggregated descriptive statistics and cross-tabulations were calculated using PASW Statistics 18.

Inter-rater reliability

In observational studies there is potential for coding bias, particularly when only one researcher codes all the data. To address this, the video data was analysed by one researcher (MJ) with a second researcher (JC) independently analysed footage for 13 participants (36.1%). Inter-rater reliability was calculated using two variables (*event severity* and *event nature*) for a third of events

(30.3%). The results were analysed using the Kappa statistic. The inter-rater reliability were *event severity*, Kappa = 0.768 and *event nature* Kappa = 0.734. Both measurements can be interpreted as being of substantial agreement.[75]

2.5.2. GPS data

The GPS data were used to identify the travel speed of cyclists and the role of cyclist speed in cyclist-driver interactions. Findings from the Melbourne study indicated that cyclist speed may be a major risk factor in cyclist-drive interaction; however speed was not recorded in that study.[35]

Two cyclist speeds were calculated: average travelling speed and maximum speed. The average travelling speed is the speed cyclists travelled excluding stops (e.g. intersections, start and end of trips etc). All maximum speeds were recorded when the cyclists were travelling downhill, verified by the elevation profile from the GPS data and video footage review. A further contributing factor may have been a tailwind; however, it was not possible to determine the presence or absence of wind from the generated data. Both speeds provide a new insight into the travel speeds of Australian cyclists.

To calculate the cyclists' speeds, the GPS data was used only when the cyclist was in motion. This non-stop cyclist average travel speed excluded data points that were recorded while the cyclist was stationary (e.g. stop signs, red lights). This calculation provides an accurate representation of the cyclists' average travel speed *while they were moving*. This method of calculation is distinct from 'average' cyclist travel speed (i.e. total travel time/total distance travelled) as average travel time includes the cyclist has stopped and does not differentiate between time in motion and time stationary. The average travel speed is a crude measurement that systematically underestimates the travel speed of a cyclist, particularly when interacting with other road users.

The GPS data output could only be viewed in the proprietary software which had limited capacity for analysis. The GPS data was exported in a tabular format, but this precluded any meaningful analysis across the cohort. To address these limitations, a geospatial expert (D Chong) was engaged to re-analyse the data. The reanalysis involved mapping the cyclists' trips using GPS point density mapping. Analysis included details of each participant's travel speed across their entire trip as well as in relation to cyclist-driver interaction events.

Given the limitations in the GPS data, the top 1 per cent of all ride recordings was excluded. To avoid potential anomalies that occurred in the GPS data, averaging was used to normalise the results. Given the limitations of the GPS data, using the average of the daily maximum speed was considered to give a better representation of participant peak cycling speed. Locational accuracy and as a result speed, is highly dependent on the number of satellites available to the GPS unit. GPS units require line of sight access to satellites. Insufficient satellites can result in artificial fluctuations in location and as a result, calculated speed. Speed function of change in location but can be augmented with the use of on-board accelerometer.

The GPS data generated by the participants highlights some of the problems with GPS use in urban areas. Buildings, vegetation, power poles, bridges, all affect the positional accuracy of the GPS units. This is borne out in the data generated. Anomalies highlighted by exceptional fluctuations in speed are present in most of the participant data. The GPS data was generated every second using fixed time sampling.

Occasionally a trip was interrupted, typically due to the participant stopping, turning off the camera then restarting the camera. Often this break would be due to personal activities during the commute, such as shopping, stopping at a café etc, and then the trip would restart. However, some trips were interrupted by sudden stops in filming and the next trip would start at a different location unrelated

to the original trip. These interruptions seem likely to be due to the camera battery having insufficient charge to film the entire trip.

Given the breaks in trips, it was decided that each video/GPS data file would be considered separately as it was too burdensome to join the part trips together and could introduce errors. As a result, it is not possible to calculate outputs by trips, and in all calculations either time or kilometres are used as the denominator.

In addition to the speed data, the GPS data points were used to map cyclists' trip and these trips were then plotted on a GPS point density map. The point density map represents the frequency that a cyclist GPS point was recorded across the entire study cohort. The density of travel is represented in colour from yellow (low frequency) to red (high frequency).

Each event that was identified was plotted onto GoogleMaps. All events are colour coded using the Definitions for Classifying Accidents (DCA) codes. Each colour represents a group of classifications:

- Blue 100-109 pedestrian on foot, in toy/pram
- Red 110-119 vehicles from adjacent directions, intersections only
- Green 120-129 vehicles from opposing directions
- Aqua 130-139 vehicles from same direction
- Purple 140-149 manoeuvring
- Pink 160-169 on path

There are four other classification groups in the DCA codes: overtaking; off path on straight; off path on curve, and; passenger and miscellaneous. These event types were not identified in the study and therefore are not included in the event mapping.

2.6. EXIT INTERVIEWS

Thematic analysis of the exit interview transcripts was conducted to identify the main topics that concerned cyclists with regard to their safety. The themes were grouped under the four components of the Safe System approach: safer road users, safer roads and roadsides, safer speeds and safer vehicles.

2.7. SURVEYS

Summary demographic data is presented and was cross tabulated with video and GPS data (total time recorded, total distance recorded, speed, trip routes), cyclist-driver interactions and cycling safety concerns.

3. RESULTS

In total, 36 participants completed the study. The results are presented in the following sections: 1) characteristics of participants; 2) video and GPS data (total time recorded, total distance recorded, speed, trip routes); 3) crash-related events; 4) speed of cyclists; 5) comparison of ACT and Melbourne naturalistic cycling study data, and; 6) safer cycling in the ACT.

3.1. CHARACTERISTICS OF PARTICIPANTS

Participant demographic characteristics are included in Table 1 below. The majority of participants were male and this is comparable to the reported gender proportions of cycling participation in the ACT (males: 63.2%).[11] The target population of this study was commuter cyclists and high proportions of employment (work or study) are to be expected.

Of note is the high household income of the study cohort with the majority earning over $100,000 (71.9%). While this is likely to be a function of the high level of employment (working full time: 78.1%), it is also likely to be influenced by the ACT workforce. The ACT has the highest proportion of people in the workforce in Australia (73% of the population aged over 15 years)[76] and the highest median household income ($72,800 in 2005)[77]. It is probable that the study cohort is representative of the working population in the ACT however without more recent income data this is difficult to verify. Further, the demographic characteristics of cyclists in Australia are not known therefore it is not possible to confirm if this cohort is representative of all cyclists in the ACT.

Table 1 Demographic characteristics of study participants

	Study participants	
	Count	Percent
Gender (n=36)		
Male	25	69.5
Female	11	30.5
Age (n=32)		
25-34 years	2	6.0
35-44 years	12	37.0
45-54 years	12	37.0
55-64 years	6	18.0
Marital status (n=32)		
Married/relationship	28	87.5
Divorced/separated	3	9.4
Single/never married	1	3.1
Current employment status (n=32)		
Working full time	25	78.1
Working part time	6	18.8
Full time student	1	3.1
Part time student	1	3.1
Education (n=32)		
Secondary school	2	6.3
Technical school or TAFE	2	6.3
University degree	16	50.0
Higher degree (Masters or PhD)	12	37.5
Household income (n=32)		
$41,000-$75,000	2	6.3
$76,000 - $100,000	7	21.9
$101,000 - $150,000	8	25.0
$151,000 and over	15	46.9

3.1.1. Travel characteristics of participants

All respondents had a current driver's licence and had held a licence for an average of 26.7 years (range: 4-42 years). Three participants reported they had ever been in a crash while driving; no injuries were sustained in any of these crashes. Figure 3 presents the distribution of estimated weekly distance driven.

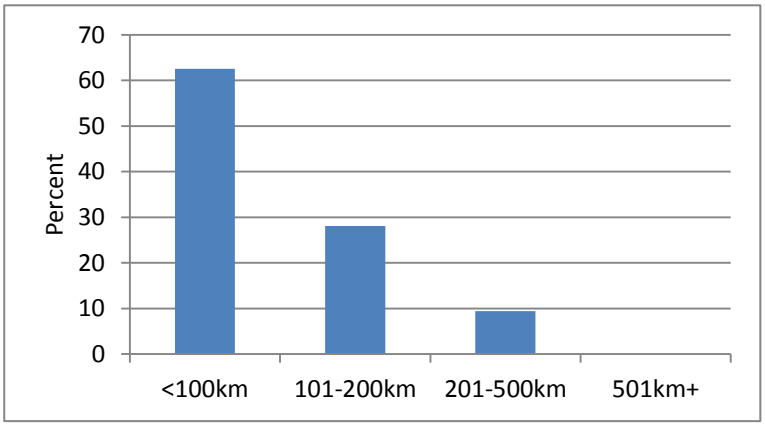

Figure 3 Estimated weekly distance driven by participants

In the two years prior to the study, a third of participants had received a traffic infringement (34.4%). Of the participants with driving infringements, one participant had been fined twice for exceeding the posted speed limit (both <10km/h over and >10km/h over). The other participants who had been fined had received one infringement each; most infringements were for speeding less than 10km/h over the posted speed limit (90.0%).

3.1.2. Cycling characteristics of participants

Participants were experienced cyclists, the average number of years participants had been cycling was 26.6 years (range: 5-51 years). Every participant rode three or more times per week.

Summary details of the daily commuter in the study cohort were:

- Average distance: 27.1km (range: 6 to 60km)
- Average time of trip: 1 hour, 8 minutes (range 30 mins – 2 hours, 40 mins)
- Average kilometres per week: 137km (range: 30 to 350km)

In addition to commuting, participants rode their bikes for other trip purposes. The breakdown of the proportions participants rode their bike for varying trip purposes is displayed in Figure 4 below.

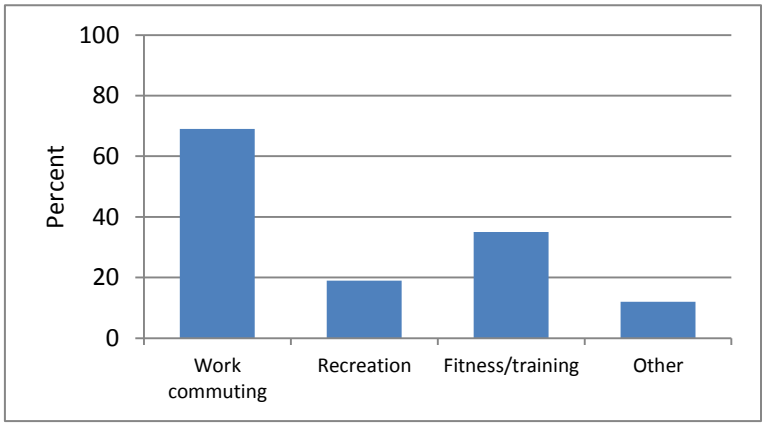

Figure 4 Proportion participants rode their bike for varying trip purposes (average across cohort)

The majority of participants rode mainly in urban areas (93.8%) with the majority of time spent riding on the road (69.4) compared to off-road (31.6%). Riding the majority of the commuter trip on the road was a study inclusion criterion.

The majority of participants (74.2%) belonged to a cycling club or organisation. More participants were members of Pedal Power (47.2%) than any other cycling group which is to be expected as an announcement in their newsletter was a recruitment strategy. Participants also belonged to local cycling clubs and larger national organisations including Audax and Mountain Bike Australia (MTBA). Two thirds of cyclists (65.6%) had not taken any type of bicycle training course. Of those cyclists who had undertaken a course, the courses undertaken were typically conducted by the club they belonged to and were taken as an adult rider.

The use of safety items varied across cyclists. While all participants used bike lights at some time and the majority wore light coloured clothing, fewer participants wore a fluorescent/reflective jacket.

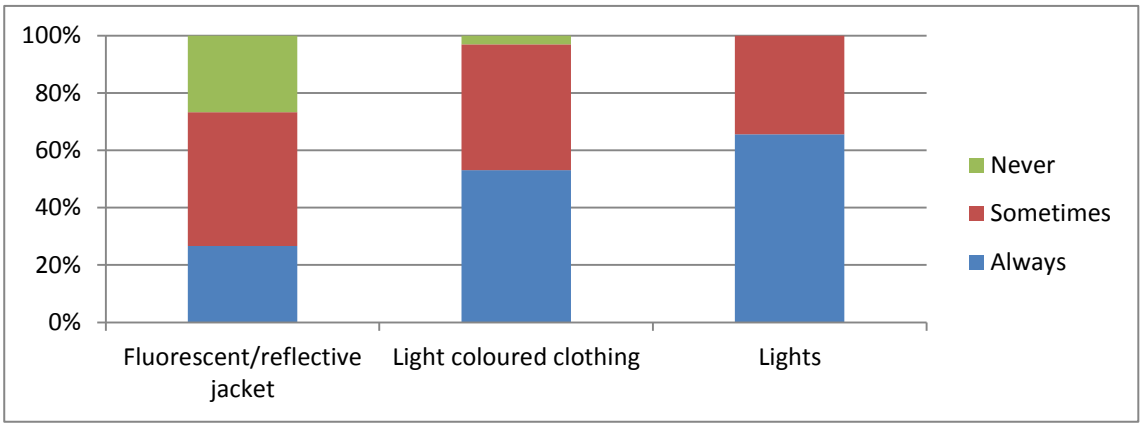

Figure 5 Frequency safety items were worn/used by participants

On-road participants were most likely to indicate (hand signal) before turning right with the majority (75%) indicating always. Participants were less likely to indicate when turning left, signalling to turn left when cycling is not required by law in the ACT. Compliance with road rules and road signs was reported as either always or sometimes and over half the participants (59.4%) always stopped at red lights. Not being able to activate the inductive loop to change the lights was the main reason given for non-compliance at the red lights.

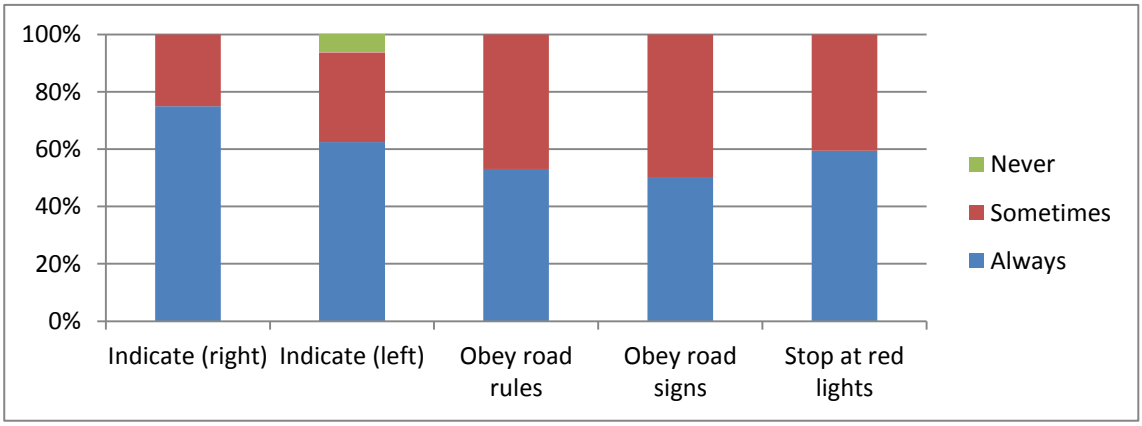

Figure 6 Frequency of on-road behaviour (indicating and obeying road rules/signs)

Knowledge about bicycle facilities on the road and the meaning of line markings was most commonly gained by participants seeking information independently (self-informed), by observing other cyclists or participants considered the purpose was intuitive (30.7%).

Almost half the participants (47.2%) had ever been involved in a collision with a vehicle while cycling. Of those who had crashed as a cyclist (n=17), a total of 43 collisions has been experienced and only 17 (39.5%) were reported to police. Reasons for non-reporting included:

- 69.2% no major or serious damage, participant was not seriously injured
- 15.4% negative views on police – unhelpful or uninterested in filing a report
- 15.4% vehicle drove away without stopping, no witnesses

Most participants (83.3%) had been involved in a *near*-collision when cycling on the road. Some participants stated that they had been involved into many near-collisions to count. Collectively, participants recounted that they had experienced over 220 near-collisions and only 8 (3.5%) had been reported to police. The participants' perception was that reporting a near-collision was futile as the police were either not interested or not able to act without an actual collision.

3.2. VIDEO AND GPS DATA

3.2.1. Total time and distance recorded

The total time recorded by all participants was 466 hours, 20 minutes. Footage that was recorded in very low ambient light times (early morning/evening) was excluded. In total 1 hour, 20 minutes were excluded due to low light, after exclusions, the total footage available for analysis was 465 hours. The video footage recorded participants riding on a mix of on the road, footpaths (legal for adults in the ACT) and off-road bike paths, shared paths and tracks.

The total distance travelled and recorded by all participants was 8,986km. GPS data points were recorded for all trips; in total 1,544,189 data points were generated. Across the study period, approximately 720 days were available for participants to ride to work (variation was due to public holidays over the Christmas/New Year period). Participants rode on 529 days (73.4%) of the available days during the study period. Summary statistics for the total time and distance recorded are presented in Table 2.

Table 2 Summary of time and distance recorded by gender

	Gender		Total (n=36)
	Males (n=25)	Females (n=11)	
	(hours:mins)	(hours:mins)	(hours:mins)
Total time recorded	321:05	145:15	466:20
Average time recorded per participant	12:50	13:11	
Excluded time			
Low light	1:11:20	0:08:40	1:20
Total time analysed	319:53	145:06:27	465:00
Average time recorded per participant	12:45	13:09	
Total number of days recorded	358	161	529
Average number of days per participant	14.3	14.6	14.7
Total distance recorded	6,376	2,609	8,986km
Average distance recorded per participant	255	237	249km

3.2.2. Trip routes

Cyclists' home and work locations were spread across the ACT and across the border into New South Wales (Queanbeyan, Jerrabomberra). Figure 7 is the GPS point density map of all trips made by participants across the Australian Capital Territory and into border towns in New South Wales.

