Promoting Safe Vehicles to Vulnerable Drivers

RR 18-06

CURTIN-MONASH ACCIDENT RESEARCH CENTRE

Faculty of Health Sciences

Curtin University

Kent Street

Bentley WA 6102

Peter Palamara

June 2018; revised July 2018

CURTIN-MONASH ACCIDENT RESEARCH CENTRE
DOCUMENT RETRIEVAL INFORMATION

Report No.	Project No.	Date	Pages	ISBN
RR 18-06	06	June 2018	139+	N/A

Title
Promoting Safe Vehicles to Vulnerable Drivers

Author(s)
Palamara, P.

Performing Organisation
Curtin-Monash Accident Research Centre (C-MARC)
Faculty of Health Sciences
Curtin University
Kent Street
BENTLEY WA 6102
Tel: (08) 9266-2304 Fax: (08) 9266-2508
www.c-marc.curtin.edu.au

Sponsor
Road Safety Commission
Level 1, 161 Royal Street
East Perth WA 6004

Abstract
The aim of this project was to investigate opportunities for the promotion of Safe Vehicles to the vulnerable driver groups of 17-25 years olds and drivers residing in Rural/Remote Western Australia (WA). The Safe-Vehicle related knowledge, attitudes and behaviour and type of vehicle driven by these drivers was sampled using an on-line survey which was completed by 619 drivers. Drivers were mostly responsible for the purchase of their own car. Based on the combined Australian New Car Assessment Program and Used Car Safety Ratings, 63% of the cars 17-25 year old Metropolitan drive were rated 1-3 Stars compared with 61% for same aged Rural/Remote drivers. In contrast,70.5% of vehicles driven by 26+ year old Rural/Remote drivers were rated 4-5 Stars. 1-3 Star rated cars were most commonly observed in the cars bought by younger age drivers or handed down to them. Analysis of the drivers' attitudes indicated that financial issues and not safety have the highest priority in the selection of a vehicle. Drivers consequently endorsed initiatives to provide financial incentives to purchase Safe Vehicles. Drivers were also somewhat wary and cautious of the injury reduction claims associated with the use of Safe Vehicles and were not in favour of technologies that took control away from them as the driver. Drivers were reasonably aware of ANCAP resources (50%) but less aware of UCSR (37%). A reasonably high proportion of drivers stated they would use a Safe Vehicle resource when considering the purchase of a car in the future. Most drivers preferred to access Safe Vehicle information at the 'point of sale' rather than through tradition media such as television, newspapers, and radio. A number of attitudinal factors predicted the intention of younger-age drivers and Rural/Remote drivers to replace their car with one that has more safety. Vehicle age was a predictor in the model for younger-age drivers but not Rural/Remote area drivers. A Framework to Promote the use of Safe Vehicles was developed. Three Domains for Action were specified in the Framework: Legislation and Policies, Education and Marketing, and Financial Incentives.

Keywords
Safe Vehicles; Young Drivers; Rural and Remote Drivers; Vehicle Technologies; ANCAP; UCSR

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

The following abbreviations are used throughout the report:

ABS – Antilock Braking System

ACC – Adaptive Cruise Control

ADAS – Advanced Driver Assistance

AEB – Autonomous Emergency Braking

ANCAP – Australian New Car Assessment Program

BAC - Blood Alcohol Concentration

BSM – Blind Spot Monitoring

ESC – Electronic Stability Control

ETC – Electronic Traction Control

LDW – Lane Departure Warning

LKA – Lane Keeping Assist

SRS – Supplementary Restraint System (Airbags)

UCSR – Used Car Safety Ratings

EXECUTIVE SUMMARY

Introduction

Road injury rates have steadily declined across highly motorised first world countries in line with advances in vehicle safety technology (International Transport Federation [ITF], 2016). Continued improvement in safety technologies have the potential to reduce the likelihood of crashing and the severity of injury for all drivers and particularly vulnerable drivers such as (i) younger-age inexperienced drivers; and (ii) drivers who travel on high risk Rural/Remote roads. However, little is known about the prevalence of use of Safe Vehicles (based on Australian New Car Assessment ratings and Used Car Safety Ratings) and their technologies by these drivers in Western Australia. Second to this, there is little understanding of the potential barriers and enablers for the purchase and use of Safe Vehicles by these drivers.

The overall aim of this project was to investigate opportunities for the promotion of vehicles with a high level of *currently available* safety functionality – otherwise known as Safe Vehicles - to vulnerable driver populations of young novice and rural and remote drivers in Western Australia. The specific objectives of the study were to:

1. Develop an operational definition of Safe Vehicles for the purposes of the project. This will be based on past research findings and information presented by the Australian New Car Assessment Program, the Used Car Safety Ratings Guide, and the WA Road Safety Commission's *A Consumer Guide to Safer Vehicles*.
2. Estimate the prevalence of the use of Safe Vehicles among young inexperienced drivers (17-25 years) and drivers (26 + years) residing in regional and remote Western Australia.
3. Sample the Safe Vehicle related knowledge, attitudes and behaviours of the vulnerable driver groups.
4. Development of a Promotion Framework that details the content, method and opportunities to educate and promote the purchase and use of safe vehicles among the relevant vulnerable driver groups.

Method

The cross-sectional study required 17-25 year old drivers residing in Metropolitan Perth and Rural/Remote WA and 26+ years old drivers residing in Rural/Remote WA to provide details of the car they drove most often and to complete an on-line anonymous survey of their Safe Vehicle related knowledge, attitudes and behaviours. Following pilot testing of the survey, a

non-probability convenience sampling method was used to recruit drivers to the study. In the Rural/Remote area, target drivers were recruited with the assistance of community and sporting groups and the local government *Roadwise* officers. In Metropolitan Perth, drivers were recruited through Curtin University. A survey panel company was also engaged to supplement the recruitment of drivers across Metropolitan Perth and Rural/Remote WA. Recruitment occurred during the period October 2017 to March 2018.

The drivers' vehicle details were manually cross-checked against a database of vehicles and corresponding ANCAP and UCSR to retrieve the relevant Safe Vehicle ratings. Vehicle age and the combined ratings were used to describe the prevalence of Safe Vehicle across the three driver groups. The responses by drivers in the three Age-Region groups to the knowledge, attitude and behaviour survey items were analysed using a mix of descriptive, univariate and multivariate methods.

Selected Results

Description of the sample

- A total of n=660 on-line submissions were received of which n=619 were retained for analysis. Forty-one submissions were excluded from analysis due to missing or incomplete information required to categorise the Age-Region of the driver or because they did not meet the specified recruitment criteria.
- Of the 619 drivers, 47.2% (n=292) were aged 17-25 years and 52.8% (n=327) aged 26+ years (Rural/Remote). Approximately 23% of the younger-age drivers resided in Rural/Remote WA. The sample, across all ages, was biased towards from Rural/Remote WA (64.7% *versus* 35.3%).
- The median age of older-age drivers from Rural/Remote WA was 49 years (26 years min.; 82 years max.), while the median age of Metropolitan Perth and Rural/Remote younger-age drivers was 20 years and 21.6 years respectively.
- Across all driver Age-Region groups the majority held a full C-Class drivers' licence.

Prevalence of Safe Vehicles: Vehicle Age, ANCAP/UCSR ratings and ESC

- The median age of vehicles for older-age drivers in Rural/Remote versus younger-age drivers across the regions was significantly different: 6 years versus 10 years (Median Test p=.000)

- The distribution of year of manufacture significantly (X^2=35.37, df=6, p=0.000) varied across the driver Age-Region groups. The majority of older-age driver vehicles were manufactured 2012-2017 compared with 2007-2011 for both younger-age driver groups.
- Combining the UCSR and ANCAP ratings showed that:
    - 62%-61% of young-age driver vehicles were rated 1-3 Stars;
    - 70.5% of older-age driver vehicles were 4-5 Stars (X^2=57.48, df=2, p=0.000).
- Based on the manufacturers specifications it was estimated that Electronic Stability Control was fitted in 36.4% of cars driven by younger-age Rural/Remote drivers, 48.4% in the cars of younger-age drivers in Metropolitan Perth, and 67.7% in the cars of older-age Rural/Remote drivers.
- Multivariate analysis revealed that younger-age drivers holding a Red Provisional (OR=0.217) or Green Provisional licence (OR=0.441) were significantly *less likely* to drive a 4-5 Star rated car as were younger-age drivers who reported being involved in crash in the previous three years (OR=0.492). Younger-age drivers who sometimes or more frequently drove with passengers under 17 years of age were two times (OR=2.2) *more likely* to drive a 4-5 Star rated vehicle.

Knowledge of vehicle safety features

- Around half of all drivers had incorrect knowledge of the fitment of ESC in their car. Between 84%-93% of these responses were of the 'false-negative' kind (i.e., claimed it was not fitted when it was – based on the manufacturer's specifications).

Acquisition of the vehicle by Star Rating

- Across all driver Age-Region groups the majority of drivers (69% n=68) purchased their own car, while 22.7% n=64 of older-age drivers in Rural/Remote WA drove a car provided by their employer. Eighty-seven percent of these latter vehicles were rated 4-5 Stars
- The proportion of 1-3 Star rated cars was highest for younger-age Metropolitan drivers who bought their own car (69.4% n=68) compared with 39% (n=60) for younger-age Rural/Remote drivers. Younger-age drivers were more likely to drive a 4-5 Star rated car when they share use and ownership of the car (66.7% n=6 Metropolitan Perth, 80% n=36).

Attitudes toward vehicle safety, Safe Vehicles and the safety of their own car

- Across all drivers, vehicle safety and safe features was ranked around 4th out of seven issues Only 15% (n=43) older-age Rural/Remote drivers ranked it as being the most important issue (Rank 1) compared with 13.6% (n=23) of younger-age Metropolitan drivers and 9.3% (n=5) younger-age Rural/Remote drivers.
- Over 70% of all drivers and up to 80% of older-age Rural/Remote drivers considered that car with high safety ratings could not protect occupants against injury in the event of 'bad' crash.
- Just under 60% of all drivers and a similar proportion of younger-age Metropolitan Perth drivers claimed they would find it difficult to trust crash avoidance technologies that took control of the car away from them.
- Across all age and region groups, around 60% stated that cars with high safety ratings were expensive and less affordable than cars with lower ratings.
- Over 55% of younger-age Metropolitan Perth drivers and around 60% of younger-age drivers in Rural/Remote WA claimed not to be able to afford a safe car.
- Around 45% of all younger-age drivers did not see the need to replace their car with another that has additional safety features
- Less than half of drivers in all age and region groups felt their car had enough of the right safety features to avoid having a crash. Nearly 60% of those who drove cars with a 1-3 Star rating claimed the car had enough of the right features or were unsure.
- Over 61% of all drivers agreed that governments should offer financial incentives to purchase safe cars.
- Around 70% of all younger-age drivers stated they were happy with the level of safety of the car they drove.

Knowledge of Safe Vehicle resources

- Approximately 58% of all drivers claimed to be aware of ANCAP and 49% aware of the UCSR program. Approximately 16.4% were claimed awareness of the RSC *Consumer Guide to Safer Vehicles*.

Factors associated with the intention to replace current vehicle

- Around a third of all drivers and around 43% of all younger-age drivers stated they intended to replace their current car with a safe one in the next two years.

- For all younger-age drivers, multiple linear regression identified two factors to be significantly associated with intention:
    - As the age of the vehicle increased, so did the intention to replace the car (B=.039, p=.006)
    - As the perceived need to replace the car with another that had additional safety features increased, so did the intention to replace the car (B=.347, p=.000)
- For all Rural/Remote area drivers, multiple linear regression identified three factors to be significantly associated with intention:
    - Increasing interest in Safe Vehicles (B=.152, p=013) was associated with an increasing intention to replace an existing car.
    - As the perceived need to replace the car with another that had additional safety features increased, so did the intention to replace the car (B=.384, p=.000)
    - As drivers' increasingly believed that their risk of crashing and injury had more to do with their driving skills than the safety of their current car increased, their intention to replace their car increased (B=.199, p=.002).

Discussion

This study found that the vehicles of younger-age drivers across Metropolitan Perth and Rural/Remote were older (median age 10 years) compared with those driven by older-age drivers in Rural/Remote WA (median age 6 years). On the whole, the cars of younger-age drivers are less safe as the majority (60%) of the vehicles were rated 1 -3 Stars (based on a combined ANCAP/UCSR rating). In comparison, around 70% of the vehicles driven by older-age Rural/Remote drivers were rated 4 – 5 Stars. An additional safety concern of the vehicles of younger-age drivers is that many lack ESC as an important crash avoidance feature. Fitment was as low as 36% for Rural-Remote younger-age driver and 48% for Metropolitan younger-age drivers. Fitment was higher (68%) in the cars of older-age Rural/Remote drivers. Where it was fitted, many drivers were either uncertain or unaware this technology was fitted to their car. The absence of ESC increases the risk of a run off road single vehicle crash for the drivers of these vehicles, particularly for those travelling on rural and remote area roads. The uptake by all drivers of more recent vehicles (e.g., post-2010) fitted with ESC could be addressed through a combination of educational and financial initiatives.

The vast majority of the vehicles of the surveyed drivers lacked emerging Advanced Driver Assistance Technologies like Autonomous Emergency Braking and Lane Keeping Assist.

Most drivers correctly understood these features were not fitted to their car. Other responses from drivers suggested that they were cautious or wary of Advanced Driver Assist technologies that took control over the car away from them. Even so, they endorsed initiatives that would make it easier for them to obtain a Safe Vehicle.

A good proportion of drivers lacked awareness of the ANCAP and UCSR resources, particularly the latter, which suggested that additional efforts need to be undertaken to improve the awareness of these resources to increase their potential use. This is particularly important for younger-age drivers and the UCSR because this age group are most likely to purchase a second hand car. The findings did show however that many drivers would consult a Safe Vehicle resource when they next intended to purchase a car, with most preferring to source that information at the 'point of sale'.

How drivers, particularly younger-age drivers, came to acquire the car was related to the vehicle's rating. In most cases, financial or availability issues seemed to be a linking factor in younger-age drivers driving 1- 3 Star rated cars. The rating of cars for younger-age drivers was highest (4 – 5 Stars) when they drove a car that was owned by another or bought for them (but not handed down to them). For older age drivers in Rural/Remote, they were more likely to drive a car with a higher rating when the car was either provided to them by an employer or co-owned and shared with another. For these drivers, corporate fleet purchasing policies and the means to afford a safe car are the likely mechanism underlying their use of safer cars in their region.

Overall, vehicle safety was not ranked as a high priority by the majority of drivers in the selection of a car. Understandably, financial concerns were the highest ranked factor for younger-age drivers who also felt they did not have the means to afford a safe vehicle. Many were happy with the level of safety of their lower rated car and consequently seemed to over-state the primary and secondary safety of their vehicles. For older-age drivers in Rural/Remote WA, they understandably rated the suitability of the car for their driving needs as the most important factor. The safety of the vehicle was ranked third.

Most drivers stated they were not intending to replace their car in the next two years. Of those who were (around a third), drivers of 1 -3 Star rated cars were no more likely than drivers of 4- 5 Star rated cars to intend to do so. Drivers' intention to replace their car was nevertheless significantly related to their perception of the safety of their car and the need to replace it

with one with more safety. There are however, subtle differences across younger and older drivers in other factors associated with an intention to replace their car. These appear to be related to financial issues and perceptions of driving skill and the risk of a crash.

A number of limitations were noted for the study which may limit the validity, reliability and generalisability of the findings. The limitations relate to the (i) recruitment and sampling of drivers and their vehicles and, (ii) how information about the drivers' vehicles was retrieved and categorised. These limitations should be taken into consideration.

Recommended Framework for the promotion of Safe Vehicles

The findings from the survey of the vulnerable driver groups and other information were used to develop a stand-alone *Framework for the Promotion of Safe Vehicles*.

The *Goal* of the Framework is to support the State's *Toward Zero Road Safety Strategy 2008-2020* to increase the use of Safe Vehicles on Western Australian roads, particularly among identified vulnerable drivers. The identified *Target* drivers are those aged 17-25 years and those who reside and drive in Rural and Remote Western Australia.

The *Priorities* of the Framework are to:

- Especially target the promotion of Safe Vehicles to those drivers who have a comparatively higher risk of crash involvement and injury.
- Make use of existing opportunities as well as propose new opportunities to promote the use of Safe Vehicles among the identified target driver groups.
- Propose actions to reduce the barriers to the use of Safe Vehicles by the target driver groups.
- Reduce the use of vehicles that have low Safe Vehicle ratings and lack critical safety technologies by the identified target driver groups.
- Reduce the incidence of death and serious injury among the identified target driver groups associated with the use of vehicles that have low Safety Ratings or lack critical safety technologies.