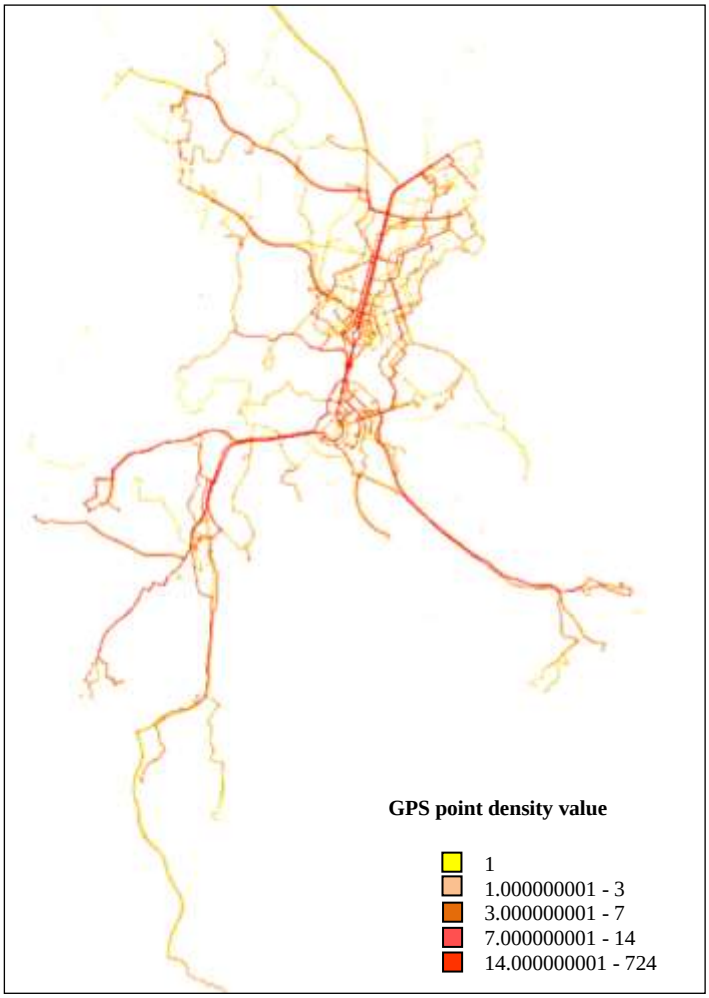

Figure 7 GPS point density map for all study participants (ACT)

The density of the GPS points clearly identifies the major routes for participants. As would be expected, there is considerable cyclist traffic linking the north and south areas of the ACT via Northbourne Avenue with major routes from the north west approach being Ginninderra Drive and Belconnon Way/Barry Drive; Adelaide Avenue from the south west and Canberra Avenue from the south east. These routes are representative of the routes that link people to major employment areas in Civic, Belconnen, Parkes and Woden.

3.3. CRASH-RELATED EVENTS

In total, 91 events were identified: 0 collisions, 1 near-collision and 90 incidents. Prior to each identified event, the majority of cyclists were (97.8%) were riding in a safe and legal manner. All cyclists maintained control of their bicycle before, during and post-event. Descriptive statistics for selected variables are cross tabulated by gender and presented in Table 3.

Crash type, or DCA code, was the only event variable was statistically significantly different when compared by gender. For all participants, the left turn side swipe was the most common event type. This involves the driver travelling in the same direction, parallel to the cyclist then turning across the cyclist's path, often without indicating their intention to turn, or without adequate indication. However, for female participants, the equal most common event was a car door unexpectedly opening in front of them, also known as 'dooring' (28.1%). Whereas for males, the lane side swipe and cross traffic were the next highest frequency events.

Table 3 Summary data for key variables for each event by gender

			Male (n=25)		Female (n=11)		P value
			Count	Percent	Count	Percent	
Number of events			59	100.0	32	100.0	
Severity	Collisions		-	-	-	-	
	Near-collisions		1	1.6	-	-	0.45
	Incident		58	98.4	32	100.0	
Time	AM		33	55.9	13	40.6	
	PM		26	44.4	19	59.4	0.26
Relation to	Non-junction		14	23.7	11	34.3	
junction	Intersection/intersection related		45	76.3	21	65.7	0.35
Bike lane	Yes		12	20.3	10	31.2	
	No		47	79.7	22	68.8	0.24
DCA codes	Pedestrians						
	100	Pedestrian near side	1	1.6	-	-	
	102	Pedestrian far side	-	-	1	3.1	
	109	Pedestrian (other)	1	1.6	-	-	
	Vehicles from adjacent directions (intersections only)						
	110	Cross traffic	9	15.2	3	9.3	
	111	Right far	8	13.5	1	3.1	
	113	Right near	2	3.3	-	-	0.01
	116	Left near	6	10.1	1	3.1	
	Vehicles from opposing direction						
	121	Right through	3	5.0	2	6.2	
	123	Right left	-	-	1	3.1	
	Vehicles from same direction						
	133	Lane side swipe	9	15.2	-	-	
	135	Lane change left	-	-	4	12.5	
	137	Left turn side swipe	12	20.3	9	28.1	
	Manoeuvring						
	142	Leaving parking	-	-	1	3.1	
	147	Emerging from driveway	1	1.6	-	-	
	On path						
	163	Vehicle door	7	11.8	9	28.1	
Fault	Cyclist		1	1.6	1	3.1	
	Driver		55	93.0	30	93.8	0.86
	Pedestrian		1	1.6	1	3.1	
	Unknown /both		2	3.3	-	-	
Cyclist	No reaction		18	30.5	5	15.6	
reaction	Braked		36	61.0	20	62.5	0.91
	Swerved right/rode wide		-	-	5	15.6	
	Braked + swerved right		5	8.5	2	6.3	
Vehicle type	Car		38	64.4	18	56.3	
	Commercial van		3	5.1	2	6.3	
	Bus		2	3.4	2	6.3	
	4WD		7	11.9	6	18.8	0.92
	Ute		6	10.2	3	9.4	
	Truck		1	1.7	-	-	
	Pedestrian		2	3.4	1	3.1	
Vehicle	Yes		9	15.3	11	34.4	
indicated	No		3	5.1	1	3.1	0.10
	N/A, unknown		47	79.7	20	62.5	
Driver	No reaction		57	96.6	31	96.8	
reaction	Braked		2	3.4	1	3.2	0.71

3.3.1. Location of events

The location of all events was plotted using GoogleMaps (see Figure 8). All events were located in the north eastern area of the ACT, as expected given the distribution of population and workplaces in the ACT. Each interaction type is colour coded by the DCA categories. Details of each category of event type are presented in the following figures in order of the most to least frequent event types.

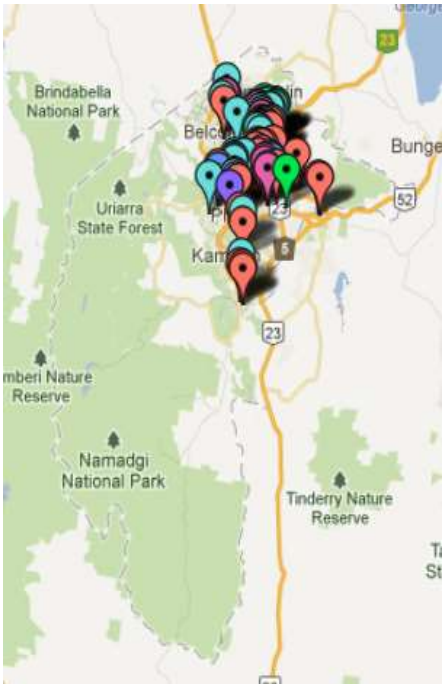

Figure 8 Map of coded cyclist-road user interactions for all participants (Australian Capital Territory)

DCA 130-139, vehicles from the same direction (n=34)

Events involving the participants and vehicles from the same direction were the most common interaction type. Over a third (37.3%) of all observed interactions involved the cyclist and the driver travelling in the same direction. The events plotted on the left map in Figure 9, show the DCA 130-139 events across the ACT. Figure 10 shows a closer view of the majority of this incident type. Of this category, the majority of events were left turn side swipe (61.7%) and this was the most common interaction of all events observed in this study.

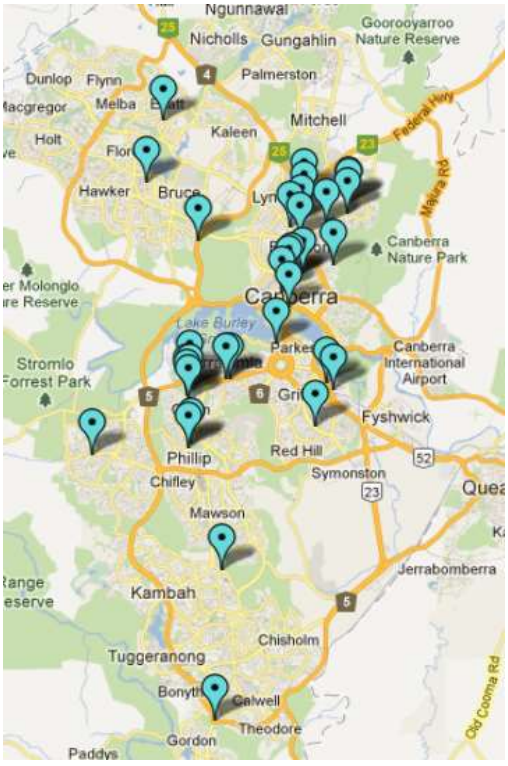

Figure 10 All events involving vehicles from same direction

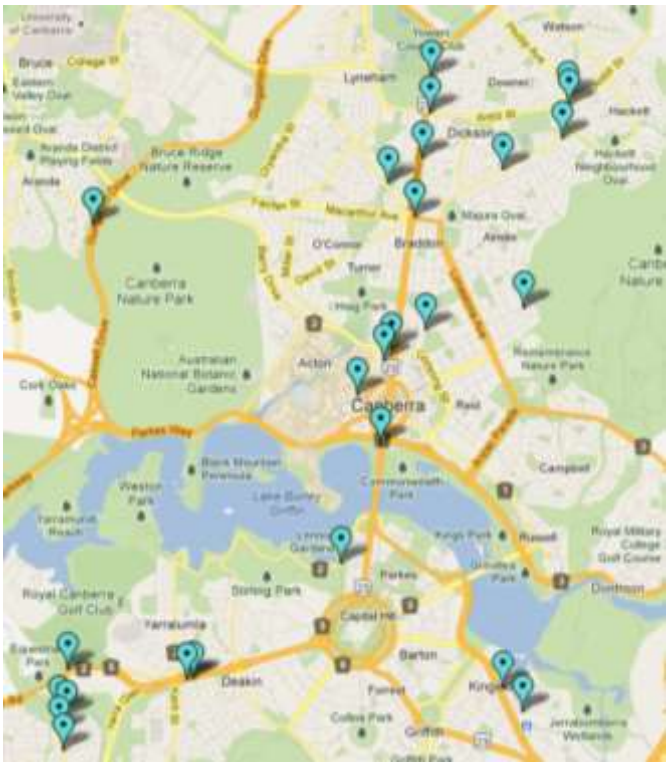

Figure 9 Close up of the majority of events involving vehicles from same direction

Left turn side swipe is graphically represented in Figure 11. The typical configuration is cyclist (2) and driver (1), the driver turns left in front of the cyclist, often without indicating, and the cyclist must brake and swerve to avoid a collision. The driver is not visible from the video footage so it cannot be determined if the driver looked for, or saw, the cyclist prior to turning. In two cases, it is possible that the cyclist was positioned in the driver's blind spot and was not visible to the driver even if they had a made a head check to their left prior to turning.

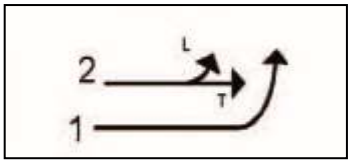

Figure 11
DCA137 Left turn side swipe

DCA 110-119, vehicles from adjacent directions (n=30)

Events involving vehicles from adjacent directions were the second most common cyclist-driver event and are plotted on Figure 12. In all events, the driver turned in front of the cyclist and the cyclist needed to brake, and in some cases swerve, to avoid a collision.

The most frequent event types in this category were cross traffic (40.0%) (see Figure 13) and right far (30.0%) (see Figure 14). In cross traffic events, the cyclist (2) was travelling straight and a driver (1) approached from the left and drove across the cyclist's direction of travel. In the majority of the right far events, the cyclist (1) was travelling straight and a driver (2) turned across their path.

Figure 12 All events involving vehicles from adjacent directions (intersections only)

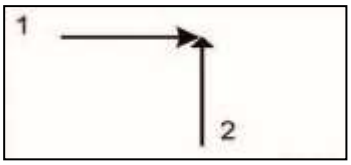

Figure 14
DCA110 Cross traffic

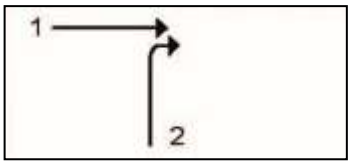

Figure 13
DCA111 Right far

DCA 163, vehicle doors (n=16)

The second most frequent *single event* type involved an unexpectedly opened vehicle door or 'dooring'. In all cases, a collision was avoided by the reaction of the cyclist who swerved wide of the door to avoid being hit. While this created the potential for a secondary crash (i.e. risk of collision with a vehicle travelled behind or to the right of the cyclist), no secondary events occurred. This event type is widely distributed across the ACT (see Figure 15).

Figure 15 All cyclist-open vehicle door events

DCA 120-129, vehicles from opposing directions (n=6)

Six events occurred in this category with the cyclist and the driver approaching each other from opposing directions (see Figure 16). The most common interaction of this interaction type was right through (see Figure 17).

In the majority of the right through interactions, the cyclist (2) was travelling straight and the driver (1), travelling in the opposite direction turned across the cyclists' path. The cyclist response was to brake or swerve to avoid the turning vehicle.

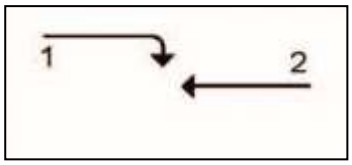

Figure 17
DCA121 Right through

Figure 16 All events involving vehicles from opposing directions

DCA 100-110, pedestrian related (n=3)

Three cyclist-pedestrian interactions were identified and are plotted on Figure 18. Two events involved an adult pedestrian and one involved a child. In all three events, the cyclist was travelling in a safe and legal manner. In each incident, a collision was avoided by the reaction of the cyclist.

In one event, a group of three adult pedestrians walked from the road onto the footpath directly in front of the cyclist. The cyclist slowed and swerved to avoid the pedestrian who saw the cyclist at the last minute and leapt out of the way onto the grass. In the second adult pedestrian event, a pedestrian walked onto the road from between parked vehicles and did not check to their right for any traffic, including the approaching cyclist. The cyclist braked heavily and swerved to avoid colliding with the pedestrian. The third pedestrian event involved a child on a shared off-road path. The child had been on the grass adjacent to the path and suddenly ran onto the path in front of the cyclist who braked heavily and swerved to avoid a collision.

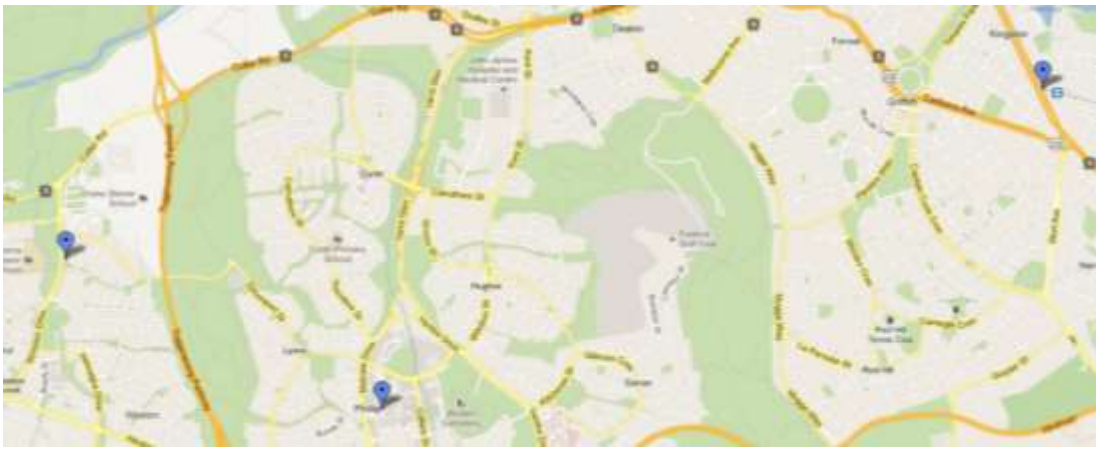

Figure 18 All pedestrian related interactions

DCA140-149, manoeuvring (n=2)

Two events were observed that involved vehicles manoeuvring (see Figure 19). In both events, the cyclist was travelled straight on the road. In one event, the vehicle left a parallel parking bay, in the other event, the vehicle exited driveway in front of the cyclist and cut across the cyclists' path. Both cyclists braked and swerved to avoid the vehicle.

In both events, it appeared that the driver did not look/see the cyclist. In both cases, the cyclist's evasive action was the reason a collision was avoided.

Figure 19 All events involving manoeuvring

3.4. SPEED OF CYCLISTS

The average travelling speed for all participants was 22.7km/h (16.7-29.3km). Male participants' average speed was slightly higher 23.5km/h (17.2-29.3km/h) than female participants (21km/h; 16.9-25.5km/h). The distribution of the average speed for male and female participants is included in Figure 20 and Figure 21.

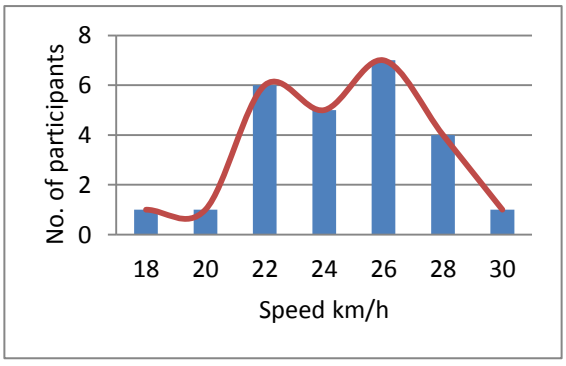

Figure 21 Distribution of average travel speed, male cyclists

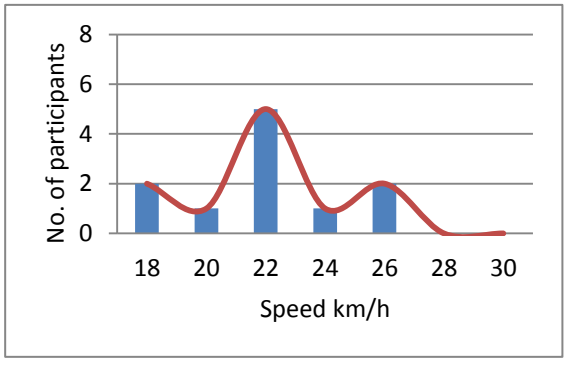

Figure 20 Distribution of average travel speed, female cyclists

Across the cohort, the maximum speed cycled was 56km/h (29.5-56.0km/h). Again, male cyclist speeds were higher with a maximum speed of 56km/h (30.6-56km/h) compared with female cyclists who recorded a maximum speed of 49.1km/h (29.5-49.1km/h) (see Figure 22 and Figure 23).