The Framework specifies a number of *Principles* to guide the promotion of the use of Safe Vehicles. These are:

- The use of a broad, multisector approach across the driving life-span
- The promotion of the use of Safe Vehicles as a positive health-related behaviour

- The importance of access and equity issues in the promotion of Safe Vehicles
- The unique vehicle requirements of drivers

Three *Domains of Action* and examples of supporting initiatives were specified in the Framework covering:

- Legislation and Policies
- Education and marketing
- Financial incentives

ACKNOWLEDGEMENTS

The author would like to acknowledge the following for their assistance with this project:

- Associate Professor Stuart Newstead and Ms Casey Rampollard, Monash University Accident Research Centre, for their assistance and advice in retrieving the safety rating of surveyed vehicles.
- The WA Department of Transport, Driver and Vehicle Services, for the supply of driver licensing data.
- Ms Terri-Anne Pettet, Manager, Roadwise, and Roadwise Regional Road Safety Officers, WA Local Government Association, for their assistance with the promotion of the study and recruitment of drivers.
- Officers of the various sporting and community groups across Rural Western Australia for their assistance with the promotion of the study and recruitment of drivers.
- Pureprofile for their assistance with the recruitment of drivers
- Dr Kyle Chow, C-MARC, for his statistical advice.
- C-MARC colleagues and others who provided advice and feedback during the development of the on-line Safe Vehicle Survey.
- All of the drivers who generously provided their time to complete the survey.

1 INTRODUCTION

1.1 Background

Advances in vehicle safety technology have contributed to a steady decline in road injury rates across highly motorised, first world countries (International Transport Federation [ITF], 2016). In the United States (US) it is estimated that around 600,000 lives have been saved over the period 1960 to 2012 as a result of the introduction of improved vehicle safety technologies (Kahane, 2015). Other Australian research suggests that improvements in vehicle safety and design over a 15 year period have contributed to a 75% reduction in the risk of death or serious injury for vehicle drivers (Anderson & Searson, 2014).

Fully autonomous vehicles are anticipated to be the pinnacle of advances in vehicle safety as they will take full responsibility and control over the driving task under all conditions (Insurance Institute for Highway Safety [IIHS], 2016). This is expected to reduce the risk of collision and thus injury to occupants and other road users such as pedestrians and cyclists (IIHS, 2018). The estimated date for the introduction and saturation of this level of automated functionality varies however between 2018 and 2032 (Somers & Weeratunga, 2015; Driverless Car Market Watch, 2018). In the interim, manufacturers are continuing to produce vehicles with an ever increasing high level of affordable safety technology. These technologies serve two important functions, which are to support and assist the task of driving to reduce the risk of collision associated with driver error or risk taking (known as *primary safety*), and secondly, to provide increased protection to vehicle occupants and other road users to reduce the risk of injury in the event of a crash (known as *secondary safety*) (ITF, 2016).

Vehicles in today's market that have a high level of secondary safety and are fitted with select crash avoidance technologies are collectively known as *Safe Vehicles*. In Australia, these new and used Safe Vehicles are identified through the respective rating systems of the *Australian New Car Assessment Program* [ANCAP] (https://www.ancap.com.au) and the *Used Car Safety Rating* [UCSR] program (Newstead, Delaney & Watson, 2003; http://www.howsafeisyourcar.com.au/Rating-Process/What-is-UCSR/). The contemporary rating systems of both programs define 5-

Star rated vehicles as offering the highest comparative level of protection against personal injury in the event of a crash and select crash avoidance technologies.

A number of studies have shown that Safe Vehicles have the capacity to reduce the incidence of road-related death and serious injury (e.g., ITF, 2016; Kahane, 2015; Page, Cuny, Zangmeister, Kreiss, Hermitte, 2009) and insurance claims associated with crashes (Reagan, Cicchino, Kerfoot & West, 2018). In the Australian context, early modelling by Newstead, Delaney, Watson and Cameron (2004) estimated that road injuries could be reduced by as much as 26% if all vehicles in the private, light-vehicle sector at that time were the safest in their class. In Western Australia, statistical modelling of the potential reduction in road injuries from an optimal uptake of safe vehicle technologies in the corporate and government vehicle fleet sector estimated that over 3,000 serious injury casualty crashes could be saved in isolation of other initiatives over a 12-year period (Corben, Logan, Fancuilli, Farley & Cameron, 2010).

In combination with other countermeasures targeting roads, speeds, and road user behaviour, the promotion and uptake of Safe Vehicles has become an integral component of a *Safe System*-based road safety strategy (ITF, 2008). For example, both the *National Road Safety Strategy 2011-2020* (Australian Transport Council, 2011) and Western Australia's *Toward Zero* road safety strategy for 2008-2020 (https://www.rsc.wa.gov.au/About/Role-of-the-Commission/Towards-Zero-Strategy/) highlight a range of initiatives to promote the uptake of safe vehicle technologies in the commercial; government, and private vehicle fleets.

The Western Australian strategy has particularly identified a need to promote Safe Vehicles to young novice drivers and those who predominantly drive in rural and remote locations. Young drivers are at risk because they have a substantially elevated risk of crashing due to their lack of experience and maturity (Palamara, Molnar et al., 2013; Oxley, Charlton, Starkey & Isler, 2014). They also have an increased likelihood of crashing in older, less safe vehicles (Watson & Newstead, 2009). Rural and remote area road drivers are similarly vulnerable because they frequently drive on less safe roads and at higher speeds (Centre for Accident Research and Road Safety-Queensland, 2012). They are also more likely than urban area drivers to be involved in a crash that results in death or serious injury, particularly where there driver has lost control and run off the road (Palamara, Kaura & Fraser, 2013).

Primary and secondary Safe Vehicle technologies have the potential to reduce the likelihood of crashing and the severity of injury for these vulnerable driver groups and their vehicle occupants. Unfortunately there is minimal research about the prevalence of the use of Safe Vehicles and their technologies by these drivers in Western Australia. Secondly, there is a lack of understanding of the potential barriers and enablers for the purchase and use of Safe Vehicles by these drivers. Understanding these issues is therefore central to the effective promotion of the use of Safe Vehicles to these vulnerable drivers and others to support the State's *Toward Zero* strategy.

1.2 Project Aim and Objectives

The overall aim of this project was to investigate opportunities for the promotion of vehicles with a high level of *currently available* safety functionality – otherwise known as Safe Vehicles - to vulnerable driver populations of young novice and rural and remote drivers in Western Australia. The specific objectives of the study were to:

1. Develop an operational definition of Safe Vehicles for the purposes of the project. This will be based on past research findings and information presented by the Australian New Car Assessment Program, the Used Car Safety Ratings Guide, and the WA Road Safety Commission's A Consumer Guide to Safer Vehicles.
2. Estimate the prevalence of the use of Safe Vehicles among young inexperienced drivers (17-25 years) and drivers residing in regional and remote Western Australia.
3. Asses the Safe Vehicle related knowledge, attitudes and behaviours of the vulnerable driver groups.
4. Develop a Promotion Framework that details the content, method and opportunities to educate and promote the purchase and use of safe vehicles among the relevant vulnerable driver groups.

1.3 Project Benefits

The study will provide an estimate of the prevalence of the use of Safe Vehicles among drivers aged 17-25 years and those residing in Rural/Remote Western Australia. Understanding the Safe Vehicle related knowledge; attitudes, and behaviours, including behavioural intentions, of these vulnerable driver groups will provide useful insight of the range of factors that are barriers and enablers to the use of Safe Vehicles. These findings can be used to underpin the development and implementation of tailored strategies to promote the use of Safe Vehicles to these driver groups and reduce the risk

of crashing and injury. This focus is consistent with the *Toward Zero* strategy to upgrade drivers to the safest possible vehicle (in their class) to reduce the overall incidence of death and serious injury on Western Australian roads. The findings will also provide an important baseline for the longer term monitoring and evaluation of implemented strategies to promote the use of Safe Vehicles among these drivers.

2 METHODS

2.1 Ethics approval

The research was undertaken with the approval of the Human Research Ethics Committee, Curtin University: approval number HRE2017-0615 (11th September 2017).

2.2 Literature Review

A search of the peer review and 'grey' literature published in Australia and internationally (1995-2017) was undertaken to identify, retrieve and review material related to:

- Vehicle age and safety
- Current and emerging safe vehicle technologies and their benefits
- The testing and classification systems for the safety of vehicles in Australasia;
- Issues related to the purchase and use of safe vehicles, particularly relating to the identified 'vulnerable' driver groups.

Key words (e.g., vehicle technology; safe vehicles; safe vehicle testing; safe vehicle ratings; pre-crash technologies; collision avoidance; occupant protection; driver assist technologies; vehicle crash worthiness) were used to search databases such as Google; Google Scholar; ProQuest; Medline; ScienceDirect, and PsycInfo for the retrieval of reports, scientific journal articles, conference papers, and educational-promotional materials. In addition, a 'web-scan' was undertaken of the content and information of International and Australian websites targeting safe vehicle technology and safe vehicle testing and/or rating.

The findings from the review of the literature assisted with the identification of the safe vehicle topics to be surveyed and the development of the survey items.

2.3 Development of the on-line survey

An on-line survey was developed for the purposes of conducting a convenience sample cross-sectional survey of drivers aged 17-25 years and drivers residing in Rural/Remote WA. The intention of the survey was to collect information on the vehicle most frequently driven and to sample the safe vehicle related knowledge, attitudes, and behaviours of the target drivers. The content of the survey is detailed below and a copy of the survey can be viewed in Appendix 1.

Demographics, driving history and driving exposure

- Sex, age, residential location (name of suburb or town) and post-code.
- Type of C-Class motor vehicle driver licence held (full, red or green provisional).
- Amount of driving (days per week; average kilometres travelled per day).
- Frequency of driving with passengers and passengers under 17 years of age.
- History of involvement in a crash as the driver in the last three years or since licensure.

Details of the car most frequently driven

- Make, Model, Year of Manufacture.
- How vehicle was acquired (e.g., purchased by self or provided by other).
- Level of input in the decision to purchase the vehicle.
- Ranking of the importance of factors in the selection of the vehicle (e.g., financial considerations; safety; performance).

Driver Knowledge of their car's Safe Vehicle technology and Safe Vehicle resources

- Knowledge of the fitment of select crash avoidance technologies in their car (e.g., Electronic Stability Control (ESC); Forward Collision Warning (FCW); Autonomous Emergency Braking (AEB); Lane Departure Warning (LDW); Lane Keeping Assist (LKA), and Blind Spot Monitoring (BSM))
- Knowledge of Safe Vehicle resources (e.g., Used Car Safety Ratings program; the Australian New Car Assessment Star Rating program).

Driver Attitudes toward Safe Vehicles

- Agreement/Disagreement with Safe Vehicle statements pertaining to interest in safe vehicles; belief and trust in safe vehicles; cost and affordability of safe vehicles; government action to regulate and promote safe vehicles.
- Agreement/Disagreement with Safe Vehicle statements pertaining to the primary safety of their car; the secondary safety of their car; satisfaction with the safety of their car; the importance of their car's safety, and their driving skill and vehicle safety.

Driver Behaviour

- Past use of Safe Vehicle resources.
- Rated usefulness of Safe Vehicle resources.
- Likelihood of consulting a Safe Vehicle resource in the future.
- Preference ratings on the mode for accessing Safe Vehicle resources.
- Intention to purchase a 'safer' vehicle in the next two years.

2.3.1 Pilot testing of the survey

Following the development of the survey, pilot testing was undertaken with a convenience sample of n=45 drivers. Drivers were recruited through the author's network of professional colleagues and social contacts and community groups in non-metropolitan areas. The sample consisted of drivers aged 17-25 years residing in Metropolitan Perth and Rural/Remote WA and drivers aged 26+ years residing in Rural/Remote WA. The survey responses were analysed and reviewed. Based on these findings and interviews with a number of pilot test participants, the items and structure of the survey was edited to improve the clarity and face validity of the items and the overall readability of the survey.

2.4 Recruitment of drivers for the on-line survey

A number of strategies were used to recruit a non-probability, convenience sample of drivers aged 17-25 years across residing in Metropolitan Perth (n=500 target), drivers aged 17-25 years residing in Rural/Remote WA (n=500 target), and drivers aged 26+ years residing in Rural/Remote WA (n=1,000 target).

The recruitment of older age and younger age drivers residing in Rural and Remote Western Australia

i. Nine Regional WA *RoadWise* (WA Local Government Association) road safety advisors were provided with details of the project and a link to access the on-line survey to promote the recruitment of drivers among their regional area road safety network.

ii. Thirty-six sporting, community, and service clubs across Regional WA were contacted by telephone and/or email and provided with details of the project and a link to access the on-line survey to promote the recruitment of drivers amongst their members.

iii. A survey panel company (www.pureprofile.com/researchers) was contracted to identify, recruit, and supply survey responses for drivers aged 17-25 years and 26+ years residing in regional and remote WA.

The recruitment of younger age drivers residing in Metropolitan Perth

i. Details of the project and the request for drivers were advertised to Curtin University students through the on-line Student Oasis Noticeboard.

ii. Metropolitan Perth *RoadWise* road safety advisors were provided with details of the project and a link to access the on-line survey (see Appendix 3) to promote the recruitment of younger age drivers among their metropolitan road safety network.

iii. The survey panel company was contracted to identify, recruit, and supply survey responses for drivers aged 17-25 years residing in Metropolitan Perth.

The recruitment of drivers occurred during the period October 2017 to March 2018. Participants were provided with on-line Information Sheet which detailed the scope of the project, the requirements of their participation, as well as information on their rights of participation and the University's obligation in relation to anonymity and data protection. Drivers were not required to provide information that could be used to identify them and their responses (i.e., they were *not* required to provide their name, address, motor vehicle driver licence number; vehicle registration plate number; email contact). The on-line survey was hosted on the University's Qualtrics Survey System (www.curtin.qualtrics.com).

2.5 Data manipulation

Data for completed surveys that were hosted and managed by Curtin University were downloaded as SPSS (Version 23) data files from the Qualtrics Survey System. Data for completed surveys that were hosted and managed by PureProfile (the panel survey company) were provided to C-MARC as SPSS (Version 23) data files in the sequence and format of the aforementioned Qualtrics-generated files. The unit records were assigned a unique number and a value to identify their origin (i.e., Curtin=1; PureProfile=2) and then merged into a single data file.

2.5.1 Classification of drivers

Based on the drivers' declared age and place of residence (e.g., suburb/town, post-code) the drivers were assigned to one of three groups for analysis: 1=17-25 year old

residents of Metropolitan Perth; 2=17-25 years old residents of Regional WA, and, 3=26+ year old residents of Regional/Remote WA. For some analyses the younger-age regional groups were combined (i.e., all drivers aged 17-25 years) and the Rural/Remote area drivers combined (i.e., all age drivers residing in Rural/Remote WA). The decision to maintain three groups for the primary analyses was based on an initial scan of the drivers' responses. This showed similarities and differences within and between the younger age and Rural/Remote drivers that would best be highlighted through a primary analysis of three groups.

2.5.2 Establishing the safety rating of the vehicle and identifying the vehicle's select primary crash avoidance features

Information provided by the drivers on the Make, Model and Year of Manufacture of their vehicle was used to retrieve, where available, existing Safe Vehicle ratings (either UCSR or alternate ANCAP) for the vehicle and the manufacturer's specifications on the fitment of select primary safety technologies. Pilot testing had shown that drivers, particularly those aged 17-25 years, had limited ability to identify the correct 'variant' of their car's model. This can be an important issue in the retrieval of manufacturer's specifications and in some cases the retrieval of the vehicle's safety rating. Consequently, in consultation with the developers of the Used Car Safety Ratings program at Monash University, it was decided to assume that the driver's vehicle was the 'base model' variant and retrieve information for that variant where multiple variants of the model existed.

A number of resources were consulted for the retrieval of information on the base model variant of the drivers' vehicle. To establish the vehicle's safety rating, data for the Make, Model and Year of Manufacture of the drivers' vehicles were obtained from the Used Car Safety Rating program managed by the Safe Vehicle Research Group at Monash University. This extract provided information on the most recent UCSR and historic ANCAP ratings for the Make, Model, Variant, and Year of vehicles. The base model was identified (cross checked against redbook.com.au) and the relevant UCSR or alternate ANCAP Star rating (1- 5) retrieved and used where no UCSR was available. Though ANCAP and UCSR share the same 5 Star rating format, the criteria for the assignment of a particular rating differs across the programs. For the purposes of this study however, the ratings will be combined and the number of stars accepted as a general ranking of the safety of the vehicle regardless of the source of the rating.

Manufacturer's specifications on the fitment of crash avoidance technologies for the drivers' (base model) vehicle were retrieved from redbook.com.au. This site provides full manufacturer's specifications for vehicles by Make, Model, Variant and Year of Manufacture. Other resources such as ANCAP, howsafeisyourcar.com.au and carsales.com.au were consulted as required. For each (base model) vehicle we identified whether or not the vehicle was fitted with the following features: ESC, AEB, FCW, LKA, FCW, BSM. This information was then manually cross-matched against the driver's response in regards to the fitment of these technologies in their vehicle to produce a 'correct' or 'incorrect' knowledge response. This process also provided information on the prevalence of these technologies in the sample of vehicles.