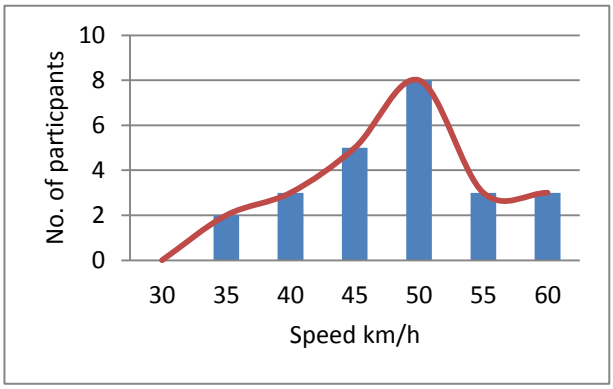

Figure 23 Distribution of maximum travel speed, male cyclists

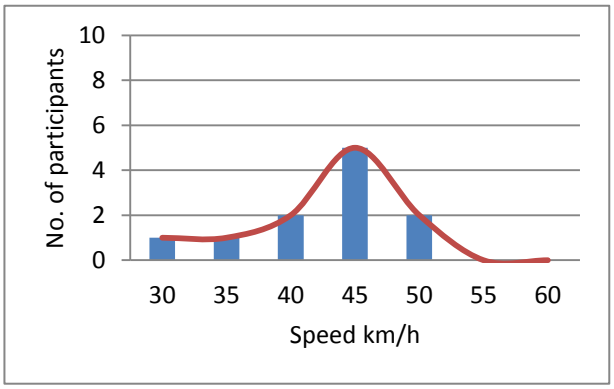

Figure 22 Distribution of maximum travel speed, female cyclists

The cyclists' maximum daily speed distribution is skewed towards slower maximum speeds with a small proportion of cyclist riding at high speeds.

3.4.1. Speed at events

For all 91 events, the cyclists' speed profile 60 seconds before and 60 seconds after the event was analysed. In almost two thirds of events (64.8%) cyclists braked in reaction to a potential collision.

Prior to the identified events, cyclists were travelling of speeds up to 43km/h. The hardest braking profiles related to vehicles turning in front of cyclists, typically the driver did not indicate (signal) their intention to turn or gave insufficient indication turning on their indicator light only as they were turning. The graphs below provide a sample of the profile speeds of cyclists; the identified event is positioned near zero on the x axis.

Figure 24 is the speed profile of a female rider (aged 45-50 years) who was travelling straight, in a bike lane, the driver turned across her path to enter into a turning lane to turn left.

Figure 25 is the speed profile of a male rider (aged 45-50 years) who was travelling straight, when a vehicle cut cross his path from a street on the left.

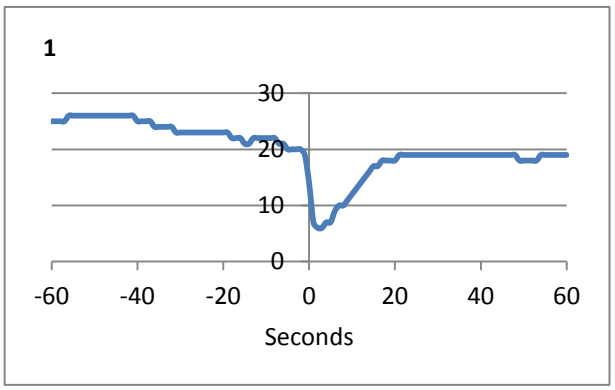

Figure 25 Cyclist speed profile (DCA 135)

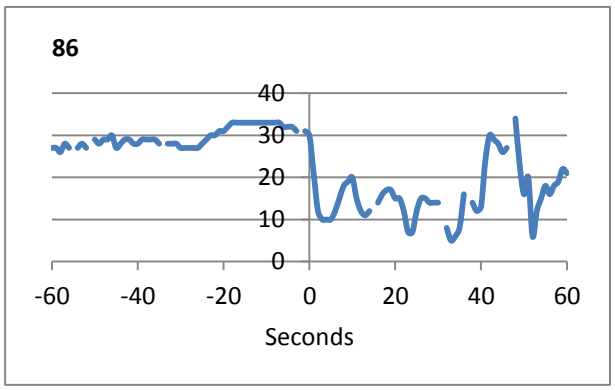

Figure 24 Cyclist speed profile (DCA 110)

3.5. COMPARISON OF ACT AND MELBOURNE NATURALISTIC CYCLING STUDY DATA

One study aim was to provide a comparison of events from this study with a previous naturalistic study conducted by the authors in Melbourne.[35] The intention was to determine if learnings from one city could be applied to the other city to improve cyclist safety. Table 4 presents summary descriptive and comparative data for the ACT and Melbourne naturalistic cycling studies.

There were notable differences between the observed events in Melbourne compared to the ACT. In Melbourne, there were more 64 per cent more events per participant compared to the ACT (Melb: 4.1; ACT: 2.5). Of the event variables compared, 6 were statistically significantly different between the two studies.

More events of greater severity were identified in Melbourne compared to the ACT (χ^2 (2)=11.087, p<0.001). In Melbourne 11.1 percent of all events were near-collisions and 2 cyclists crashed with vehicles during the study. In comparison, 99 percent of events in the ACT were 'incidents', the lowest severity non-collision event type.

Bike lanes were statistically significantly different between the two studies with almost half the events in Melbourne (44.4%) occurring at locations with bike lanes, while in the ACT the majority of events occurred at locations without bike lanes (75.8%)(χ^2 (1)=6.428, p=0.01).

Event types were also statistically significantly different. The majority of events in Melbourne were coded as Vehicles from the same direction (DCA130-139: 63.0%) include the left turn side swipe (see Figure 11). Lane change left events may be a function of more complex road design in the Melbourne metropolitan area. While this event type was observed in over a third of events in the ACT (37.4%), there were more events in the ACT involving vehicles from adjacent directions (33.0%) and doorings (17.6%))(χ^2 (5)=14.183, p=0.01). While there were three pedestrian related events in the ACT and none in Melbourne, this was not a function of adult cyclists being permitted to travel on the footpath as the events occurred on shared paths or the road.

Vehicle indication was statistically significantly different between the two studies. In the majority of events in the ACT it was either not applicable or not known if the driver indicated (73.6%), whereas in Melbourne there was a greater distribution between indicated (44.4%), did not indicate (33.3%) and not applicable/unknown (22.2%)(χ^2 (3)=60.760, p<0.001). It is probable that the types of events experienced in the two studies contributed to this variance. In the ACT there were a higher proportion of events involving vehicles from the adjacent direction and in many of these encounters the vehicle's indicator light may not be visible or applicable in relation to the cyclist-vehicle event identified.

There were statistically significant differences in cyclists' reactions between the two studies. In both studies braking was the most common reaction (ACT: 72.2%; Melb: 61.5%) with more riders in Melbourne swerving right or riding wide to avoid an event (9.9%)(χ^2 (10)=83.296, p<0.001). The differences in cyclists' reactions are likely to be associated with the event types experienced.

The final variable analysed that was statistically significantly different between the two studies was driver reaction (χ^2 (1)=7.981, p<0.01). More drivers in Melbourne were observed to brake following the event (16.7%) however in both studies, no reaction was observed for the majority of drivers.

Table 4 Summary data for key variables for each event by location

		ACT (n=36)		Melbourne (n=13)		P value
		Count	Percent	Count	Percent	
Number of events		91	100.0	54	100.00	
	Per participant	2.5		4.1		
Severity	Collisions	0	0	2	3.7	
	Near-collisions	1	1.0	6	11.1	0.00
	Incident	90	99.0	46	85.2	
Time	AM	46	50.5	30	55.6	0.64
	PM	45	49.5	24	44.4	
Relation to junction	Non-junction	25	27.5	15	28.3	0.96
	Intersection/intersection related	66	72.5	39	71.7	
Bike lane	Yes	22	24.1	24	44.4	0.01
	No	69	75.8	30	55.6	
DCA codes	100-109 Pedestrians	3	3.3	0	-	
	110-119 Vehicles from adjacent directions	30	33.0	13	24.1	
	120-129 Vehicles from opposing direction	6	6.6	5	9.3	0.01
	130-139 Vehicles from same direction	34	37.4	34	63.0	
	140-149 Manoeuvring	2	2.2	0	-	
	160-169 On path (163 vehicle door)	16	17.6	2	3.7	
Fault	Cyclist	2	2.2	5	9.3	
	Driver	85	93.4	47	87.0	0.52
	Pedestrian	2	2.2	-	-	
	Unknown /both	2	2.2	2	3.7	
Cyclist reaction	No reaction	23	25.3	6	11.1	
	Braked	56	61.5	39	72.2	
	Swerved right/rode wide	9	9.9	1	1.9	
	Braked and steered right	3	3.3	2	3.7	
	Steered left	-	-	3	5.6	0.00
	Braked and steered left	-	-	1	1.9	
	Hit vehicle, lost control	-	-	1	1.9	
	Forced off road	-	-	1	1.9	
Vehicle type	Car	56	61.5	33	61.1	
	Commercial van	5	5.5	6	11.1	
	Motorcyclist	-	-	2	3.7	
	Bus	4	4.4	2	3.7	0.27
	4WD	13	14.3	7	13.0	
	Utility	9	9.9	3	5.6	
	Truck	1	1.1	1	1.9	
	Pedestrian	3	3.3	-	-	
Vehicle indicated	Yes	20	22.0	24	44.4	
	No	4	4.4	18	33.3	0.00
	N/A, unknown	67	73.6	12	22.2	
Driver reaction	No reaction	87	95.6	45	83.3	
	Braked	3	3.3	9	16.7	0.00
	N/A	1	1.1	-	-	

3.6. SAFER CYCLING IN THE ACT

Overall participants were positive about their experiences of cycling in the ACT. Many participants noted the extensive on-road and off-road cycling facilities were enthusiastic about their cycling. Below is a sample of comments about cycling in the ACT:

I really enjoy cycling and Canberra is the perfect city to cycle in. ***Belinda, 45-50yrs***

I'm very grateful for what they have done here. The cycling lobby is very active... overall it's very positive here. ***Craig, 45-50yrs***

The bike paths encourage riding. My sister recently started riding and she really likes it. She's on the bike path because she's nervous and unsure but she said when she's more experienced she'd think about riding on the road. I think it's a great place for people to get into it and keep doing it. ***Heather, 30-35yrs***

All participants were asked an open ended question about what they would like to see changed to make cycling safer in the ACT. Prompts were used to ask if there was a role for the government, for police or for road users themselves. The analysis was structured into the four components of the Safe System: safer road users; safer roads and roadsides; safer vehicles.

3.6.1. Safer road users

Issues related to safer road users was the Safe System component raised most frequently by participants. Behaviour, attitudes, the need for education and enforcement were all discussed as factors that need attention to increase safety for cyclists. The topics raised in relation to safer road users are presented below.

Attitude and behaviour

Attitudes and behaviours were the most common factors that were raised by participants.

Attitude from the 25% of cyclists who are idiots and the 25% of drivers who hate cyclists who are idiots. ***Belinda, 45-50yrs***

Improvements from both driver and cyclist attitudes and behaviours were identified as key components to creating a safer cycling environment. Participants who had been riding in the ACT for a number of years observed that their experiences with drivers had improved. Over recent years, drivers seemed more aware of cyclists on the road and the general level of harassment from drivers had decreased.

It would be better if you didn't have this really kind of alienated behaviour between the drivers and the cyclists. I'm not sure why it's kind of developed, you can actually sense it. ***Jenny, 45-50yrs***

I think it's just consideration and tolerance from both riders and drivers. Generally I'm happy to ride on the road and feel safe pretty much all the time. ***Klaus, 45-50yrs***

I've been cycling in Canberra for 6 years on the road and already drivers are more aware of cyclists now than they were 6 years ago. The biggest reason for this I think is because there are more cyclists are on the road. There are more of them there so they are more obvious but also more of them have friends who are cyclists so they tend to be more aware of them. And cycling is becoming a bigger political issue with bigger media coverage, even if people don't agree with cycling, they're aware that cyclists are out there. ***Eric, 40-45yrs***

Participants were clear that any negative experiences from drivers in the ACT were significantly less than what they had experienced in other Australian cities:

> *I find drivers in Canberra much more careful and much more considerate. I find they slow up and give way to you, wait to go around you so overall the experience is so much better than Sydney, I was amazed at the difference. There's the occasional idiot which you get everywhere. Here people who live here don't realise how good it is. For me, comparing this to Sydney, I realised how much more stressful it was riding in Sydney, you're in a constant heightened state of awareness and watching for everything generally here it's really good.* ***Heather, 30-35yrs***

Some participants offered their own theory about cyclist and driver attitudes and behaviours in the ACT.

> *One of the reasons I think Canberra drivers are bad drivers is because most of the time we don't have any traffic. We have really nice wide roads, so you kind of have this sense of 'I have full control and I can just pretty much do whatever I want to do and no one is going to inconvenience me. And if someone does inconvenience me, I don't need to co-operate, I can just get angry. I don't need to let people in, let traffic in'. Whereas in Melbourne or Sydney, where you constantly have high traffic... you simply have to co-operate. You couldn't afford to be bloody minded and pigheaded about things because if you were then you just stop the traffic and nothing was working. Plus you probably wouldn't be so angry by the time you got to work.* ***Jenny, 45-50yrs***

> *I think that one of the problems with cars, generally drivers, because the roads are so good we get very slack and blasé and impatient. In Sydney, if you put your indicator on people let you pull in because they know if they don't it causes a mess. Whereas in Canberra, it's a sign to speed up because you don't want to let someone in, because you can and it doesn't have that flow back [effect]. And I think it's one of the problems with cycling here.* ***Dennis, 40-45yrs***

> *Talking to friends who drive cars and there is a disconnect between bike riders and car drivers. They both think each other is at fault and that can cause a bit of pressure. There's probably not as much respect as there should be between the two different users of roads. I think there's a problem there.* ***Kevin, 35-40yrs***

Some participants considered off-road bike paths contributed to driver attitudes. Their perception was that given the extensive off-road paths available, some drivers believed cyclists should not be on the road but on the paths and this gave drivers justification to be intolerant of cyclists on the road as they 'weren't supposed to be there'.

> *Here there's a need for people to know that people don't have to ride on the footpaths. I think that some drivers don't realise that people can ride on the roads... everyone has the same impression of Canberra that cyclists will ride on the bike paths.* ***Heather, 30-35yrs***

> *Our cities make the motorists the first class citizen... There is a huge perception amongst Australian motorists that cyclists have no right on the road.* ***Nigel, 55-60yrs***

> *Some drivers consider that roads are for cars.* ***Brian, 45-50yrs***

> *I think it's important that they [drivers] are aware that riders are also users of the road and they have the same rights that they have.* ***Tania, 50-55yrs***

Some participants stated that a road user hierarchy that positioned active transport users ahead of motorised vehicles was a necessary paradigm shift to improve safety for all road users. Frequently participants' experiences riding in Europe were mentioned as an example of how roads need to be managed to encourage more people to cycle and to create a safer cycling environment.

[In Europe] cyclists are legitimate road users, that's the biggest thing, that cyclists have a right to be there. I would like to see some of our major cities, like Sydney and Melbourne, more like Copenhagen and some of the European cities where they close off large swathes to cars. They shut down roads so bikes can have precedence, make it so people can go close to the city then take public transport. I don't believe the current way they do things here are sustainable in the future because you can't double the number of cars and still have them come to the city and they're gonna come to that, that realisation will come. ***Steve, 60-65yrs***

It is perfectly possible to have a safe and useable and efficient system where roads are used by both bicycle and cars. It works. They don't always need to be separated. It depends on how the infrastructure is put together... where there's no room to put an extra lane, you're better off just taking the lane and using it and generally that's low speeds and small suburban streets ***Nick, 35-40yrs***

Driver behaviour

Several participants commented specifically on the negative experiences with drivers which ranged from apparent negligence or disregard on the part of the driver, to active acts of aggression.

Riding my bike to work is the most stressful thing I do in my day. It's very stressful. Because I'm always having to worry about someone who has abused me, or side swiped me very closely. ***Daryl, 50-55yrs***

Drivers tend to be abusive, putting the car very nearby, but they also do things like tooting. If you are riding and someone comes with a car behind and toots you, you get jumpy, it's the worst thing you can do to a person. Because they are in the car they don't realise how loud their tooting is actually. ***Tania, 50-55yrs***

Drivers underestimate, they cut me off at the roundabout probably didn't anticipate that I'd be arriving at the roundabout at the same time that he would. ***Klaus, 45-50yrs***

As the participant suggested, the arrival time to intersection is possibly a function of the driver underestimating the speed of the cyclist. This experiential data corroborates the empirical data discussed in Section 3.4.

Driver behaviour – Buses

The primary mode of public transportation in the ACT is by bus as the ACT does not have metropolitan train or tram network. Participants had mixed views about sharing the road with buses. Some participants believed that bus drivers were professional drivers who were likely to be more courteous on the roads than non-professional drivers:

I take the view that buses and trucks, they're professional drivers and that's their livelihood so they're probably a bit better than cars. ***Brian, 45-50yrs***

I had an experience with one bus driver who then waved out the window at me to going sorry I did something bad then, and I thought oh, that's nice. And I have had experiences when the bus will sit behind you for a little while and then pull in, so some of them are aware. ***Matthew, 55-60yrs***

Whereas others believe that bus drivers were deliberately aggressive, impatient and showed no regard for the safety of cyclists.