2.6 Data analysis

Descriptive statistics were undertaken on the data to identify data quality issues to correct inappropriate or missing data. Once the data was corrected, a series of univariate analyses (frequency counts; median score tests; cross-tabulations; Chi-Square analyses) were conducted to describe and compare the survey responses across the three driver groups, and where appropriate, two groups (all younger drivers; all Rural/Remote drivers).

Binary Logistic Regression was also undertaken to investigate the association of select driver variables with the two-group classification binary outcomes variables (e.g., two-group vehicle Star ratings: 0=1-3 Star Rating; 1=4-5 Star Rating). Simple and Multiple Linear Regression analyses were similarly conducted, where appropriate, to determine the association of select driver demographic, knowledge and attitude variables and select continuous variables (e.g., behavioural intent).

3 LITERATURE REVIEW

3.1 Introduction

This review will focus firstly on the relationship between vehicle age and safety. This will be followed with an overview of the developments in primary (crash avoidance) and secondary (occupant protection) safety that has contributed to the evolution of Safe Vehicles. The programs that currently test and define the Safe Vehicle status of new and used vehicles - The Australian New Car Assessment Program (ANCAP) and the Used Car Safety Ratings Program (UCSR) - will then be reviewed. The final sections of the review will focus on the need to promote the use of Safe Vehicles by the two vulnerable driver groups: young novice drivers and Rural/Remote area drivers.

3.2 The relationship between vehicle age, vehicle safety, and injury

Vehicle safety and the risk of crashing and associated injury to vehicle occupants are intrinsically linked to the age of the vehicle. The most recent examination of crashes involving vehicles manufactured over a 50 year period reported that the risk of a driver being killed or seriously injured had declined by around 73% (Newstead, Watson & Cameron, 2016). This estimate was based on the analysis of the records and vehicles of 800,000 injured drivers involved in 'tow-away' crashes across Australia and New Zealand during the period 1987-2014. As shown in Figure 3.1, there is a linear trend of increasing crashworthiness[1] with increasing year of manufacture for vehicles manufactured between 1964 and 2014 (Figure 3.1). The crashworthiness estimate plotted in Figure 3.1 for each year of manufacture is presented as a percentage of the number of drivers killed or admitted to hospital (Killed or Serious Injury) per 100 drivers involved in a crash. The driver KSI rate for crashing vehicles manufactured in 1964 was calculated to be 7.74 compared with 2.11 for crashing vehicles manufactured in 2014 – a reduction of around 73% in the rate of driver death or serious injury over the 50 year manufacturing period.

[1] The crashworthiness of vehicle manufacture date was estimated by multiplying the individual injury risk for the driver and the injury severity, both of which were adjusted for the influence of confounders (Newstead et al., 2009).

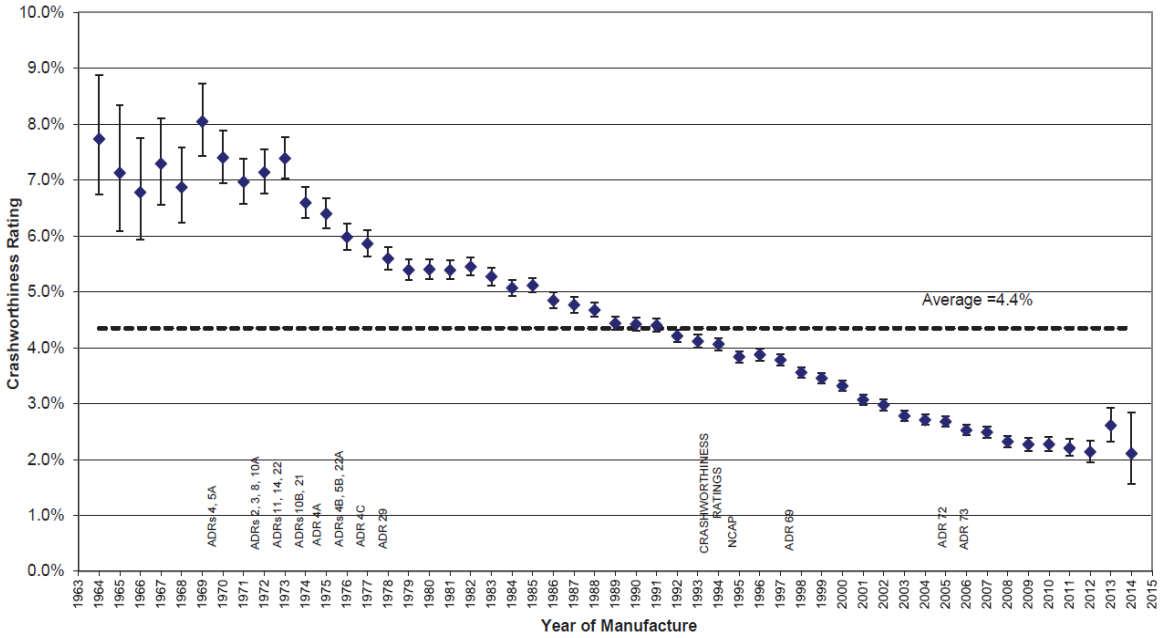

Figure 3.1 Crashworthiness rating and 95% Confidence Intervals by year of manufacture for driver Killed and Serious Injury crashes; Australia and New Zealand 1987-2014 (Source: Newstead et al., 2016).

More recent evidence to highlight the relationship between vehicle age and injury risk was provided by ANCAP (2017). Their analyses showed that older age vehicles were over-represented in occupant fatalities occurring in Australian crashes in 2015 compared with recently manufactured vehicles. Figure 3.2 shows that vehicles manufactured prior to 2001 accounted for around 20% of registered light passenger vehicles but were involved in 33% of occupant fatalities in 2015. The over-representation was slightly less for vehicles manufactured between 2001 and 2005. The over-representation is presumed to be due to the comparatively lower level of crash avoidance technologies and occupant protection features of older vehicles. One limitation of this analysis however, is that it did not take into account the potential confounding influence of driver age, i.e., those who are younger and elderly. As previously noted, younger age drivers have a higher risk of crashing (Oxley et al., 2014) and are more likely to drive an older-age vehicle (Watson & Newstead, 2009). Similarly, drivers aged 70+ years are also more likely to drive an older-age vehicle compared with their middle-age counterparts (Langford & Oxley, 2006), but they also have a high level of biologic fragility (Meuleners, Harding, Lee & Legge, 2006) which means they are more likely to be killed or seriously injured when involved in a crash – particularly in a less crashworthy vehicle.

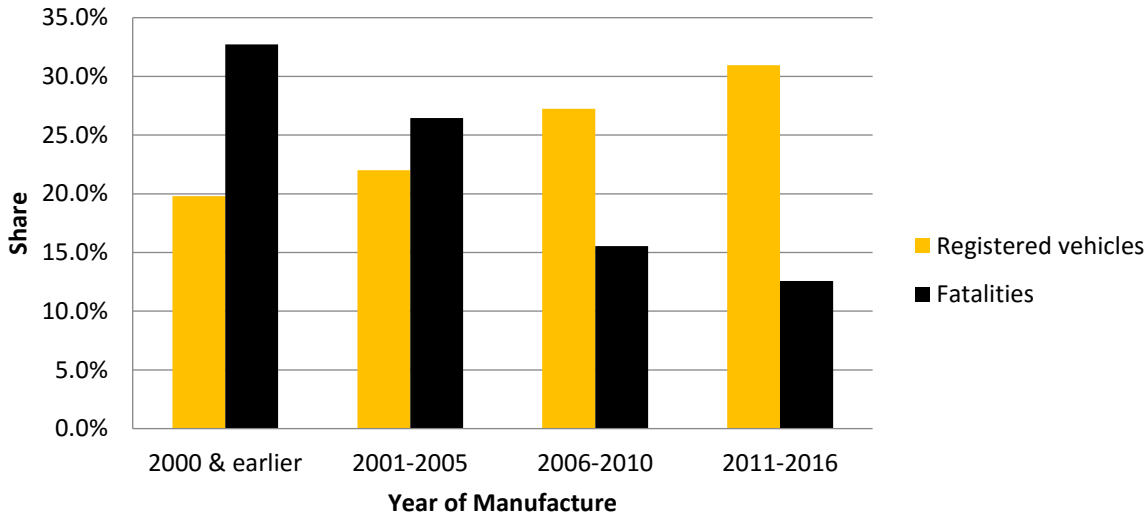

Figure 3.2 Proportion of Australian vehicle occupant fatalities and registered passenger vehicles in 2015; by year of vehicle manufacture (Source: ANCAP, 2017)

Notwithstanding the potential confounding due to driver age, the above findings highlight the risk of death or serious injury for drivers and other occupants of older age-vehicle if involved in crash. On average, Western Australians drive a light passenger vehicle that is around 10 years of age (ABS, 2017) while the average age of the Australian light passenger vehicle fleet is 9.8 years (Australian Automobile Association, 2017). Other calculations show that approximately 43% or 681,647 light passenger vehicles registered in Western Australia in 2017 were manufactured prior 2007 (ABS, 2017). These vehicle registration figures strongly suggest that many Australian and Western Australian drivers retain their vehicles for prolonged periods and as a consequence are slow to take advantage of evolving primary and secondary safe vehicle technologies – thereby increasing their risk of injury in the event of a crash.