I've been sideswiped by an Action bus twice. One time they dragged me by the handlebar as they were coming around a left hand turn. I was coming around Wentworth Avenue, they turned left onto Wentworth Avenue and cut back too soon, grabbed me by the handlebars and dragged me along. Fortunately it catapulted me off the road, anyway

they got away with that. I rang Action buses and they said well we'll warn our drivers to be careful. ***Daryl, 50-55yrs***

He [bus driver] kept pulling front of me and pulling over to drop off passengers. A bus pulls up behind you, overtakes then a little bit down the road stops to drop off passengers and you think you could have waited. It happens often enough. ***Matthew, 55-60yrs***

Participants also commented on the bike rack facility on buses in Canberra. The vehicle facilities on buses in the ACT are discussed below.

Driver attitudes

It's the ones who aren't courteous or have a hatred of cyclists who I don't think will listen to most awareness campaigns who are the danger and are a very, very small minority. ***Craig, 45-50yrs***

Participants often reported that a small minority of drivers held extremely negative attitudes towards cyclists. While the number of drivers with this type of attitude was considered small, the impact of these drivers was disproportionately large and the potential damage by such drivers could be catastrophic for a cyclist.

There was a green ute...He was going along abusing people and his number plate was taken and reported to the police, he was yelling out...it was one of those semi-country roads and he probably expected he could go 100km/h but he couldn't because there were all these bikes there that were causing issues. ***Brian, 45-50yrs***

I saw one car, that had a hit list for a whole lot of different things, cyclists, strollers, pregnant women. There was a little picture, an image on the front near the passenger door of his car. The driver was a young hick driving a Holden or Ford. You know the cars that have 'this is my family', it was like that but it had 4 bicycles, 4 strollers and 5 pregnant women, crossed off. ***Tess, 55-60yrs***

One participant linked driver attitudes and behaviour, that an unwillingness to wait for a cyclist when driving could lead to erratic driving and consequently cycling behaviour:

I go down Majura and there's two roundabouts, I'm going to through those roundabouts at 30km/h plus, they're [drivers] going to go through the roundabout at 20km/h and yet do you think they can wait 20m so we can get to the roundabout. No! They've got to fang around me, sometimes ostentatiously wide, sometimes close, stamp on the brakes and then do their manoeuvre with me screeching to a halt so as not to go into the back of them. It's totally unacceptable to wait for cyclists. ***Nigel, 55-60yrs***

Some participants noted that road users' attitudes they had experienced in Europe were in stark contrast to their experiences on Australian roads:

Having been the Europe a number of times I really found the attitude over there towards cyclists in Europe completely different to Australia and I'm not sure where that's been derived from. But I really do hope that the European attitudes towards cycling come to Australia. ***Elliott, 55-60yrs***

Cyclist behaviour

Participants recognised that cyclists' own behaviour needed to improve to create a safer cycling environment.

People say that Canberra drivers are bad drivers, but I think the Canberra cyclists are bad cyclists. ***Jenny, 45-50yrs***

cyclists' behaviour is often appalling and it's across the board. A lot of people complain about people in lycra roaring all over the place and I've seen people passing me, I might be doing 35-40km/h and they zoom passed me and I've seen them passing other people and they don't look behind them and just pull out in to the traffic lane. And I've seen cars have to come to a screeching halt for that sort of thing. And also cyclists going through red lights, that doesn't endear you to anyone. Blatant disregard for the road rules, I think a lot of people don't like that either. ***Craig, 45-50yrs***

Sometimes they need to respect more the regulations. Because they're a rider doesn't make you exempt of using the road properly. ***Tania, 50-55yrs***

Erratic or unpredictable cyclist behaviour was identified as one of the factors that may contribute to drivers discomfort when sharing the road with cyclists.

'I think people are afraid of cyclists being unpredictable and I have noticed that cyclists don't always signal, they don't always look. I'm a bit of a community care bear and I wave and people give way to me but I've noticed that not all cyclists do that as well. I think knowing that we are allowed to be there and there are a few people who do crazy mad things and the rest of us kind of cop it. ***Nadine, 35-40yrs***

However, some situations created by cyclists and ride organisers, seemed to contribute to confusion on the road. An organised ride up Mount Ainsley on a Sunday resulted in a slow climb by cyclists, followed by a high speed descent. The road was not closed to vehicular traffic and as a result, a potentially dangerous situation, as well as increased confusion and undoubtedly stress and concern ensued.

On Sunday, on the 5 peaks ride going up Mount Ainsley then coming back down and the road wasn't closed off so you had drivers going up. And drivers were in a sense trying to do the right thing and give the riders climbing up a wide berth, but they were putting themselves right over the double yellow line where there were other cyclists flying down at 50-60-70km/h. There were no accidents, there was no patrolling and the road wasn't closed.

I don't know whether you really [could close the road]. I would think the far more appropriate thing would have been to have someone at the bottom saying there's a cycling event on be careful, there are people going up and down and it may take you a long time to get up. There was no alternate route, there is only one road up and the same road down.

I don't have a lot of criticism of the organisers for that. I think drivers should have to take into account for the cyclists. The only reason you go up to Mount Ainsley is to look at the view, it's a not a major route to a destination to you have to use it to get to somewhere you only go up there because you're sightseeing. So if it takes you 5 minutes longer to get up to the top then so be it, I don't have a lot of sympathy for the cars. ***Brian, 45-50yrs***

Canberra big bike ride was on a couple of weeks ago, a friend of mine was involved in organising it. He was absolutely blown away by the number of people who rode across the double line, three abreast, we really need to promote what is safe, what is legal and what is expected. ***Belinda, 45-50yrs***

In addition to the on-road relationship between cyclists and drivers, many participants identified the role of the media in influencing the public discussion about cyclists and subsequent attitudes and behaviours.

Media

> *There are a lot of shock jocks on the radio who are forcing motorists to think of cyclists in a different way. Whenever I write a letter to the paper or the minister I request please could they join me on a bike ride that would be a great thing. Then they can see both sides of the story.* ***Elliott, 55-60yrs***

In the main, participants focused on the negative impacts of the media on cycling safety and expressed that the mainstream media often marginalised cyclists. One participant believed that the animosity directed at cyclists was an anomaly that would not be acceptable if directed at other groups in the community:

> *People advocate hurting people [cyclists]... you can't incite people to racial violence, I don't see why that can't apply to all kinds of violence. For Fairfax and News Limited, in theory all the comments go through the editor before they're published. If it's entirely factually wrong or it's advocating violence I don't see why it should get published. It doesn't add to the debate and I don't think the comments section is meant to be there for keyboard warriors to vector and political opinions that are potentially dangerous.* ***Keith, 25-30yrs***

Two specific incidents in Australian media were frequently commented on: 1) the 'comedy' skit involving Magda Szubanski and Julia Morris, and; 2) the interaction between Shane Warne and a cyclist in Melbourne. Participants frequently made a direct connection between these two incidents and an increase in their experience of verbal and physical harassment from drivers.

The first incident was broadcast on Channel 10 in September 2009 on a comedy/satire program *Good News Week*. In a segment, led by Magda Szubanski and Julia Morris, the focus was on the annoyance on-road cyclists caused to other road users. The clip was instantly available on YouTube, titled *Magda Szubanski encourages violence against cyclists* http://www.youtube.com/watch?v=LyEeGFg9F0k Both women are professional comediennes, however participants considered the tone of the segment was not humour but frustration and aggression. Specific comments included:

> *I don't want to be in my car and have to look at your sweaty lycra bum raised in the air when there is a bike path, a tax payer funded, one metre away. Ride your stupid bike on the stupid bike path! ...If you're going 'round the corner and you've got it on that stupid speed when it's just spinning, spinning, spinning and I can't get passed you – put it in a different gear!* ***Magda Szubanski***

> *What about everybody saying we deserve our slice of the road, it's as simple as that, but then not following any road rules and going straight through the red lights and just nearly knocking people over... just drive and take 'em out [motioning that drivers should swerve to crash into cyclists]* ***Julia Morris***

The skit ended with Szubanski saying and motioning with her arm that drivers should actively open their door in the path of cyclists. The segment received considerable backlash and both women have publicly apologised and acknowledged that they did not intend to promote violence towards cyclists.

Participants commented that in the days after each incident, the harassment they experienced from drivers increased. Experiences included being verbally harassed with obscenities yelled from passing cars, to one participant who experienced three separate events on a single trip while riding home along Northbourne Avenue:

> *The worst night of getting harassed while riding my bike, that I can remember, was the Friday after the Magda Szubanski and Julia Morris anti-cyclist rant... I was riding up*

Northbourne Ave, late in the evening, when I had three harassment events. Two harassment events were people yelling at me from their cars as they overtook me. The third occurred when I was turning right from Northbourne Ave into Wakefield Ave. I had a right turn arrow and the single car heading south on Northbourne Avenue had a red light. As I was crossing the south-bound carriageway, the car 'jumped' a little, as if the driver had deliberately jumped on the accelerator and then the brake. The driver, as seen through his windscreen, was not looking surprised or shocked by what happened, if it had been an accident on his part. But was looking at me with a look of pride or aggressiveness or superiority.

I associate that night's harassment with the Szubanski-Morris skit because I've never had three separate harassment incidents on one ride. Once a ride happens now and then, and two on a ride is very rare. Three on a ride is so far outside my normal experience that I regard the skit and the harassment on that night as being related. ***Lawrence, 50-55yrs***

The second incident involved an on-road interaction between Australian cricketer Shane Warne and an on-road cyclist, Mathew Hollingsworth, in Melbourne in January 2012. In this incident at an intersection, Warne reportedly lurched his car forward hitting and damaging the back wheel and Hollingsworth's bike. Immediately after the event, Warne tweeted that Hollingsworth had thumped the bonnet of his car and been abusive and denied any wrongdoing. Neither man was charged over the incident.

Many participants commented that there was a direct link between this incident and increased harassment on the roads:

'When we had the Shane Warne incident in Melbourne, for about 2 or 3 weeks I copped so much abuse on the road but after that it's toned down. So I think that [driver abuse] peaks with those incidents'. ***Jenny, 45-50yrs***

Education

There are a lot of drivers who are really anti-cyclists. There could be some kind of awareness raising with some car drivers. 99% of people are pretty good but there are some that are just arseholes and scream and yell. They're probably like that to everyone. ***Tess, 55-60yrs***

Most participants agreed that there was an important role for education in improving safety for all cyclists. Many agreed that the cycling groups, such as Pedal Power, were contributing to increased awareness and education; however there was a greater role for government to develop education and awareness messaging and campaigns.

I'd like to see more driver education and the public service messages out there showing that cyclists and drivers can mix on the roads. Because I'm both. But both can be fools and idiots when they think that no one's watching. ***Nathan, 50-55yrs***

I see next to no education. The education I see does not speak to people. ***Steve, 60-65yrs***

I think the TAC in Victoria has been successful in their messages on speeding and drink driving and seat belts... I think there's definitely a role for education. ***Keith, 25-30yrs***

The messages participants wanted to see publicised in a broad education/awareness campaign focused on the right and responsibilities of cyclists and drivers on the road. Suggestions from participants included:

I think the attitude of 'you don't pay for the ride you don't have a right to be here' I think that is a very common outlook...People need to be aware of rights and responsibilities on

the road because they aren't that clear. A lot of people aren't aware that if the room is available then cyclists are allowed to ride side by side, a lot of people just don't know that. It would be really nice if people were more aware of this stuff. ***Nadine, 35-40yrs***

I'd say at least half the people who do something wrong to a cyclist don't do it deliberately, don't mean to endanger the cyclist. But don't realise that turning left after you've just passed that bike might cause problems for the bike. It's a lack of awareness. I think a key place to start is intersections and roundabouts at the top of the list and just watching out for bikes. ***Darren, 40-45yrs***

I think a lot of it is education of drivers of things like bikes are allowed to ride 2 abreast and take up a whole lane and if they slow you up well they slow you up and they need to be careful turning left, understanding cycling boxes at traffic lights. I was riding back from Woden one day and there's a cycling box at one of the lights there and I was up on the line and so there was a car turning left, 4WD turning left. They actually wound down the window and said you're gonna get hit there. And I said, I've actually got the right of way, but there wasn't enough time before the lights changed and they accelerated and cut off in front of me. When they started that conversation I was already watching out for them, so I wasn't going to get hit. They were just idiots. ***Brian, 45-50yrs***

Other participants suggested that there was a need for targeted education campaigns that addressed the behaviour of drivers who they believed intentionally sought to endanger cyclists on the road.

Targeted education... that identifies the type of group that causes the most problems. From my perspective I'm talking about the tradies. I think that's the majority of people are fine, but there are certain elements, the very young and some of the tradies and bus and truckies a bit as well. They view is that you're on the bloody road, you don't pay for it so piss off and get out of my way because my time is so valuable. I do pay for it, I pay through the nose in my taxes. ***Steve, 60-65yrs***

Education – drivers

Specific, driver targeted education was recommended by many participants. Several participants noted that there was no cyclist related content in the driver's licence handbook when they were being tested for their licence, others commented that their children were studying for their licence and there was still no cycling-related content.

New infrastructure was also a cause for additional education. Participants often cited the green painted bike lanes as an example of frequent confusion amongst both cyclists and drivers, particularly at the points of exit or entry on a roadway with a green painted bike lane. Participants commented that without a clear, broad awareness campaign of how to interact at these sites, road users had organically developed norms of interaction, however these new road user norms were not consistent across all road users and were not consistent at all locations. This confusion added to a sense of unpredictability and uncertainty:

Drivers are confused, they don't know what to do, they haven't been educated. They don't know whether they're supposed to slow down, speed up, stop. In my experience, people when I'm on a green part of the lane, cars usually really slow down behind me which can cause impact on the cars behind them or they cross over on the left hand side of me and go off the ramp that way or speeding up and cutting across in front of me. ***Tess, 55-60yrs***

Some drivers try to do the right thing but it confuses things further. ***Jenny, 45-50yrs***

Education – cyclists

Education targeted at cyclists including the road rules, rights and responsibilities and skills training were also suggested as necessary for improving cyclist safety. Cycling education as part of the school curriculum was considered important by participants:

> *Education is probably lacking a lot. I'm not sure how much is taught in school anymore. I know when I was in school it was compulsory for everyone. But maybe people reach late teens or early twenties and think they're superhuman and forget it. I see a lot of people doing really stupid things on bikes.* ***Ed, 40-45yrs***

> *It's good and bad that there's more people cycling on the road now. It's good because there's more awareness, because I've been riding for quite a while now and when I first started off you really were treated as bit of a leper firstly for riding and then cars didn't expect you there and they were very aggressive so with more people, it's getting better. But then there's also the morning commuters and they do lots of stupid things on the road, they're just dangerous in general. They're not very predictable, they're not very good cyclists. There's a lack of training.* ***Dennis, 40-45yrs***

Other participants commented on the need for cyclist education, particularly for adults who were returning to cycling or for people who had not previously cycled in Australia.

> *I think it has to be more education like when I started riding, I didn't used to ride on the road, that was a while ago. I started to ride regularly to work about 5 years ago and at that stage, I hadn't been riding in Australia at all and I wasn't aware of certain things and I was taught by my children. For example indicating when I'm turning, putting my hand out, I will turn around and see if someone is coming or not but my son said you have to do that even if there is no one there because sometimes you can't see them but two seconds later a car whose speeding comes and if you have already done the indication they will see you. So I do it as a matter of fact, it doesn't matter if there is anyone on the road to see you do it and you do it automatically.* ***Tania, 50-55yrs***

Enforcement

> *If police are visibly enforcing the rules for car drivers and for cyclists that increases the realisation that both parties are responsible,* ***Eric, 40-45yrs***

Participants acknowledged the need for enforcement to improve both cyclist and driver behaviour. They considered the police attention to be an important component in the perception of parity among road users and positioning cyclists as legitimate road users.

> *I totally believe there are 25% of cyclists out there who are absolute idiots and if law enforcement made even half of them lift their game then I believe that it would improve cycling and driving safety,* ***Belinda, 45-50yrs***

Participants frequently commented that the regular enforcement focus on cyclists in efforts to improve cyclist safety failed to recognise the role of drivers in improving cyclist safety.

Legislation

Default driver responsibility

> *Strict liability is in place in Germany and at least it encourages everyone to pay a bit more attention.* ***Keith, 25-30yrs***

The participants understood the law to state that in the event of a collision between two road users, the road user operating the larger vehicle is automatically responsible until proven otherwise. The

actions of the 'smaller' road user may be found to be at fault and this would mitigate the 'larger' road users' responsibility. The participants who discussed this law considered its importance was created by the onus of proof being automatically on the 'larger' road user afforded greater protection to 'smaller' road users.

> *Anyone in a car who runs over a cyclist and it's shown to be not the cyclist's fault should be not up for a normal road accident. The cyclist didn't have a steal cage, airbags, the driver needs to be more conscious of that and needs to take the increased hit because of that. I think it should be an automatic minimum to the penalty, if you cause certain amount of injury you automatically lose your licence for a period of time. Even if you're totally contrite and say it just happened to you, and this is a little bit for the benefit of the rider, but just to say they do need to take extra care... It's a privilege to be driving and you're meant to keep yourself in a fit state to be a defensive driver...If there is one area that the government needs to take control it's that. I think that if they reviewed that across the board, they might see a benefit to cyclists and other road users like cyclists.* ***Neville, 55-60yrs***

In the case of a collision between a cyclist and driver, the onus of proof would always be on the driver to prove that the cyclist was responsible. Further, participants believed that this law would ensure drivers are penalised as a default.

Numerous participants were keen to see a more European-style attitude towards cyclists. A key component of this attitude was identified as being driven by the legislation known as 'strict liability' (Germany) or default driver responsibility and is a law that is currently active in Germany, the Netherlands and Denmark.

> *I have a friend whose was put in hospital for weeks, broken pelvis, broken arm, he was cleaned up from behind by a car doing about 100km/h across double lines, just taken out big time. The driver has not been prosecuted. In Europe, if you hit a bike you are in the wrong, prove you aren't. And the attitude change that that will eventually drive through society with some very high profile and very hotly debated prosecutions is the attitude that I saw when I was in Europe.* ***Nigel, 55-60yrs***

The participants who had cycled in other countries, reported that this law had a significant effect on the way cyclists and drivers interacted on the roads:

> *I'd like people to, as in Europe, basically acknowledge the fact that a cyclist has a right to their section of the road. So in simple terms in Europe they give you the lane, if you're in the lane, they give you the lane. If they can't get passed you, they'll wait. That's what I would really like changed.* ***Elliott, 55-60yrs***

Participants also referred to other international locations where there is greater responsibility on the driver as the operator of a machine that could cause a fatality:

> *In Argentina, it is considered that if you drive a car it is the same condition as if you were using a weapon. Because the car is so heavy and is so dangerous that you are using a mortal weapon on the street.* ***Tania, 50-55yrs***

Participants considered the current situation in Australia to be the opposite. Drivers are frequently not penalised even when their actions clearly caused a crash, even if the crash resulted in a cyclist's death or serious injury. Police are infrequently called to cyclist crashes when there is no property damage and crashes reported to police post-crash do not frequently result in any penalty.