Reducing the age of the vehicle fleet in Australia – particularly for vulnerable drivers such as young novices and regional and remote area drivers - through the purchase of newer, safer vehicles is thus a high priority strategy. Based on the calculated annual reduction in injury risk associated with a one year difference in manufacture date, a reduction in the average Australian vehicle fleet age by just one year over a four year period would have a substantial road safety impact. A one year change in the average vehicle fleet age was estimated to reduce the number of road fatalities and

hospitalisations by nearly 1,400 and 45,000 respectively over a 20 year period (Australian Automobile Association, 2017).

The section has highlighted the relationship between vehicle age, safety and injury and the need to promote the uptake of newer vehicles with improved secondary and primary safety systems to reduce the incidence of road injury. Nowadays, vehicles that have a high level of occupant protection against injury and are fitted with key, crash avoidance technologies are rated and promoted as Safe Vehicles. A summarised account of key Safe Vehicle systems and their effectiveness (where available) is presented in the following sections. This will provide a context for the discussion to follow of the ANCAP and UCSR programs which rate the safety of new and used vehicles in Australia.

3.3 Primary Safety: Crash avoidance technologies

The history of vehicle manufacturing is replete with examples of improvements in vehicle design to assist driving and reduce the likelihood of crashing. Advancements in vehicle braking are among the earliest and most notable examples; this includes the progression from drum brakes to hydraulic brakes and then to disc brakes to improve braking performance (Lentinello, 2011). Crash avoidance technologies have notably advanced over the last two decades to the point where their fitment now significantly contributes to the Safe Vehicle ratings assigned to new and even used cars (to be discussed in Sections 3.5.1 and 3.5.2 to follow). A selection of key and advanced crash avoidance technologies and their effectiveness is summarised in the following sections.

3.3.1 Vehicle Control and Stability systems

Antilock Braking Systems

Antilock Braking Systems (ABS) were introduced in Australian in the mid 1980's (https://www.dba.com.au/electronic-stability-control-abs-brakes-history-pt-15/) and were the first of the 'smart' technologies introduced to assist the driver to maintain control of the vehicle to minimise the occurrence of a crash (Safety Research and Strategies Inc., 2004). The intent of ABS is to minimise wheel 'lock up' and uncontrolled skidding under hard braking, thus allowing the driver to maintain steering control over the vehicle (Insurance Institute for Highway [IIHS], 2017). The fitment of ABS to passenger cars and light commercial vehicles in Australia rapidly progressed during the 1980's (Fildes, Newstead, Rizzi, Fitzharris & Budd, 2015; Kahane & Dang,

2009) with high expectations based on motor track testing that the technology would significantly reduce the incidence of crashes and associated injury (Broughton & Baughan, 2002).

Investigations into the effect of ABS on crashes and the risk of injury have evidenced varying and inconsistent results over the years (Broughton & Baughan, 2002). The most recent long term investigation by Kahane and Dang (2009) of ABS using US reported crash data, 1995-2007,concluded that ABS had near zero net effect on the incidence of fatal crashes but was associated with a 12% reduction in crashes involving multiple vehicles on wet roads and a 13% reduction in fatalities involving pedestrians. A 6% reduction was also noted for non-fatal injury collisions. The authors reported however, that ABS was associated with a 9% *increase* in fatal run off road collisions during the study period.

There are a number of possible reasons why ABS has not been associated with the safety outcomes that were broadly expected, despite the standard (non-optional) fitment of the technology over many years. Firstly, ABS is unlikely to be of use in crashes were there was no attempt to brake to avoid the collision, for example, where the driver is not sufficiently alert or attentive to apply the brakes as might be the case in single vehicle run off road crashes due to fatigue or sleepiness. Secondly, the potential of ABS may not be fully realised because drivers lack the knowledge of and skill required to apply the correct braking technique to activate ABS. Early research reported that the effectiveness of ABS can be influenced by driver training in the understanding of and use of the technology. Mollenhauer, Dingus, Carney, Hankey and Jahns (1997) found that drivers who received training in the correct brake activation technique were able to stop in shorter distances and in a straight line compared with those drivers who did not receive training.

Electronic Traction Control

Electronic Traction Control (ETC) was first introduced in high-end, luxury cars in the late 1980s as a supplement to existing ABS systems (http://brainonboard.ca/safety_features/active_safety_features_traction_control.php).

Along with ABS, ETC is a foundation technology for the contemporary system of braking, traction and steering control generically referred to as Electronic Stability Control [ESC] (Safety Research and Strategies Inc., 2004). ETC uses the ABS wheel

speed sensors to gauge wheel traction; if the wheel(s) is spinning or slipping it will selectively and temporarily reduce engine power and apply the brakes to regain traction to ensure smooth, non-slip acceleration (Tracy, 2013). This review could not locate published studies on the effectiveness of ETC as a stand-alone technology to reduce crashes and injuries.

Electronic Stability Control

As noted above, ESC builds on the foundation technologies of ABS and ETC. In summary, the system recognises unstable driving conditions and applies corrective action, independent of the driver, to maintain the driver's control over the vehicle to facilitate the correct and intended direction of travel (Phan, 2017).

ESC was first introduced by Mercedes Benz in the early 1990's (Tracy, 2013) but did not appear in the Australian new car market until 2002 (Gargett, Cregan & Cosgrove, 2011). The intent of ESC is to reduce the incidence of vehicle loss of control-run off road crashes resulting from under or oversteer by the driver (Tracy, 2013). The system uses wheel speed and other sensors to determine how fast each wheel is travelling and the direction of travel of the vehicle relative to the driver's intended travel direction. Brakes are then selectively applied to each wheel to correct the vehicle's position to realign it with the driver's intended direction of travel so as to return control over the vehicle back to the driver (Mackenzie & Anderson, 2009; Pepper, 2015). Importantly, simulation-based research findings indicate that the functionality of ESC is independent of driver age (which typically correlates with driver experience) and gender (Papelis, Watson & Brown, 2010). The implication of this is that younger age drivers and males – both of whom have an elevated crash risk – will potentially benefit from the use of vehicles fitted with the technology.

Investigations into the effectiveness of ESC report that it is strongly associated with significant reductions in loss of control single vehicle crashes and fatalities, findings which affirm the technology's status as a 5 star enhanced safety rating (Mehler, Reimer, Lavalliere, Dobres & Coughlin , 2014) and a Global New Car Assessment Program priority technology (Ward, 2015). Early research from the US showed that ESC was effective in reducing single vehicle fatality crashes during the period 1997-2002 by 35% for light passenger cars and 67% for SUV's (Dang, 2004). Mehler, Reimer, Lavalliere, Dobres and Coughlin (2014) believe the greater impact of ESC on SUV

crashes may be due to their inherently lower level of stability due to high centres of gravity. A more recent meta-analysis undertaken by Hoye (2011) of ESC evaluation studies confirmed that ESC was most effective in reducing crashes resulting in loss of control by 40%; vehicle roll-over crashes by 50%, and all single vehicle run off road crashes by 40%).

Across Australia and New Zealand, ESC has been found to be similarly effective in reducing crashes, though the effect varies by crash type and injury severity. The updated analysis by Scully and Newstead (2010) of nearly 470,000 crashes involving ESC equipped and non-equipped vehicles found that ESC contributed to a 28% reduction in single vehicle crashes of all injury severities and a 32% reduction in crashes where the driver was injured (all severities). As noted in the US studies, the effect of ESC was highest for 4WD crashes (the SUV equivalent) - the authors reported an 82% reduction in roller-over crashes. Other findings showed that ESC contributed to a minor but still significant 8% reduction in crashes of all types involving injury (all severities) to the driver. The authors noted however, that ESC was less effective in preventing single vehicle serious injury crashes compared with less serious injury crashes, perhaps because the former crashes were an outcome of circumstances that did not allow the driver to take back control over the vehicle, eg, sleep/fatigue or substance impairment. This point was exemplified by the research conducted by Mackenzie and Anderson (2009). Using simulations of real-world crash scenarios from rural South Australia they noted that ESC failed to impact the crash outcome in a scenario where the driver had a known elevated Blood Alcohol Concentration Level of approximately 0.206gm%. These findings affirm that ESC is effective in reducing particular types of crashes, namely single vehicle run off road hit object and roll-over crashes where the driver is sufficiently attentive and alert to resume control of the vehicle.