> *At present there are so few incentives, that if you did hit someone, be it a cyclist or a pedestrian, in a car, driving away is almost the best strategy because there is a strong*

chance that you will never get caught... There needs to be some rethinking around regulations. ***Keith, 25-30yrs***

Adequate overtaking distance

The need to legislate adequate lateral clearance distance when drivers overtake cyclists was identified by several participants.

Participants suggested that such a law would be an important step to changing driver behaviour. Participants also discussed the value of such legislation in situations where there was no bike lane as drivers would be required to provide adequate overtaking space regardless of infrastructure. This legislation was considered important to shifting driver attitude, driver behaviour and improve cyclist safety.

Mandatory helmet use legislation

Bicycle helmet use is mandatory in Australia. Since 1993, all cyclists have been required by law to wear a bicycle helmet.

All participants were asked if the helmet law was repealed tomorrow would they stop wearing a helmet when riding. The majority of participants stated that they would continue to wear a helmet, considered helmets to be 'part of the kit' and they would not consider cycling, particularly on the road, without one.

Some participants said they would be less inclined to wear a helmet when riding if the cycling environment was safer. Poor driver attitudes and lack of well maintained and connected bike lanes were cited as the main issues that negatively affected a safer cycling environment. Most participants related riding on the road and riding at high speed to be risk factors that would lead them to wear a helmet when riding.

Some participants said they would choose not to wear a helmet on some trips that they determined to be 'lower risk', for example short trips to the local shops or on a bike path. However, participants would not allow their children to ride without a helmet and there was no consensus on how old a child needed to be to stop wearing a helmet.

One participant did not support helmets. He considered it a poorly thought out policy that was damaging to cycling participation and lessened the benefits of cycling in the community.

Road user responsible for own safety

Cyclists are pretty conscious of their safety. I think there's a role for cyclists and motorists to be responsible and fair with one another and to integrate better on the shared roads. I think it's up to both of us – I'm a motorist and a cyclist and it make sense to do the right thing and make room for people. ***Tess, 55-60yrs***

The need for cyclists to be alert and compliant road users and to take responsibility for their own safety was also a strong theme amongst participants. Defensive behaviour, likened to motorcycle riding was a common suggestion:

I'm a big fan of the defensive approach which means if you're doing it, you'll look after it. You're the one who will be hurt, even if its emotional hurt, so that's the first responsibility. One hopes that applies to all road users and cycle path users, so primarily responsibility is to yourself. ***Neville, 55-60yrs***

Safety comes down to defensive driving. Whether you're a cyclist, riding safely, giving way to people when you should, watching out for people doing the wrong thing. ***Ed, 40-45yrs***

I [rode] a motorcycle for a few years and in the compulsory motorcycle courses, you have to do... work around defensive riding. It is fantastic and it would be really good if a little bit more of that was available for cyclists because things like making eye contact with people, being aware of other people's blind spots is really good defensive work. I think that's a really helpful thing for people to know and especially for people who haven't spent too much time as a driver, perhaps they wouldn't be as aware of that sort of stuff. ***Nadine, 35-40yrs***

Benefits of cycling

I would also like some acknowledgement for the fact that I'm actually a carbon offset. I'm sure there is some bureaucrat in the ACT government who is counting us every day who is offsetting, cashing in, on the fact that we ride. ***Elliott, 55-60yrs***

Several participants commented on the environmental benefits generated by their choice to regularly cycle. The value of riding were considered from the environmental perspective, that on a bike individuals were not generating vehicle exhaust emissions and reduced traffic congestion. It was considered likely that some government department was, or would soon be, counting cyclists and offsetting the environmental benefits of individuals as a government environmental target.

Another participant made direct links to his increased daily activity and his personal health benefits. With improved personal health he considered that there should be benefits to him from his health insurance, perhaps even tax incentives to reward his cycling that could be used as an incentive to other people to cycle.

3.6.2. Safer roads and roadsides

In Canberra we're pretty lucky... infrastructure that's gone in [over the last 10 years] is quite amazing. Some of it is not well thought through, you've got some crazy bike lanes that just stop and then start again. Maybe they'll get it right next time, at least they're doing things and moving forward. ***Mary, 55-60yrs***

The second component of the Safe System approach is safer roads and roadsides. The facilities in the ACT were widely appreciated and it was generally considered that the ACT had amongst the best on-road and off-road cycling facilities of any city in Australia.

Despite the extensive facilities available in the ACT, participants identified parts of the cycling facilities that needed improvement. The need for more bike lanes, greater connectivity, signage and end of trip facilities were all discussed. The topics raised in relation to safer roads and roadsides are all presented below.

More bike lanes

The most common recommendation made by all participants was more bike lanes both on-road and off-road. Bike lanes were considered to be an important component of a safe cycling environment.

I'd like to have more lanes, like the ones on Adelaide Avenue on other roads as well, as dedicated cycle lane. ***Jenny, 45-50yrs***

Obviously there is a need for more bike lanes, there are a lot of roads where there isn't bike lanes, providing in a push bike facility in a new development and making sure there is enough adequate bike lane to encourage bike riders to ride safely on roads and through roundabouts. ***Kevin, 35-40yrs***

Places like Melbourne where you get the bike lane up the left hand side of the road then there's space at the front where you can spread out just doesn't exist here in Canberra,

things like that would be really useful. Then you don't get stuck behind five cars in traffic lights, you can get through. ***Lachlan, 40-45yrs***

However, some participants were critical of some bike lanes, in particular the green painted bike lanes. As discussed above in the Safer road user section, participants had experienced confusion in interacting with drivers, while one participant commented that the position he rode in while on the green lane was dangerous:

Green lanes of death. You're moving away from the safe bike lane on the left and putting yourself in the middle of a three lane road of traffic moving at 80km/h. ***Klaus, 45-50yrs 02***

At some locations, even with a continuous bike lane, some cyclists still avoid the location as there is a perception that the bike lane is too narrow and the cars pass too closely:

I don't go down Northbourne, people complain about Northbound, it is very narrow and motorbikes use it. Whenever I have used it, the buses come into it and cars come into it and they turn into it, that's the thing. You come to an intersection and they'll sit in it or turn through it. ***Dennis, 40-45yrs***

Factors that the participants considered to negatively impact bike lanes were a lack of connectivity and the interruption caused by roadworks when a practical alternative was not implemented.

Connectivity

The lack of connectivity of bike lanes, particularly at critical points on the road was a concern noted by most participants. Some participants conceded that the introduction of bike lanes was an iterative process that would gradually improve over time, while others wanted to see a higher priority for continuous, connected bike lanes. Participants considered connected bike lanes to be a key component of safer roads for cyclists.

Bike lanes help to make me feel safe on the road ... On my route, the bike lanes are reasonably well connected. I know there are plenty of parts where the bike lane starts and stops around intersections and generally through Canberra they need to be better connected. ***Klaus, 45-50yrs***

Since I've been riding we've got bike lanes on Hindmarsh, it doesn't go all the way through, up and over the hill. It would be nice if they had a little bike lane, – that's a personal wish... Connectivity is sometimes just difficult to get from one cycle path to another. ***Mary, 55-60yrs***

I think that they need to be a bit more sensible... They actually have a bike lane and the next thing it runs out and there's nowhere to go and it squeezes and you suddenly merge with buses and trucks. ***Darren, 40-45yrs***

The worst and I believe the most dangerous one is Magira Avenue, by the airport, that new section of road out the front of the depot places. Beautiful, massive cycle lane, so if you ride to the north, the cycle lane at about 3-4km past that last roundabout just disappears and there's no verge, there's nothing. So you're on the road, a thin road, with the majority of truck traffic that goes between Canberra, Melbourne and Sydney. It is absolutely terrible.

Specific locations mentioned included access to Fyshwick, Belconnen Way and Commonwealth Avenue.

Fyshwick is absolutely atrocious to ride to... actually entering Fyshwick, there's no option. You've got to go on the road without any options, it's one of those lovely cycle lanes that goes along and along and along and then there's a massive intersection and the cycle lane just disappears. The cycle lane is on a almost decommissioned piece of very flat road which then goes underneath the highway, Monaro Highway, and turns into Newcastle Street. So as it goes underneath, there's a cycle lane approaching Monaro Highway and not only is there a section of the cycle lane up to the lights but there's even a specially made sensor for the lights for cyclists but there's no cycle lane on the other side of the intersection and Newcastle Street is the main drag. There's parking all along the sides, tight roundabouts. I assume it's the same in most industrial areas, but it's got that wonderful combination of lunatics in white utes doing 80 [km/h] and little old ladies in hatchbacks looking for a place to buy a microwave doing 20 [km/h]. ***Nick, 35-40yrs***

Coming up Belconnen Way, I ride through the union the ride home and ride through the car park, stop at the lights and there's three lanes, two of the lanes are for cars and one is a bus lane, but it's also a merging lane at the traffic merge into on the other side of the intersection. It's a section of about 200-400m that's three lanes then merges into a wide bike lane, but there's a gap. So that's bit dicey on occasion. ***Darren, 40-45yrs***

Cloverleaf at Commonwealth Avenue... that's a classic one, if cars just keep going and don't change their speed you can get through there without too much trouble and you don't need a big gap because you're going at speed. But if they stop to let you through or if the cars are, there is too much congestion and you've got to stop then you find yourself like a shag on a rock out in the middle of two lanes of traffic around you. ***Brian, 45-50yrs***

Some participants suggested that a potential solution may be a mix of on-road and off-road paths, particularly at squeeze points on the road:

The next thing is to link things up. There is a discontinuity of cycle tracks and they dump you in the worst spot. You're riding along, you've got an adequate car lane, you've got an adequate bike lane and everybody's happy, then you come to a constriction and my bike lane just peters out. Hey, this is not good enough. You've got to actually think it through so there's a place for the bike to go and a place for the car to go and keep them separate. ***Nigel, 55-60yrs***

There are areas where the shoulder disappears and in Canberra there's massive verges in the middle and the side but the shoulder still disappears. So there's plenty of space but for whatever reason the shoulders disappears. ***Heather, 30-35yrs***

From an early review of the video recordings, some participants were riding on the road when an off-road bike path or shared path was immediately adjacent. When asked in the exit interviews about what motivated them to use the road instead of the adjacent path, participants provided a range of reasons, the most common were:

- Safety concerns including:
    - Risk of crashing due to:
        - poorly maintained path, cut grass clumped on the path, overhanging trees, broken bitumen/concrete
        - narrow path, particularly on corners
        - female participants noted personal safety concerns as these paths were often poorly lit and sometimes obscured from the view of passing drivers
- Paths were undesirable due to:
    - Sharing with pedestrians, particularly children and dogs – pedestrians were considered unpredictable

    - Participants needed to ride at a slower speed than when on the road
    - Too circuitous, path was scenic and not utilitarian
- It was considered faster and less effort required to use the road

However, there were factors that detracted from riding on the roads, in particular:

- Road debris, in particular, participants repeatedly noted excessive broken glass on the road
- Bike lanes that discontinue and provide no alternative for cyclists

Roadworks

Detours, of lack of, were also noted at time of roadworks or construction when the blocking of the road also ended the on-road bike lane. This break in connectivity was often due to the lack of a clear, marked alternative for cyclists during the roadworks period.

> *Roadworks are appalling, they'll cut up a road and assume a bike lane doesn't need to be there during the road works. I can understand to an extent, but there's a part in my ride that they've only just fixed where you turn off and start riding down this part of the GDE and then you discover they're actually starting to do road works and they haven't put a sign up earlier on to say there's no bike lane. So the next thing you know you're having to merge in with high speed traffic [80km/h] without having any warning.* ***Dennis, 40-45yrs***

The broader issue of signs was raised as a means of informing cyclists and drivers of expected behaviour. Again, signs were considered beneficial to cyclist safety.

Signs

Permanent signs along the roadside and alongside off-road paths were considered by many participants to be helpful when present, and many participants believed there was a greater need for signage, particularly to inform drivers.

> *Car drivers don't know how to give way. In Wentworth Avenue there's a bike path that goes through some building carparks, so the cars going in and out of there and people walking and bikes, because that's their bike path. So they could be signposted better. Signage would help as well as general education. I know a lot of drivers are confused by the green lanes on roads like on Adelaide Avenue where there are ramps up and down.*
> ***Tess, 55-60yrs***

> *One of the reasons I think that Canberra cyclists do use their bells is because there are signs everywhere saying pedestrians don't block the paths, cyclists use your bell, cyclists have to give way to pedestrians and people with dogs have a responsibility to control their dogs. So these are the four things that are always on those signs and I think that's really good to have that stuff around the place and I think it helps because the rules are really clear, use your bell. If you had those kinds of signs for drivers that might make a difference.* ***Nadine, 35-40yrs***

However, one participant was cynical of the benefit of the signs and contested the priority given to implementing signs. He suggested that the money spent on signage could have been more effectively used elsewhere.

Planning

> *I wish that they would properly plan the cycle paths here.* ***Nick, 35-40yrs***

One of the key criticisms of the bicycle facilities in the ACT was an apparent lack of planning. Participants did not believe there was a master cycling plan that took a holistic view of the ACT and

sensibly linked the existing on-road and off-road paths or considered efficient and effective land use planning for future cycling routes and corridors.

> *Sometimes they put bike lanes in where they're just not going to get used enough. Usually because there's a better route to go down or a nicer road to go down than the one they've put the bike route on... they've got a couple on the big roads coming from the satellite towns, they've got bike lanes on them because they're new roads, but no bike rider would use them, they would be crazy. Because there are much nicer alternatives and better and faster, more direct for a bicyclist without ups and downs, so those bicycle lanes are empty.* ***Neville, 55-60yrs***

One participant suggested that bike paths that are partially completed were more dangerous than no path at all, as they left the rider stranded amongst vehicular traffic, often at high speed.

> *Half done in some of those cases is more dangerous than not done at all and they need to do the whole thing or they need to do half of it and just close it. Put cones up and signs and say you can't use this until we've done the other half.* ***Nick, 35-40yrs***

Connectivity to local amenities including shops and schools was also considered lacking and required well considered planning to address:

> *There really needs to be an assessment around schools about cycling friendliness and pedestrian friendliness. For the students and people riding to school, because I ride my kids to school and it's so, so dangerous. There's no safe spots to really cross the road. Doing things like raised pedestrian crossings, putting traffic lights in, they're all things that slow the traffic down and gives a really good safe spot for kids to cross.* ***Dean, 40-45yrs***

> *I reckon the planners don't think about serious bikes and bike riders and with electric bikes, electric bikes go 30km/h. I've had a go on an electric bike, we've got them at work and we can borrow them at lunch time or go to work on them.* ***Ben, 50-55yrs***

Poor road surfaces in bike lanes

Some participants commented that the quality of the road surface in the bike lane was substandard when compared to the vehicular lanes. They suggested that a cheaper, coarser material was used to surface the bike lane compared to the vehicular lane. Participants suggested that bike lanes be included in road resurfacing and the smooth finish bitumen used on the vehicle lanes be used on the bike lanes.

> *The on-road cycle lanes along Belconnen Way, between Gungahlin Drive Extension and Fairfax St/Macarthur Ave, have been patched and repaired many times, which has resulted in a rough ride. I think it is because the edge of the road, which the cycle path runs along, was not designed to carry heavy traffic, but has had heavy traffic run along it...The solution I would suggest is to build roads to the full standard across the full width, including on-road cycle lanes, rather than building to full standard across the motorised traffic width and adding cycle lanes built to carry only light weight traffic.* ***Lawrence, 50-55yrs***

One participant commented the time any road was being resurfaced was the time to put in bike lanes at locations where there was no bike lane or the bike lane discontinued. He suggested that the resurfacing was a time a reconsider the way the road was being used and maximise the space for cyclists on those routes with higher cyclist traffic.

Poor road surfaces were also contributed to by a lack of maintenance on the bike lane, in particular sections of road were commonly the site for broken glass which participants considered to be the result of weekend anti-social behaviour as frequently bottles for alcoholic beverages were

identifiable by the labels or brown coloured glass. Glass highways or crystal highways were terms used amongst some participants to describe sections of road with significant and repeated amounts of broken glass.

> *I'd like them [the roads] to be swept, I'd like to send the sweeper to certain sections because there is so much glass in there...I do know that at the big roundabout that goes from Commonwealth Avenue around Parliament House, there was lot of glass, with really big smashed [pieces] of glass and that was a relatively short section, around 1km, after the tunnel. And the area between the continuation of Melrose Drive into Adelaide Avenue when you're coming towards the city, there is a lot of broken glass in there as well.* ***Jenny, 45-50yrs***

> *I think in terms of cycling safety, the cycle routes are second class routes. The premium routes are right alongside the roads but well maintained. [At other locations] the road surface is swept and clear of debris, the cycle lane is grass clipping that are rotting, broken glass from four weeks ago that is still there that I've reported but hasn't been fixed.* ***Nathan, 50-55yrs***

The roadsides at some locations also contributed to a poor experience on the road as sightlines were blocked or obscured by fences or roadside trees.

> *The bicycle path going down Barry Drive, from West to East, has some unsafe areas near the bottom. There are two places where other paths join the bicycle path and are obscured by fences. I think that they are dangerous because, at the bottom of the hill, I am going quite fast, more than 40km/hr, and would find it very hard to stop safely if someone suddenly emerged from behind a fence.* ***Lawrence, 50-55yrs***

Participants also commented on the lack of verge or road shoulder particularly on roads where there currently was no on-road bike lane or adjacent off-road path.