Consistent evidence of the positive effect of ESC on crash and injury outcomes and the increasing fitment of ESC into new Australian vehicles from the early 2000's (albeit initially in luxury vehicles) contributed to two important policy outcomes for the Australian new vehicle fleet. Firstly, in 2008 the Australian New Car Assessment Program (www.ancap.com.au) (see Section 3.5.1) which tests and rates the 'crashworthiness' of new vehicles adopted ESC as a mandatory Safety Assist Technology for the assignment of a 5-Star rating. This mandatory requirement was then

extended annually from 2012 for a 4-Star, 3-Star, 2-Star, and 1-Star rating (Australian New Car Assessment Program [ANCAP], 2014). Secondly, in 2009 the Australian Government announced a new vehicle standard, Australian Design Rule 88/00 (Federal Chamber of Automotive Industries [FCAI], 2018), which mandated the fitment of ESC to all new passenger cars from the 1st November 2011 and all new vehicles two years later (Searson, Ponte, Hutchinson, Anderson & Lydon, 2014). Given the time taken for new technologies to populate the registered vehicle fleet in Australia, it has been estimated that the penetration of ESC will reach 90% by 2030 (Gargett et al., 2011). Over this time the technology is expected to be associated with a "…corresponding (although proportionally less) reduction in fatalities…" (Gargett et al., 2011, page 6).

To capitalise on the decision to mandate the fitment of ESC, the state government of Western Australia undertook a campaign to promote the benefits of ESC for Regional and Remote area driving (Painted Dog Research, 2013). During the period 2012 to 2013, multimedia advertising (television, radio, print media, social media, outdoor billboards, newspapers) was exclusively aired in Regional and Remote WA to promote the benefits of ESC to maintain vehicle control. Follow-up surveying of 418 area drivers aged 17+ years found that 77% expressed (prompted) awareness of the campaign. In addition, 40% of respondents correctly indicated that ESC was effective n maintaining control of the vehicle. The impact of the program was around seven in ten respondents indicated they would look to purchase a car with ESC when they were next considering a car (Painted Dog Research, 2013). The findings suggest that campaigns of this type can produce positive behavioural intentions to purchase safer vehicles.

3.3.2 Forward Collision Avoidance systems

Technologies to mitigate forward collisions (e.g., front to rear end vehicle crashes; crashes with pedestrians) are increasing in their sophistication and fitment. The earliest systems provided an alert or warning only to drivers to adjust their speed if their vehicle was judged to be too close to a vehicle in front (Eichelbergeer & McCartt, 2016). Contemporary, advanced forward collision avoidance systems may not only warn the driver but will also apply the vehicle's brakes and reduce speed – autonomously - should the driver not take action (Mosquet, Andersen & Arora, 2015). Autonomous Emergency Braking (AEB) and Adaptive Cruise Control (ACC) are two examples of

advanced driver assistance technologies to mitigate forward collisions. Each of these technologies is summarised below.

Autonomous Emergency Braking

AEB emerged internationally around 2006 (Mosquet et al., 2015). In Australia, it is estimated that up to 30% of all new passenger vehicles and 20% of SUVs delivered to the Australian market have AEB functionality (Australian National Road Safety Partnership Program, nd.). Based on the 30-year estimate by Gargett et al. (2011) for the spread of safety technologies into 90% of the Australia passenger and light commercial vehicle fleet, AEB may not reach that level until closer to 2040. This time frame could be reduced however as ANCAP has indicated that from 2018 a 5-Star safe vehicle rating will only be awarded to those passenger cars fitted with AEB (McCowen, 2017).

Contemporary, advanced AEB uses sensing systems (e.g., radar, laser or cameras) to detect objects, pedestrians, or other vehicles that, taking into account vehicle speed, could potentially result in a collision. If a collision is imminent, the system will 'autonomously' apply braking to slow the vehicle's speed (Davidekova & Gregus, 2017). There are at least three variants of AEB systems. Low speed systems relate to city area driving to prevent low speed impact collisions (e.g., up to 30-40km/hour) (http://www.howsafeisyourcar.com.au/Safety-Features/Safety-Features-List/Low-Speed-Auto-Emergency-Braking/; Fildes et al., 2015), whereas high speed systems use long range radar (up to 200 metres) to prevent crashes at much higher speeds (http://www.howsafeisyourcar.com.au/Safety-Features/Safety-Features-List/Higher-Speed-Auto-Emergency-Braking/). In addition, some manufacturers offer AEB systems that use a combination of radar and camera technologies to detect pedestrians to avoid collisions with these unprotected road users (http://www.howsafeisyourcar.com.au/Safety-Features/Safety-Features-List/Pedestrian-Auto-Emergency-Braking/).

Studies of the effectiveness of AEB vary in terms of the features evaluated (e.g., AEB with and without forward collision warning), the methodologies used (e.g., simulation studies; evaluation of real-world crashes), and the outcomes (e.g., rear-end crashes; collisions with pedestrians). Overall, there is consistent evidence of the effectiveness of AEB systems to reduce rear-end and pedestrian crashes and associated injury outcomes.

The review by Fildes et al. (2015) of 11 published studies using a mix of simulation and real-world crash methodologies noted that AEB was associated with reductions in rear-end crashes of 25% to 40% and reductions in pedestrian crashes of 4.3% to 44%. Less than half of the studies reviewed provided evidence of the associated reductions in injuries. Of those that did, the reduction in fatalities varied between 2.2% and 50% for rear-end crash fatalities and 15% for pedestrian crash fatalities.

Further evidence of the effectiveness of AEB on crash outcomes has been obtained through the application of 'induced exposure' methods (to adjust for the lack of true exposure information on the use of AEB) to administrative crash data (Rizzi, Kullgren & Tingvall, 2014; Fildes et al., 2015). Rizzi et al's. (2014) analysis of 3,922 injury crashes occurring in Sweden, 2010-2014, found that low-speed AEB systems were associated with a 35% to 41% reduction in striking rear-end crashes irrespective of the posted speed limit. The effect was even higher for striking rear-end crashes occurring in 50km/hour zones: 54%-57%. Using the same induced exposure methods, Fildes et al. (2015) undertook a meta-analysis of the unpublished effects of low speed AEB across 3,326 all-injury rear-end crashes reported by six (unnamed) predominantly European countries. They reported a "…38% [95% CI 18%-53%] overall reduction in real-world, rear-end crashes for vehicle fitted with low speed AEB compared to a comparison sample of equivalent vehicles [without AEB]" (page 28).

A more recent study was undertaken by Cicchino (2017a) of 197,606 police-reported crashes occurring during the period 2010 to 2014 in the US. The study analysed the crashes of seven different vehicle makes without AEB or fitted with Collision Warning (CW) only, AEB only, or Collision Warning and AEB (CW+AEB). The results indicated differing levels of impact on crash and injury outcomes by AEB/CW type. After adjusting for exposure (based on days of insurance), the study reported rear-end striking crash reductions of 27% (CW), 43% (AEB) and 50% (CW+AEB). Similar reductions were noted for rear-end striking crashes that resulted in injury: 20% (CW), 45% (AEB) and 56% (CW+AEB). These findings suggest that the most effective forward collision avoidance system is a combination of Forward Collision Warning *and* AEB.

Adaptive Cruise Control

Cruise Control was introduced as early as 1958 (Mosquet et al., 2015) and was originally intended as a 'comfort aid' for drivers to maintain a set speed over long distances (Reyes, Roe, McDonald, Friberg & McGehee, 2017). Drivers were required to 'set' the speed and to take control over the vehicle (via braking or deactivating the system) if the headway to the vehicle in front was subsequently reduced and threatened to cause a rear-end collision.

Advanced versions of Cruise Control are known as Adaptive Cruise Control because the system is designed to adapt the vehicle's speed to maintain a constant, safe headway behind the lead vehicle when in cruise control mode (Dickie, Ng & Boyle, 2009). This system relegates the driver to a supervisory role, leaving the adjustment of the vehicles' speed and the maintenance of a safe headway distance under the control of the ACC. ACC differs to AEB in that it will not perform emergency braking but may provide moderate braking to maintain a safe headway time (Mehler et al., 2014). Earliest versions of Advanced Cruise Control systems were introduced in the late 1990's among luxury vehicles and have been increasingly fitted from the mid-2000's (Reyes et al., 2017).