> *There's a few spots where the shoulder could be fixed so there's room for a bike lane. There's a few places where bike lanes meet pedestrians and cars and there's a lot of confusion.* ***Tess, 55-60yrs***

Separation between road users

The participants in this study all rode, at least part, of their commute on the road, however most preferred some form of separation between cyclists and other road users:

> *In places like Copenhagen where they have the cars and then they'll have parked cars then they have cycle lanes, then they have the footpath. That can work really well as well. In the CBD of Canberra that would work really well.* ***Eric, 40-45yrs***

> *I would like to see things like rumble strips to keep drivers out of my lane so you can turn a corner and they'll cut it just for fun because they think I'm slow. Because they don't realise that down a hill I can hit 60 [km/h]... it's not 30, I do 30 on the flat. Drivers think they couldn't possibly be going that fast so they cut the corner.* ***Nathan, 50-55yrs***

> *I think having some kind of raised lip between the cycle lanes and the rest of road. I think people can easily drift into the cycle lanes. I don't think it has to be huge even like little cat eye kind of size.* ***Ed, 40-45yrs***

> *You don't realise how tense you are until the pressure is taken off. If there were cycle only tracks separate from roads and pedestrians, there would be a helluva lot more cycling going on. You don't realise until you're physically, until you have that physical barrier away from the traffic. You have to actually engineer it into the roadscape.* ***Nigel, 55-60yrs***

Many participants commented on the benefits of low speed zones, particularly around schools, areas of high pedestrian and cyclist activity and in these spaces it was considered appropriate for road users to share the space:

> *In the CBD in Civic if it was more like some European cities so that have either everything mixed so you have pedestrians and cars and bicycles all mixed in together because in the places where I've seen that in Europe it works really well because everyone slows down, everyone is hyper alert of what's going on around them and it just seems to work.* ***Eric, 40-45yrs***

End of trip facilities – bike parking

End of trip facilities at work were mixed with some participants reported good facilities, while others who worked in relatively new, large government office buildings commented that there was an insufficient number of places to securely park their bike. At some buildings there was a chronic lack of showers and locker facilities that had to be shared amongst commuter cyclists, people who exercised at lunch time and other staff (e.g. catering staff and security staff who needed to change before and after work).

Despite many of the office buildings in Canberra being relatively new, participants reported that cycling facilities were not a priority in building design. As a result facilities were already reaching capacity and participants were cynical about additional provisions for cyclists:

> *It's got a good bike rack, but 200 for 4000 people...And they keep saying they're going to do something but there's no money to do anything... You can see the things they can do if someone is prepared to spend money but the owners of the building are not...they've done everything in the minimum possible standards, absolutely minimum and minimum costs.*
> ***Dean, 40-45yrs***

A lottery system was used at some government office buildings to assign a locker to individuals. However, this was considered woefully inadequate as people reported that the number of lockers was well below the number required.

> *Every year you go into a ballot and I came out of the last round, I don't have a locker and I ride nearly every day. And I was 89 on the waiting list, I think I'm down to about 12 on the waiting list and I think it will happen again in about a month's time... I know a lot of people in the last ballot, they got all their friends who don't use the locker to put in their name.* ***Dean, 40-45yrs***

Participants also commented that the use of the lockers was not monitored and some lockers were allocated but unused, while regular commuters were left to find places at their workstation to leave their clothes, shoes and towels.

> *A lot of people keep their clothes in their office, so you go in their office and there are their stinking clothes and their wet towels. It's pretty gross.* ***Lynn, 60-65yrs***

Other participants commented that no consideration had been given to cyclists when construction was being undertaken around the office building or in the car parking area where riders access the bike cages. One participant reported that she arrived at work one day to find the access to the bike cage blocked by metal fences and no way to access her bike lock. When she arrived at the only other official bike parking location on site, the bike racks were already full and she locked her bike outside the racks and hoped that it would not be removed while she was at work.

Changes to security systems at some government offices had also impacted the number of lockers available to staff as many lockers in public spaces being removed, again without adequate notification. One participant commented that she had lost property including toiletries and running

shoes and was unable to locate or claim for her loss. Other participants talked about secret stashes of lockers that were not advertised and typically were left empty which could be used if people took their own lock.

Pedal Power, the local bicycle advocacy group in the ACT, was reportedly about to begin workplace assessments to determine how cycle friendly organisations were and their assessment would include bike parking and shower facilities and the reported demand.

Bikes on buses

One form of connectivity that was identified in relation to public transport by several participants was the facility for taking bikes on the bus. With a front rack that allowed cyclists to mount their bike to the front of the bus without any extra cost to allow cyclists to utilise a mixed mode of transport.

> *The other night I was riding home and just completely ran out of energy so I just pulled into the next bus stop and waited for the next bus. Which was really convenient... it is really annoying is that they haven't rolled them out to all the buses yet and I think that's the plan for the government but it could take while... you can't rely on it. So for example, I couldn't take my bike out today when it was going to rain in the morning but not in the afternoon, I can't take my bike down to the nearest bus stop, catch my normal bus to work and then ride home because I can't rely on it.* ***Eric, 40-45yrs***

Participants valued the extra flexibility offered by the ability to put their bikes on the bus. However, there were practical limitations related to the limited capacity, each bus can only carry two bikes at a time.

The inter-jurisdictional differences were also noted by participants. Queanbeyan is close to the ACT border and many residents commute to the ACT for work. One participant lamented the lack of bike racks on buses that serviced Queanbeyan:

> *Dean's bus service which is the Queanbeyan bus service which is the Civic bus service and goes into Woden, but you're not allowed to take your bike on the bus. So I would get permission to take your bike on the bus or bike racks on the front.* ***Lynn, 60-65yrs***

Role for government

All levels of government were considered to have an important role in the improvements of roads to increase safety for cyclists.

> *Local government yes, and federal government in designing as a percentage of the road build should be put towards improving cycling construction. Both sort of, Canberra has the Action buses now and most of them have the things for cycles on them, and there are some schemes with park and ride and bike and ride, so there's good cages set up at certain bus stops. So you can see they are doing things to promote cycling but there is still a lot to do. There should be more things that actual businesses do.* ***Dean, 40-45yrs***

3.6.3. Safer speed

The role of speed in the ACT and how it contributed to a safer cycling environment was considered multi-faceted. Participants commented on the posted speed limit, drivers' speed, cyclist speed and the role that the physical environment played in dictating the actual speed road users should travel.

Drivers were considered to regularly exceed the posted speed limit, regardless of whether they were travelling in a low or high speed zone.

> *Cars come along Canberra Avenue at 100km/h or more [80km/h zone]...the speed limit needs to be lowered in metropolitan areas.* ***Lynn, 60-65yrs***

Regarding cyclists' speed, many participants stated that drivers were likely to *under*estimate the speed they were travelling. Participants commented that drivers frequently turned in front of them or race them to the entrance of a roundabout and seemed surprised that the cyclist had arrived as quickly as they had – as though the driver thought the cyclist was travelling slower than they actually were:

> *Drivers have a lot of difficulty judging the speed of cyclists, particularly on the green bits [green on-road bike lanes]. I'm always checking, is that car going to go behind me or in front of me, because drivers aren't very good at it.* ***Mary, 55-60yrs***

The physical environment was considered under-utilised by participants who suggested that more could be done to create a road network that dictated the appropriate speed to all road users. One participant noted that the speed limit in his neighbourhood was the default urban speed limit (50km/h), however due to the road design with wide streets and generous sweeping bends, he estimated drivers often exceeded the speed limits and at some sections of road reached speeds of 80km/h:

> *When it's built in the streetscape that this is a 20km/h street, then it will be a 20km/h street. Until it's built into the streetscape that cyclists have equal rights to cars, cyclists won't have equal rights to cars.* ***Nigel, 55-60yrs***

The high quality roads for vehicles in the ACT was also noted as a deterrent when sharing the road as a cyclist. There was also a belief amongst some participants that the broader infrastructure, including the traffic signals was calibrated to encourage a higher speed:

> *The speed limit is 60km/h but no one does 60km/h along there [Limestone Ave], a lot of people go faster. The lights are synced along there and a taxi driver told my girlfriends once that if you go at something like 70km/h you tend to get the lights along there. But if you don't speed along there you catch all the [red] lights. I don't know if that's true, I found that the lights are just not synced along there so if you're going along Limestone you may or may not catch the green.* ***Lachlan, 40-45yrs***

3.6.4. Safer vehicles

> *All vehicles are 1500kg death machines. It only takes the slightest thing and if I'm not watching, I'm dead.* ***Nick, 35-40yrs***

Participants were asked if there were specific vehicle types or vehicle features they were more wary of than others. Most participants differentiated between the type of vehicle and the driver, citing the driver behaviour to be a greater concern than any specific vehicle type. There were two clear exceptions: utility vehicles (utes) and four wheel drive vehicles.

All participants were commuter cyclists and their trip time varied, travelling before, during and after the peak travel times. Participants who rode before/during the peak travel times in the ACT noted a difference in behaviour in drivers citing utes and the various vehicles driven by tradesmen (tradies) to be a source of concern. Tradies were considered to be particularly aggressive on the road, deliberately intimidating cyclists and this lead to an association between their vehicle type and concern from cyclists.

Four wheel drive vehicles were also noted by participants as a concern, primarily due to the perception that these vehicles have large blind spots and the internal pillars in the vehicle obscure the driver's view. Participants commented that even if the driver made a head check, some of them would not be able to see a cyclist as their view would be blocked by the A pillar. Participants also associated a style of driving with this vehicle that was less observant with comments that these

vehicles are frequently driven by women when driving their children to and from school and that non-occupant road users were not considered by these women drivers.

The geometry of larger vehicles was a concern for some participants. The high bonnet of a four wheel drive vehicle, the mass of trucks and buses were noted as a concern for some participants. Some participants deliberately avoided some routes, Northbourne Avenue was a commonly named route, to avoid having to share the vehicle lane with buses and trucks.

The results discussed in this section explore the study participants' experiences and safety concerns related to cycling in the ACT. In the following sections, the major findings are discussed within the Safe System approach including potential actions and recommendations to improve safety for cyclists in the ACT.

4. DISCUSSION

Canberra is like a cycling utopia. Heather, 30-35yrs

This study investigated the behaviour of cyclists and their interactions with other road users and the cycling environment in the ACT. Overall, the study participants had positive experiences cycling in the ACT. Many participants noted that they felt safer riding in the ACT than in any other Australian city. Despite these positive experiences, participants were clear that more action is needed to improve the safety of cyclists. Improved cyclists safety is particularly important given the increasing popularity of cycling in the ACT which has the highest rate of cycling per capita in Australia.[76] Findings from this study offer new insights into the safety concerns and the actions needed to improve safety for cyclists in the ACT. It is likely that findings will also be applicable to creating a safer cycling environment in other jurisdictions in Australia.

4.1. CYCLIST SAFETY CONCERNS AND POTENTIAL COUNTERMEASURES

The Safe System approach has been used to structure this Discussion, that is: safer road users, safer roads and roadsides, safer speeds and safer vehicles. Safer road users are discussed first as this was the main focus of the study and was the primary focus of much of the participants' concerns. However, the safety of all road users is broader than just the road users themselves.[78] The road network is an imperfect system and it is important to consider the broader implications of the other safe system principles, safer roads and roadsides, safer speeds and safer vehicles, and their impact on cyclist safety.

4.1.1. Safer road users

Every participant in this study was a driver.

It is important to recognise the multiple road user roles each participant has, as too often discussions about cycling classify people as either *cyclist* or *driver*. This categorisation oversimplifies people's experience in the road network and contributes to divisive 'us' and 'them' characterisations of road users. As the case for the majority of people who ride a bike, the study participants were all also drivers, pedestrians, at times public transport users and a few also rode a motorcycle.

This study focused on commuter cyclists' trips. As a result, the participants were all occupied in work or study, all had finished secondary school, many with university and higher degree and all earned an income, many above the ACT average household income.[76]

The participants were regular cyclists. On average they rode over 100km per week. Currently in Australia exposure data (e.g. trip frequency, duration, destination, route choice) is not generated so it is not possible to contextualise the participants' cycling in terms of national data. Work commuting was the main trip purpose for this group with a third also riding for fitness/training and 20 percent riding for recreation. Concerns about safe road users were the most frequently raised concern in relation to cyclist safety. The issues raised and potential recommendations, including those made by participants are discussed in the follow section.

Attitude and behaviour

In the main, participants reported positive attitudes and behaviours on the roads in the ACT. Participants with years of cycling experience in the ACT noted over the years drivers' behaviour towards cyclists has improved suggesting that this is likely to be due to an increase in cyclists on the roads. Certainly this observation is supported by Jacobsen's safety in numbers theory[36] that as the volume of cyclists' increase, drivers become more accustomed to sharing the road.

However, participants did note that there was some anti-cyclist sentiment on the road from some drivers. These subjective observations of unsafety were often referred to as a 'feeling' or a 'sense'. Some participants considered that the low volumes of traffic in the ACT may actually exacerbate tension between cyclists and drivers. They hypothesised that drivers' expectation of low traffic volumes and the ability to travel freely was interrupted when they encountered a cyclist and this may contribute to impatience from some drivers. The extensive off-road bike path network was also considered a potential factor in cyclist-driver tension. Participants commented that some drivers behaved as though cyclists should be 'off the road' on the bike paths.

Subjective safety concerns can be a major barrier to cycling,[79] particularly for people who are not regularly cycling or who live in an area that does not have extensive or connected cycling facilities. Communication campaigns that raise awareness that cyclists are legitimate road users and are permitted to travel on the roads can help to improve the relationship between road users.

In addition, participants also noted that some cyclists' own behaviour needed to improve. The need for cyclists to be responsible for their actions on the road, be complaint with the road rules and anticipate their surroundings were identified. One example of a recent campaign that targeted both driver and cyclist behaviours is *It's a two-way street* created by the Amy Gillett Foundation and funded by the New South Wales government (see Figure 26).

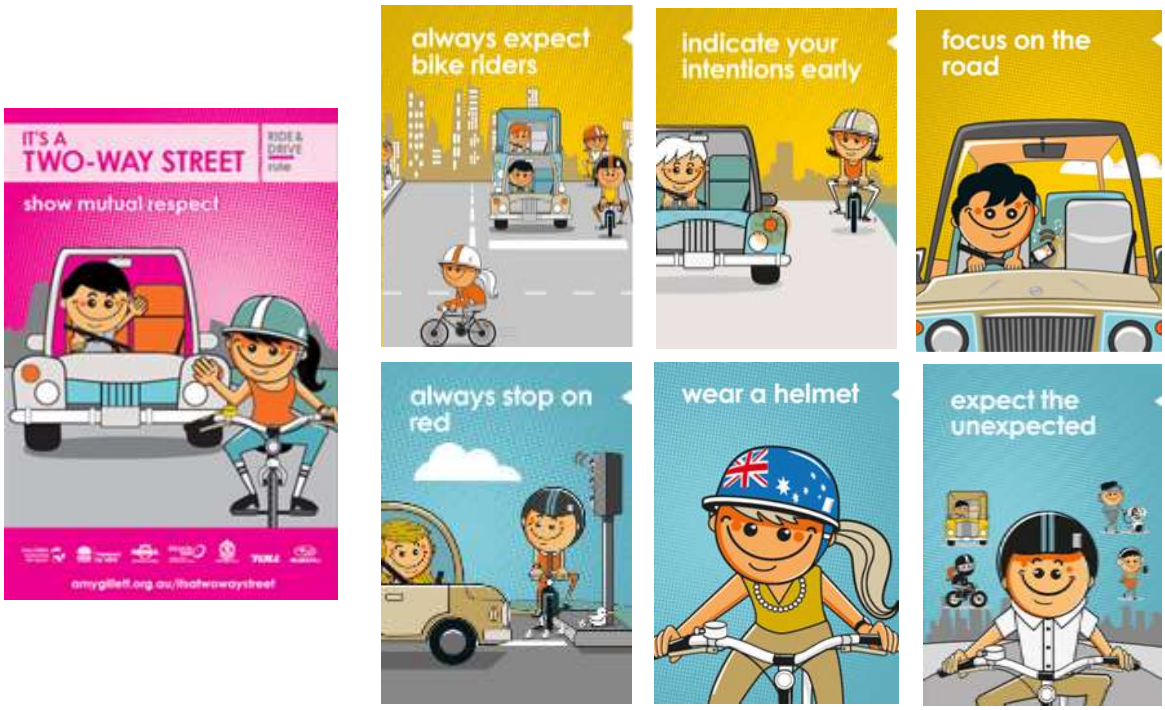

Figure 26 Selected images from *It's a two-way street* campaign (reproduced with permission)

Recommendation

To support an *It's a two-way street* communication campaign in the ACT to raise awareness about safe cycling and driving behaviours.

Driver behaviour

While the behaviour of both cyclists and drivers impacts road safety, it is the behaviour of drivers that has the greatest impact on cyclist safety.[35] Given the significance of driver behaviour, the specific issues have been addressed in more detail below.

In this study, the unsafe interaction was instigated by the behaviour of the driver in over 90 percent of events. While the road network is an imperfect system and can contribute to how people behave on the roads (discussed further in the following section), there are key driver behaviours that need to be directly addressed.

Failure to indicate

Drivers' failure to indicate prior to turning was a major cause of unsafe interactions in this study. Cyclists who were travelling in a parallel to the moving vehicular traffic could suddenly find the car that was in front or alongside them turning across their path. Drivers were often observed not indicating at all prior to turning.

Gap selection

The actions of drivers who turn in front of cyclists is clearly visible from the video footage. Frequently, drivers will wait to turn, often stopping on the bike lane while they wait, only to drive off as the cyclist approaches. It is clear from the video footage that the driver has waited for a gap in the vehicular traffic and proceeded with little or no regard for the cyclist. Despite the well painted, often green, bike lane, the driver does not appear to 'see' the cyclist. It may be that the driver looked-but-failed-to-see the cyclist[58] or that they underestimated the cyclists' speed on approach. Once again, it is likely that there is a role for education to ensure that drivers wait for a clear gap in the cyclist traffic as well as the vehicular traffic.

Inadequate overtaking distance

Drivers overtaking cyclists too closely was clearly evident in the video footage. When passed too closely cyclists would often swerve left, brake or shake their head. While this behaviour did not result in a crash, this driver behaviour was noted by cyclists as making them feel less safe when sharing the road.

An awareness campaign by the Amy Gillett Foundation, a metre matters, focuses on the need for a minimum of one metre lateral clearance between a vehicle and cyclist when a driver is overtaking (see Figure 27). Currently in Australia there is no legislation that states the minimum lateral clearance distance drivers need to provide to cyclists when overtaking. Recommendations in each state vary from 1m to 1.5m in higher speed areas.

Figure 27 *a metre matters* logo (reproduced with permission)

Recommendation

To support action to amend legislation to specify the minimum passing distance a driver must allow when overtaking a cyclist.

Aggressive drivers and passengers

Of specific concern to many participants was the deliberate aggression from some drivers as distinct from other actions which may be attributed to inattention or distraction. Participants noted that drivers and sometimes passengers yelled verbal abuse as they passed, deliberately passing too closely or tooting their horn on approaching a cyclist.

One participant recounted an incident involving his partner who was cycling. She was stopped at the intersection of Canberra Avenue and State Circuit. As the lights changed to green, the passenger

leaned out the window and poured liquid on her back as they drove off. She reported the incident to the police who advised her that they could not charge the passenger with assault with a soft drink. The police officer told her that he would call the owner of the vehicle and 'have a chat with him'.

Figure 28 Cyclist post-bullying

This police response was consistent with accounts from other participants who stated that there was no recourse following an on-road bullying event. Advice participants had received from police was that as there had been no actual incident the police could not take any action.

Bullying and intimidation of cyclists on the road is not limited to cyclist to driver interactions, participants observed that driver to driver aggression. Action to reduce bullying on the roads is needed and lessons that have been learned from successful anti-bullying campaigns, particularly in schools and the workplace, may be adapted for the roads.

Driver behaviour – buses

Participants had mixed experiences when sharing the roads with buses. As discussed for other drivers, some bus drivers were courteous and safe when sharing the roads with cyclists while others were deliberately aggressive and impatient. Buses are discussed in more detail in the Safer vehicles section below.

Driver attitudes

While in the main participants considered ACT drivers to have a positive, or at least indifferent, attitude towards cyclists, there was a small minority who were perceived to have negative and hostile attitudes. Participants often compared their experience in Australia with cycling in Europe and the significantly better attitude held there towards cyclists.

Recommendation

> To support behaviour change experts to develop an effective campaign to target aggressive driving behaviour and reduce on-road bullying.

In addition, almost half the participants had been ever involved in a collision with a car while cycling. This event occurred prior to this study. Just over a third of crashes were reported to police. The main reason for non-reporting was that there was no injury or major property damage.

However, police reports are one of the major sources of data about cyclist crashes and changes in reported crashes are often used to monitor cyclists' safety and evaluate the effectiveness of cyclist safety actions. The usefulness of police reported crashes is undermined by road users own underreporting of incidences. It is timely to consider an alternative crash surveillance mechanism to allow all road users to report unsafe events to ensure our understanding of road safety and changes over time accurately reflect the actual events.

An alternative crash surveillance system is particularly important when near-collisions are considered. The participants in this study had experienced in excess of 220 near-collisions yet none had been reported to police as it was considered futile to report such events as a crash had not occurred. Yet perceptions of the safety of cycling are directly impacted by these types of non-collision events. Subjective safety concerns are a major barrier to cycling for many people.[79]

Recommendation

To support the establishment of a crash surveillance system that allows the community to register crash events that are not reported to the police or a hospital to establish a more comprehensive understanding of cyclist safety and changes over time.

Media

Previous research on the media's coverage of cycling in Australia has identified that there is often a 'victim' or 'villain' depiction of cyclists.[80] With the 24 hour news cycle, growing number of online media outlets and social media platforms there is an increasing space for people to voice their opinions about any subject, including cycling. Study participants commented that they were directly impacted by a television segment that encouraged violence against cyclists and the altercation between cricketer Shane Warne and a cyclist in Melbourne. They correlated the two media events with increased harassment from drivers on the road. Some cyclists considered the public attack on cyclists gave drivers permissions to be more aggressive.

A broad review of the role of the media in the public perception of cyclists and the relationship between cyclists and drivers on the road was outside the scope of this study. However, we recommend that this type of research be conducted to inform actions to ensure that public discussions about any specific road user group do not lead to increased risk.

Recommendation

To support research into the role the media and online forums play in the public discussion and perception of road users. In addition, to examine the correlation between public discussion and risk to road user safety and how any such risk may be ameliorated.

Enforcement

Cyclists were cynical of the constant attention of police blitzes on the behaviour of cyclists to the neglect of the behaviour of drivers, when it was clear to them that drivers have the potential to cause much greater harm and are often responsible for cyclist-driver crashes.

While the Safe System approach acknowledges the need for all road users to be safe and compliant, this was not evident to the participants. Greater attention on the driver behaviour that created danger for cyclists including opening car doors in cyclist's path, abuse or aggressive behaviour from drivers or passing too closely, blocking/parking in bike lanes were all behaviours that participants believed were not being adequately monitored or enforced by police. The concern with the lack of police attention on driver behaviours was that this reinforced that cyclists were responsible for their own safety and drivers did not have a role to play.

Recommendation

To support targeted police blitzes on key driver behaviours that impact cyclist safety including publicity about the blitz and that the aim is to improve safety for cyclists by targeting driver behaviour.

Confusion

Behaviour and infrastructure, or the road design, are inextricably linked. Road design and the available space is often a major contributing factor in cyclist-vehicle collisions. Arguably the key safety concern for cyclists was confusion when interacting with other road users, specifically, in relation to who needs to give way. Inconsistent behaviour, often contributed to by road design that

varied or was not intuitive was evident in the recorded video footage and raised in the exit interviews.

Across the ACT, cycling facilities vary considerably with a mix of retrofitting and new sections of road. At some places, cyclists have a clear, designated space that travels in parallel to the vehicular lanes while at other locations the bike lane ends abruptly and at the end of the bike lane, cyclists do not have a safe option to continue their trip or there is confusion at the point where the off-road path intersects with the road.

Most of the cyclists rode the same route each day and there were frequent points, particularly in relation to exiting and entering roads where there was obvious confusion. One often raised example was the exit and entry ramps on and off major routes such as Adelaide Avenue and Hopetoun Avenue exit and entry ramps to and from Deakin. On one day, the participant may be able to easily cross the exit point as the drivers all give way to the cyclist travelling straight, other days, drivers turn in front of the cyclists as though their understanding is the cyclist needs to give way. In the exit interviews, cyclists believed that when they were travelling straight across and vehicles were exiting and entering, that they had right of way across the exit ramp, which is drivers needed to give way, and that cyclists needed to give way to drivers entering. Participants noted that this is clear to them from the solid green bike lane painted across the exit ramp and the grab bar positioned at the cross point of the entry lane. However, from the video it was clear that many drivers do not have the same interpretation of the space. Confusion sometimes resulted in both the cyclist and the driver slowing down and one road user waving the other through.

The result of this inconsistency is a lack of predictability for cyclists that the participants identified was uncomfortable and was repeatedly raised in terms of their safety concerns. Participants said that they rode defensively and assumed that the driver had not seen them or would not give way.

This type of confusion was not limited to new infrastructure. Similar confusion and inconsistency was observed amongst cyclists and drivers at other locations, in particular roundabouts.

Roundabouts are common in the road network across the ACT. Drivers were observed to enter the intersection when other vehicle was already travelling around the roundabout and gap selection appeared to be determined by speed: speed of the vehicle in the roundabout and speed of the entering vehicle. This behaviour was also evident between cyclists and drivers.

When a cyclist was already in the intersection, drivers would frequently enter the intersection to the cyclist's left – from this approach, the driver should give way to the road user already on the roundabout. Typically this behaviour was uneventful, with the driver entering the roundabout ahead of the cyclist and exiting or travelled through the intersection ahead of the cyclist. However, there were a small number of occasions when the cyclist needed to slow down to avoid colliding with the entering driver. It is likely that drivers, potentially non-cycling drivers, underestimated the speed of the cyclist travelling through the roundabout.

Extremes of driver behaviour were observed. Some drivers failed to give way to cyclists at either exit or entry points, or to cyclists who were already travelling through roundabouts, forcing the cyclist to stop in the middle of the roundabout and give way to drivers entering from their left. At the opposite extreme, some drivers gave way to cyclists at locations where the driver clearly had right of way, causing traffic to slow and confusion to the cyclist who typically had slowed or stopped expecting the driver to continue.

Recommendations

To support greater consistency of cycling infrastructure and line markings, particularly at intersections across the ACT.

To support education and awareness campaigns that provide clear instructions to all road users about sharing the road.

Selected video footage clips generated as part of this study could be used in education and awareness campaigns to provide 'real world' examples of the types of behaviours being experienced on ACT roads.

4.1.2. Safer roads and roadsides

All participants in the study rode on the road for some portion of their trips. Some participants also rode on footpaths, shared paths, off-road paths and tracks.

Bike lanes

There are extensive on-road cycling facilities in the ACT from a single white line denoting the bicycle lane to green treated lanes clearly allocating the space on the road to bike riders. On-road bike lanes do contribute to a feeling of safety and predictability and both cyclists and drivers have reported feeling more comfortable sharing a road with cycling-related line markings compared to roads without the line markings.[81, 82] Current ACT cycling policies indicate that there are plans to continue to install and retrofit cycling facilities to ACT roads.[25, 26] This is welcomed by cyclists in this study, with a focus on the need to create meaningful routes that are safely connected along the entire route.

The majority of events in the ACT study occurred at locations that did not have a bike lane (75.8%). This is likely to be related to the high proportion of events that occurred at or near intersections, as typically there is no cycling infrastructure on approach to an intersection.

The most recent Austroads guide[83] for cycling includes updated guidelines for on-road cycling infrastructure. Included in the guide are extensive instructions on how cycling infrastructure, typically a bike lane can be continued from the midblock, transition and intersection approach to the waiting area at the intersection stop line and continued after the intersection on departure. Despite these guidelines having been published since 2010, these continuous bike lanes are infrequently installed with bike lanes typically discontinuing at the end of the midblock/transition section of road.

However, international best practice continues cycling infrastructure to the intersection and in some locations through the intersection. A recent publication from the City of Copenhagen, includes innovative intersection designs that includes continuous bike lanes through signalised intersections (see Figure 29).[84]

Figure 29 Intersection in Copenhagen with continuous cycling infrastructure through the intersection

Recommendation

To support the implementation of continued and increased bike lanes with greater connectivity along cycling routes. In particular, improved connectivity, especially at points where the road narrows and the bike lane discontinues, a safe connected option is needed at these points.

At some locations in the ACT, road users are permitted to turn left during the red light phase. There are some locations that were observed in this study where cyclists have unofficially adopted this practice. Typically, this relates to locations where there is no intersection between cyclists and the traffic moving on the green traffic phase, for example when the cyclists are travelling across the 'top' of a T intersection.

However, other locations were identified in the study as being unable to be activated by cyclists. Cyclists believed at these intersections, they were not able to trigger the light phase from red to green and that their choices were to wait until a vehicle arrived to activate the sensor, or to proceed through the intersection against the red. Previous research of Australian cyclists reported that almost a third of cyclists infringe at red lights because they are not able to activate the sensor.[85] There may be a need to review the sensitivity of some light sensors at the identified locations to ensure the roads are cyclist inclusive and to reduce the number of cyclists who infringe at these locations.

At several locations on their commuter route participants infringed at signalised intersections or observed other cyclists' infringement. This behaviour typically occurred across the 'top' of a T intersection or at locations where the participant cyclist explained that they were unable to activate the change in the signal phase. One option may be the trial allowing cyclist to continue through all intersections during the red signal phase to turn left or across the top of a T intersection.

Further, the Austroads guidelines include details for cyclist bypass infrastructure at T intersections. To safely prioritise cyclist travel, more existing Australian guidelines need to be implemented (see Figure 30).

Recommendations

To support a review of intersections where cyclists report they are not recognised by the infrastructure that triggers a signal change.

To support a trial to permit cyclists to turn left at all signalised intersections and across the 'top' of T intersections.

To support increased implementation of Austroads guidelines to prioritise safe cyclist travel.

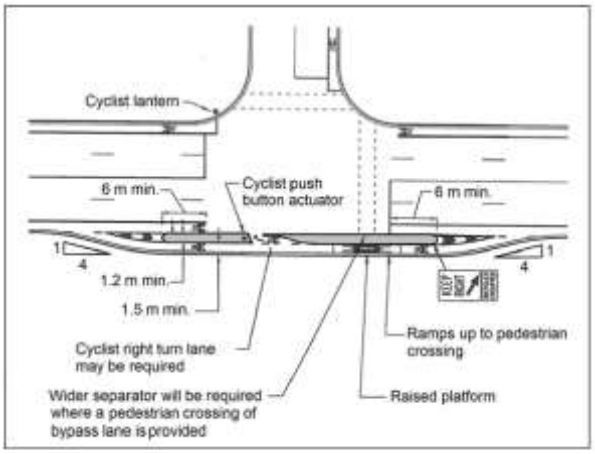

Figure 30 Austroads guide for cyclist T intersection bypass

Road surface

Some cyclists reported that the quality of the bitumen in some on-road bicycle lanes differed from the adjacent vehicles, specifically that a rougher, potentially cheaper surface was used in the bike lanes. The inferior surfacing in the bike lane resulted in a less comfortable trip that caused additional jarring on descent as the front wheel bounced over the rough surface and increased resistance on ascent as bike tyres did not roll smoothly over the lower grade surface.

Recommendation

> To support the (re)surfacing of all roadways with the same quality road surface material that is used in vehicular lane in the bicycle lane.

Glass on the road was identified as a safety concern. Participants were specific, that the majority of glass was brown glass, typically used to make beer bottles. This type of glass was specified as distinct from vehicle glass such as indicator light casings that would be expected following a vehicle crash. The need to reduce the anti-social behaviour related to vehicle occupants throwing glass from vehicles was identified as the main issue.

The most obvious outcome from glass on the road was punctured tyres. Pieces of glass either immediately punctured the tyre or lodged in the rubber and eventually worked through the tyre to puncture the tube. The safety concerns were that a suddenly punctured tyre may be destabilising, or at worst cause a fall if travelling at speed and some female participants expressed personal safety concerns if they punctured a tyre and still had considerable distance to travel to their destination. In addition to punctures, participants were concerned that swerving to avoid broken glass on the road lead to potential collisions or risk of collision with other road users.

Participants commented that they were more likely to see the glass earlier in the week, based on the assumption that this behaviour was common over the weekend. Recommendations were curative such as regular cleaning/sweeping the streets. However this was identified as costly given the extensive road network and likelihood that this type of behaviour was also along highways which were unlikely to, or rarely, cleaned. Prevention measures were also suggested, in this case focusing on a reduction in the anti-social behaviour of throwing bottles from moving vehicles. However, again, participants identified that this was a broader societal concern and required widespread government and community engagement to address.

Recommendation

> To support the introduction of a glass return scheme, as in South Australia, that provided people with a small payment per glass bottle returned to a central depot. It was suggested that this would result in fewer broken glass bottles on the road and bike paths.

Cycling by key stakeholders

One participant suggested that key stakeholders including road designers, magistrates, police and law makers should regularly ride bicycles. This would give them a better understanding of how poor road design can contribute to cyclist and driver conflict and gain a better sense of the experiences of cyclists on the road, including harassment from drivers. This suggestion lends itself to the safety in numbers theory. One tenet of the theory is that as more people cycle their understanding of the experience of cycling will make them more aware when they are drivers themselves[36]. Participants suggested that experiential understanding of cycling was necessary for key decision makers to be able to effectively implement changes that improved safety.

Recommendation

> To support programs that encourage key stakeholders, particularly road designers, to regularly cycle in the ACT to better understand the challenges and gaps for cyclists.

4.1.3. Safer speed

The role of speed in on-road crashes is well established. Excessive speed and speed that is inappropriate for the conditions are known to contribute to road trauma. Continued campaigns to ensure driver compliance of the posted speed limit is an essential factor in the ongoing safety of all

road users. It was outside the scope of this study to conduct a review of the posted speed limits in the ACT. However, it may be that there is a need for reductions in posted speed zones, particularly in areas of high cyclist and pedestrian activity.

Recommendation

> To support a review of posted speed zones in the ACT with consideration to reducing the speed in areas of high cyclist and pedestrian activity.

While much is known about the importance of vehicle speeds in road safety, less research attention has been given to the speed of cyclists and the role of cyclists' speed on safety.

Cyclists' speed

The travel speed of a cyclist can have serious impacts on how cyclists and drivers interact the road. If cyclists are travelling faster than drivers anticipate then drivers are more likely to underestimate the safe distance needed to allow before turning in front of a cyclist or opening a vehicle door. Findings from the participant cyclists' GPS data showed that their travel speeds are typically over 20km/h and can reach speeds that exceed 50km/h. It is likely that cyclists' travel speed is a contributing factor in many of the near-collision events, particularly those that involve the driver turning left in front of the cyclist as the driver underestimates the cyclists' travel speed.

Further, the cyclists' evasive responses, hard braking and swerving, indicates that all the participant cyclists were travelling within their bike handling skills. Skills training is important for cyclists to ensure they ride within their skill level and understand the braking distances required at various speeds. It is possible that some crashes are due to cyclists riding outside their skill level or not being aware of the braking distance required to stop safely.

Further, very little is known about the travel speeds of cyclists on off-road bike paths, shared cyclist-pedestrian paths and footpaths. It was not possible in the scope of this study to differentiate the cyclists' travel speed on the road compared to other off-road and shared locations. This type of analysis would yield more specific details on the cyclists' speed profile and the appropriateness of travel speeds in different locations. However, this additional analysis was outside the scope of the current study.

Recommendations

> To support education for drivers to promote a more accurate understanding of cyclists' speed and the distance required to turn in front of a cyclist safely.
>
> To support further analysis of cyclist speed data to profile the impact of cyclist travel speed on interactions with other road users in on- and off-road locations.

4.1.4. Safer vehicles

Specific vehicles of concern

Buses

Sharing the road with buses was a considerable safety concern for many participants. Specific interactions described included riding into a roundabout and having the bus enter the roundabout behind the ride, overtake through the roundabout and 'push' the cyclist into the gutter/off the road as the bus forced themselves through the roundabout. Other participants commented on the buses passing too closely and at speed.

Participants acknowledged that bus drivers have time imperatives and need to meet scheduling requirements. However, some participants considered that the drivers deliberately passed too close to cyclists or passed at too high a speed in an attempt to intimidate the cyclist. One participant was repeatedly 'pushed' off the road along the same section of road on repeated days and was convinced that the bus was being driven by the same driver and the aggressive actions were deliberate.

Some participants had made complaints to the bus company, Action, being the primary bus service provider. Participants suggested that the bus drivers need to have cyclist-specific training about how much lateral clearance is needed when overtaking a cyclist. Some suggested that the bus drivers should be made to ride along Northbourne Avenue on a bicycle as part of their bus driver training to ensure they understand the experience of being passed on a bike and develop greater empathy for cyclists.

Recommendations

To support increased education for bus drivers that focuses on: safe interactions with cyclists, safe overtaking, actual time 'delays' caused by waiting for cyclists, minimising leapfrogging. International examples of driver training, for example truck driver awareness in the UK could be adapted for Australian bus drivers[2].

To support education/awareness campaigns targeting safe cycling behaviour when interacting with buses that includes: minimising leapfrogging, reminder of the law about giving way to buses.

Utes

When asked 'is there a specific type of vehicle that you're more wary of when on the road' the most common response was utes driven by tradespeople ('tradies'). Typically driven by young men who often had a passenger, participants frequently commented on how these tradies in utes drove too close when overtaking and often verbally harassed the cyclist. Interactions were more likely to occur on the morning commute and drivers of utes seemed more likely to squeeze through gaps in traffic and squeeze out cyclists, particularly on approach to an intersection.

Four wheel drive vehicles

Four-wheel drive vehicles were the next most common vehicle type that cyclists were cautious of when sharing the road. The main concern with this vehicle type was the perception that drivers did not have a clear field of vision with the large A pillars in the vehicle which participants' believed blocked their vision when head checking to the left.

Recommendation

To support targeted education campaigns to drivers that are considered to be of concern to drivers may improve driver behaviour and reduce the level of tension between cyclists and drivers.

Advancements in non-occupant detection technology promise benefits for cyclist safety. Current technology already detects the presence of a vehicle in a driver's blind spot and alerts them before changing lanes. The extension of this technology to cyclists, and pedestrians, would further increase non-occupant safety and help to ameliorate the existing issue of drivers' failure to look/see.

[2] http://www.tfl.gov.uk/roadusers/cycling/14799.aspx

Safer bicycles

Bicycle mechanical failure has been reported as a contributing factor in some serious injury cyclist crashes[62]. However, bicycle mechanical failure was not reported to be a contributing factor in any of the events identified in this study. Nonetheless it is important that cyclists maintain a roadworthy bicycle which includes a working brake and use of bike lights at time of low light and at night.

4.1.5. Comparisons between the ACT and Melbourne naturalistic cycling studies

There were some significant differences in the experiences of cyclists in the ACT compared to Melbourne when comparing unsafe cyclist-driver interaction variables. The events in Melbourne were of a more severe nature with two collisions observed, whereas no collisions or crashes were observed in the ACT study. In addition, the rate of events observed was considerably higher in Melbourne (4.1 per participant) compared to the ACT (2.5 per participant).

Adult cyclists being permitted to ride on the footpath is a distinct point of difference between the ACT and Melbourne (Victoria). While all children up to the age of 12 years and any accompanying adults are permitted to ride on the footpath in Australia, adult cyclists may only legally ride on the footpath in select jurisdictions including the ACT, Northern Territory, Tasmania and Queensland.

Most participants rode some of their trip on the footpath, yet there were only three incidents in this study that involved pedestrians and none of those involved a footpath (shared paths or on the road). From this data, adult cyclists riding on the footpath do not create a safety risk for other road users, in particular pedestrians. Similarly, there were no issues that involved a cyclist exiting the footpath onto the roadway. Cyclists were careful to slow their speeds on approach to an intersection and made active head checks.

One clear advantage gained for cyclist safety by riding on the footpath was when the cyclist needed to travel a short distance to the right, particularly when the road contained several lanes of vehicular traffic. Cyclists frequently entered onto the footpath and rode a short distance to the right to reach the beginning of their route along a major road or shared path. By being allowed to travel on the footpath, cyclists were able to avoid crossing over major roads. From this data, it may be feasible that cyclists travelling on the footpath is a viable option for cyclists to improve their safety and in particular avoid excessively crossing vehicular lanes. This may be particularly effective at squeeze points on the road or where there is little or no pedestrian traffic and travelling on the footpath offers a safer option for cyclists than travelling on the road.

Anecdotally, the vehicular traffic varied between the ACT and Melbourne in the two studies. While it was outside the scope of this study to analyse the volume of traffic the riders shared the road with, the researchers who analysed the data (M Johnson, J Carroll) noted that there was less traffic in the ACT than in Melbourne. Further, at the pinch points on the road, participants in the ACT regularly moved to the footpath for a section then returned to the road. These two factors, less traffic and permission to ride on the footpath may also contribute to the lower severity of cyclist-driver events.

Many of the same concerns were raised in both studies. Driver behaviour was a major contributing factor to events in both studies and greater attention to driver education and continued training is essential.

Recommendations

To support a trial of adult cyclists' use of footpaths in all states where it is currently not permitted.

To support the addition of mandatory driving skills related to interacting with cyclists and cycling infrastructure and knowledge of cyclist-related road rules in driver licence training and testing.

4.2. STRENGTHS AND LIMITATIONS

The strength of this study was in the methods that provided extensive insights into the experiences of cyclists in the Australian Capital Territory and create new data on the travel speeds of cyclists. As near-collisions and incidents are rarely officially reported, the data generated in this study is not been available via any other data source. Due to the positioning of the video camera, this study has provided important insights into the interactions between cyclists and drivers on the road.

Advances in the camera technology meant that many of the limitations caused by low light sensitivity and smaller memory cards[35] were addressed in this study. Further, the addition of the GPS data logger provided new route and speed data that had not previously been generated for Australian cyclists.

The strengths of the study methods are also the main limitation, the extensive amount of video footage and GPS data meant that analysis was time consuming. Many data analyses that are possible with the data generated could not be conducted within the scope of this study.

5. CONCLUSION

The Australian Capital Territory is one of Australia's premier cycling locations. With extensive on-road bike lanes and off-road paths, the facilities across the territory have undoubtedly contributed to the one of the highest cycling participation rates in the Australia.

Improvements can still be made to increase cyclist safety. Greater connectivity of bike lanes, driver education and efforts to reduce cyclist-driver confusion are all important steps that are needed. A key finding from this study is the travel speed of cyclists and how this directly impacts how cyclists and drivers safely interact on the road. The findings from this study provide the ACT with a unique profile of their commuter cyclists and could contribute to the further enhancement of a safer cycling environment in the ACT.

6. ACKNOWLEDGEMENTS

The authors acknowledge the financial support of the NRMA-ACT Road Safety Trust in funding this project. We acknowledge the support of ABC Radio 666 Canberra and Pedal Power for their support with recruitment of participants in this study. We also thank the study participants for their time and commitment to the study.

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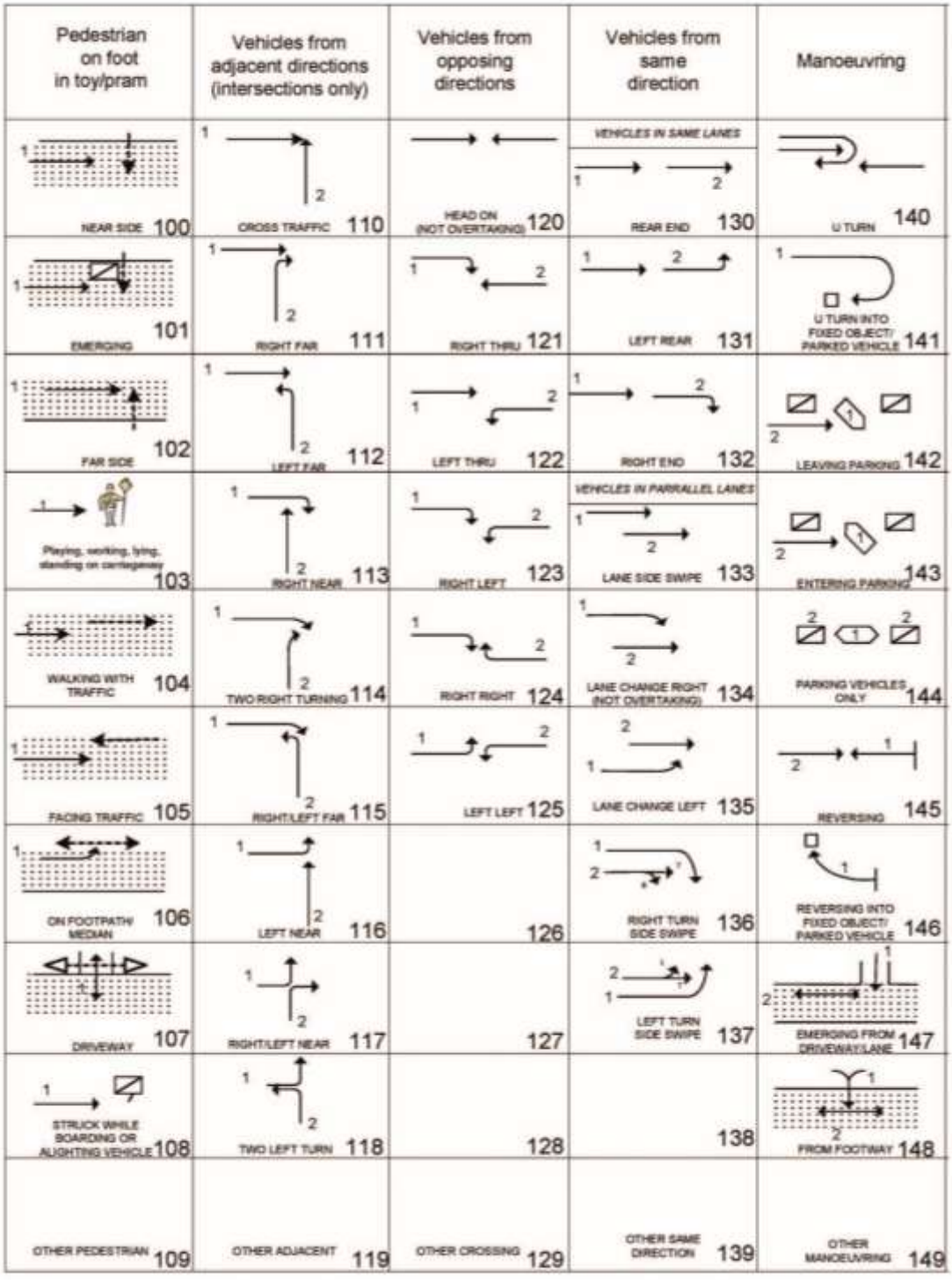
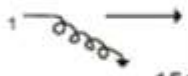
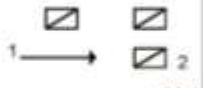
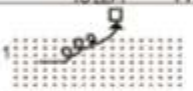
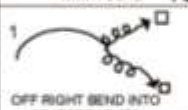
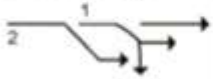
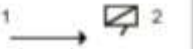
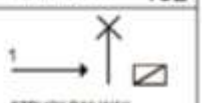
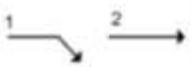
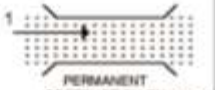
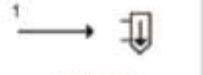
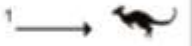
Appendix A – Definitions for Classifying Accidents (DCA)



Overtaking	On path	Off path on straight	Off path on curve	Passenger and miscellaneous
 HEAD ON (INCL SIDE SWIPE) 150	 PARKED 160	 OFF CARRIAGEWAY TO LEFT 170	 OFF CARRIAGWAY RIGHT BEND 180	FELL IN/FROM VEHICLE 190
 OUT OF CONTROL 151	 DOUBLE PARKED 161	 LEFT OFF CARRIAGEWAY INTO OBJECT/PARKED VEHICLE 171	 OFF RIGHT BEND INTO OBJECT/PARKED VEHICLE 181	 LOAD OR MISSILE STRUCK VEHICLE 191
 PULLING OUT 152	 ACCIDENT OR BROKEN DOWN 162	 OFF CARRIAGEWAY TO RIGHT 172	 OFF CARRIAGWAY LEFT BEND 182	 STRUCK TRAIN 192
 CUTTING IN 153	 VEHICLE DOOR 163	 RIGHT OFF CARRIAGEWAY INTO OBJECT/PARKED VEHICLE 173	 OFF LEFT BEND INTO OBJECT/PARKED VEHICLE 183	 STRUCK RAILWAY CROSSING FURNITURE 193
 PULLING OUT - REAR END 154	 PERMANENT OBSTRUCTION ON CARRIAGEWAY 164	 OUT OF CONTROL ON CARRIAGEWAY 174	 OUT OF CONTROL ON CARRIAGEWAY 184	PARKED CAR RUN AWAY 194
	 TEMPORARY ROADWORKS 165	 OFF END OF ROAD/ T INTERSECTION 175		
	 STRUCK OBJECT ON CARRIAGEWAY 166			
	 ANIMAL (NOT RIDDEN) 167			
				OTHER 198
OTHER OVERTAKING 159	OTHER ON PATH 169	OTHER STRAIGHT 179	OTHER CURVE 189	? UNKNOWN 199

ACT naturalistic cycling study survey

ACT naturalistic cycling study

Thank you for participating in the ACT naturalistic cycling study. The final part of this study is an online survey. This survey should only take 5-10 minutes to complete and provides details on your previous driving and cycling experience and demographic details. All information will be kept confidential according to the Monash University privacy regulations.

Matching data

Your survey questions will be matched with your video footage and GPS data to allow analysis of your trips to and from work. It is important to match your data to allow analysis by your demographic details (e.g. age, gender) as well as your previous driving and cycling experiences.

Please note that you WILL NOT BE IDENTIFIED in any report, publication or presentation. These data are for matching purposes only.

If you have any concerns, please do not hesitate to contact me.

thanks
Marilyn

***1. Please enter your initials**

***2. What is your home postcode?**

Section A: Driving Information

3. Do you have a current full driving licence?

- ◯ Yes
- ◯ No

4. If you do not have a current full driving licence, why not?

5. How many years since you got your full licence?

Years

6. On average, how many kilometres do you drive per week?

- ◯ Less than 100 km
- ◯ 101- 200 km
- ◯ 201- 500 km
- ◯ Over 501 km

7. Would you say that most of your trips in the car are:

- ◯ Less than 3 km
- ◯ 3 - 5km
- ◯ 5 - 10km
- ◯ Over 10 km

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ACT naturalistic cycling study survey

8. Who does most of the driving in your household?

- ◯ Yourself
- ◯ Your partner
- ◯ Other (please specify)

9. In the last two years, have you been involved in a motor vehicle crash (as a driver)?

- ◯ Yes
- ◯ No (go to Q8)

10. If yes, did the crash result in (tick all responses that apply)

- ☐ No injuries in your vehicle
- ☐ Minor injuries (ie not hospitalised) to you or someone else in the vehicle
- ☐ Serious injuries (ie hospitalised) to you or someone else in the vehicle
- ☐ Other (please specify)

11. In the last 2 years when driving have you incurred any of the following traffic infringements:

	No	Once	Twice	3 or more times
Speeding, less than 10km over the limit	◯	◯	◯	◯
Speeding, more than 10km over the limit	◯	◯	◯	◯
Not wearing a seat belt	◯	◯	◯	◯
Drink driving	◯	◯	◯	◯
Mobile phone related infringement	◯	◯	◯	◯
Other	◯	◯	◯	◯

12. What are the three things you enjoy most about riding on the road?

1.
2.
3.

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ACT naturalistic cycling study survey

13. What are the three things that stop you from riding on the road more often?

1.
2.
3.

14. Do you currently belong to a cycling club or organisation?

◯ Yes ◯ No

15. If yes, name of club or organisation

16. Have you taken a bicycle training course?

◯ Yes
◯ No

17. If yes,

Name of course
When was it taken

18. What riding specific items to you wear/use when you ride your bike?

	Always	Sometimes	Never
Fluorescent/reflective jacket	◯	◯	◯
Light coloured clothing	◯	◯	◯
Lights	◯	◯	◯
Other	◯	◯	◯

If other please specify

19. Please answer the following statements:

	Always	Sometimes	Never
Do you indicate (hand signal) prior to turning right?	◯	◯	◯
Do you indicate (hand signal) prior to turning left?	◯	◯	◯
Do you obey the road rules?	◯	◯	◯
Do you obey all road signs?	◯	◯	◯

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ACT naturalistic cycling study survey

20. If never, when do you not obey the road rules/signs and why?

21. Do you stop at red lights?

◯ Always ◯ Sometimes ◯ Never

22. If never, when do you run a red light as a cyclist and why?

23. How did you learn about the bicycle facilities on the road and what the line markings mean?

24. Are there any road types or locations that you avoid?

◯ Yes

◯ No (go to 29)

25. If yes, please briefly describe

26. What could be done to improve this location?

27. Have you been involved in a collision with a vehicle while riding on the road?

◯ Yes

◯ No (go to Q30)

28. If yes, what is the total number of collisions?

29. How many of the collisions were officially reported (to police, ambulance, hospital)?

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ACT naturalistic cycling study survey

30. What was the reason for not reporting the collisions?

31. Have you been involved in a near-collision with a vehicle while riding on the road?

- ◯ Yes
- ◯ No (go to Q31)

32. If yes, what is the total number of near-collisions?

33. How many of the near-collisions were officially reported?

Section B: Cycling information

34. How many years have you been riding a bicycle?

Years

35. How often do you ride your bicycle?

36. How far is your commute to work? (each way)

Km

Time

37. How many kilometres per week do you ride?

Km

38. Do you mainly ride in urban or rural areas?

- ◯ Urban
- ◯ Rural
- ◯ Other (please specify)

39. When you ride, what percentage of your time is spent riding on the road (rather than off-road bike paths)?

% on road

% off road

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ACT naturalistic cycling study survey

40. What percentage of your riding is doing the following activities:

% Work commuting

% Recreational

% Fitness/training

% Other

If other please specify

Section C: Demographics

***41. What is your age?**

42. What is your gender?

- Male
- Female

43. Do you smoke?

- Yes
- No
- Occasionally/ socially

44. What is your current marital status?

- Married/relationship
- Widowed
- Divorced/separated
- Single/never married
- Other (please specify)

45. What is your household income before tax?

- Less than $20,000
- $41,000 - $75,000
- $101,000 - $150,000
- $20,000 - $40,000
- $76,000 - $100,000
- Over $151,000

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