Like AEB, ACC has the potential to reduce the risk and incidence of rear-end crashes – the most predominant of all crash types (Xiao & Gao, 2010). Based on the type of crashes ACC would likely reduce, Paine, Healy, Passmore, Truong and Faulks (2008) suggested that ACC could be associated with 1.5% reduction in road trauma in Australia. This review could not however locate real-world crash-based evidence of the actual effectiveness of ACC to reduce the incidence of forward collisions and associated injury. At best, field testing has shown that drivers who use ACC compared with those who do not maintain longer headway distances to the vehicle ahead and reduce the amount of travel time drivers maintaining headways of less than 0.5 seconds to the vehicle in front (Kessler et al., 2012). Longer headways are likely to be protective against involvement in a forward collision as the driver will have more time and distance to respond to changes in the speed of the lead vehicle or other potential hazards ahead (Victori, 2015).

3.3.3 Lateral Collision Avoidance systems

Lateral Collision Avoidance systems function to reduce the occurrence of crashes due to *unintended* lane departures and *unsafe intended* lane departures (Jenkins, Stanton, Guy, Walker & Young, 2007). Their effectiveness however, is dependent on drivers keeping these systems active and not deactivating them due to reported false positive warning (Reagan et al. 2017. Three advanced driver assistance systems relevant to the prevention of lane departure and side-swipe collisions include Lane Departure Warning (LDW) and Lane Keeping Assist (LKA) (Jansch, 2017) and Blind Spot Monitoring (BSM) (Cicchino, 2017c). The technologies will be summarised in the following sections.

Lane Departure Warning and Lane Keeping Assist

LDW systems alert the driver, through either audio or tactile (steering wheel vibration) signals that they are unintentionally[2] departing or drifting out of their lane (Mehler et al., 2014). Once alerted, the driver should take corrective action to maintain their lane position. In some vehicles, this technology is packaged with LKA systems (Jansch, 2017). The packaged system not only alerts the driver to a lane departure but will in the absence of a driver response automatically take corrective action to re-centre the vehicle in the lane (Mehler, 2014). The packaged technology has the potential to reduce the incidence of lane departure crashes among drivers who are distracted, inattentive or impaired due to fatigue/sleepiness (Jansch, 2017). At present, the successful operation of both systems is reliant on the accurate detection of road lane markings which may not always be present across rural and remote area roads where fatigue-related crashes commonly occur (Palamara, 2016).

No research could be located on the effects of LKA on lane departure crashes and associated injuries. In respect to LDW, early research by the US Highway Loss Data Institute using insurance crash data failed to provide consistent evidence to suggest these systems were associated with a significant reduction in relevant crash types (Reagan, 2018). However, a more recent US investigation by Cicchino (2017b) of relevant police reported crash types occurring 2009-2015 found significant reductions in lane departure fatal injury crashes. After adjusting for relevant driver demographics and vehicle characteristics, vehicles with LDW (only) were found to be involved in

[2] Meaning that the driver has not activated their turn signal/indicator to signify an intended change of lane.

86% fewer relevant fatal crashes than vehicles without LDW over the study period. These findings should be cautiously interpreted given that only 31 relevant fatal crashes were analysed. While not crash related, other studies have reported that drivers of vehicles fitted with LDW improved their lane-keeping by 34%, while unintentional lane departures were reduced by 50% (Mehler et al., 2014).

Blind Spot Monitoring

Through a series of cameras or sensor fitted to the side mirrors, BSM systems detect and visually alert the driver to an adjacent lane vehicle in their 'blind spot', that is, a vehicle that is outside the usual range of visibility provided by a standard side mirror (Cicchino, 2017c; Keegan, 2018). The alert typically present as a solid activated light on the side mirror and is sometimes accompanied by an audible tone (Cicchino, 2017c). Once alerted, the driver is expected to maintain their current lane position and not depart until the alert is deactivated (i.e., the adjacent lane vehicle has passed or the driver travels clear of the vehicle in the adjacent lane). On some vehicles BSM is bundled with LDW and LKA systems (Keegan, 2018), thus making it difficult to evaluate the independent effect of BSM.

One US consumer survey of 57,000 drivers of vehicles fitted with BSM reported that up to 83% of drivers were in favour of and satisfied with the technology, but this can vary with the brand of the vehicle (Monticello, 2017). In addition, up to 35% of drivers claimed that BSM helped them avoid a crash. Driver dissatisfaction was mostly commonly reported when the BSM system gave 'false warning' of a vehicle in the adjacent lane (Monticello, 2017). Confirmation of the relatively high acceptance of the technology was noted in the study by Reagan et al. (2017) who reported that only 1% of 983 vehicles fitted with BSM had the technology 'switched off' when the vehicle was presented for service at a dealer. Drivers who had turned the system off were more likely than drivers who kept the system active to complain that lane maintenance systems like BSM were distracting and annoying.

There is emerging evidence that to show BSM technologies are effective in reducing the incidence of lane departure-lane change crashes in line with consumer reports of their effectiveness. Cicchino's (2017c) investigation of crashes occurring in the US in the period 2009 to 2015 found that lane-change related crashes of all severities and injury crashes were 14% % and 23% respectively lower among vehicles fitted with

BSM compared with those without BSM (after adjusting for other crash avoidance features). Cicchino (2017c) estimated that 50,000 crashes and 16,000 injuries could have been prevented if BSM had been fitted to all vehicles in the US in 2015 and performed at the optimal level.

3.4 Secondary Safety: Occupant protection

Should a crash occur, secondary active and passive safety systems function to reduce the risk and severity of injury for vehicle occupants by managing and reducing the kinetic energy generated during the crash (Kent & Forman, 2015). These systems include:

- improved vehicle structural integrity and crumple zones to create a strong compartment for occupants (Kent & Forman, 2015; Lund, 2015);
- seatbelts and seat-belt pretensioners to secure belted occupants during a crash (Kent & Forman, 2015);
- seat-belt reminder systems (Oxley and airbags (e.g., chest, knee, side, curtain) for drivers and front and rear seat passengers to complement or supplement the use of seatbelts (McCartt & Kyrychenko, 2007; Patel, Griffin, Eberhardt & McGwin, 2013; Kent & Forman, 2015; Lund, 2016).

3.4.1 Structural Crashworthiness

The protection of occupants through improvements to the structural crashworthiness of vehicles has been a long and consistent challenge for vehicle manufacturers. The use of steel in the mass production of vehicles has helped meet this challenge because of its strength and ability to deform and absorb impact forces though the engineering of ‘crumple zones to dissipate the kinetic energy generated by the collision (Kent & Forman, 2015). This technology creates a survivable space for occupants in the event of a crash, thus reducing the risk of injury to vehicle occupants (Khalil, 2015).

3.4.2 Seatbelts and seat-belt reminder systems

Further protection for occupants in the event of a collision is provided by seatbelts. Seatbelts function to minimise the opportunity for ejection from the vehicle or contact with the interior of the vehicle (Kent & Foreman, 2015). The best estimate of the effectiveness of seatbelts in a collision is that they can reduce the likelihood of a fatal injury in a frontal crash by 40% (Kahane, 2015; Kent & Forman, 2015) and as much as 80% for rollover crashes (Kent & Forman, 2015). Their effectiveness is reduced

however, to a low of around 10% for near side-impact crashes because of intrusion into the passenger compartment (Kahane, 2015). The effectiveness of seatbelts has improved even further in recent years with the advent of the seat-belt pretensioner (webbing clamp). Vehicle deceleration forces at impact trigger the pretensioner to wind back several centimetres of the belt to tighten the belt around the occupant to reduce potential forward travel within the belt and injury (Kent & Forman, 2015).

While there is good evidence to show that a combination of legislation and enforcement has contributed to a high level of seatbelt wearing and a reduction in death and serious injury in Australia and elsewhere (Oxley et. 2009), some occupants continue to travel unrestrained. One response to this has been to introduce 'advanced' seatbelt reminder systems that utilise a network of sensors fitted to seating positions to identify occupants who are unbelted. Some systems even limit vehicle functions (e.g., speed) until all occupants are detected to be belted (Oxley et al., 2009). In their review of the effectiveness of 'advanced' seatbelt reminder systems, Oxley et al. (2009) concluded that the few evaluations that had been conducted achieved high levels of compliance across all target groups of wearers and non-wearers. Since this review, seatbelt reminder systems have continued to advance and now offer a high level of audio-visual information about non-wearers in the most troublesome rear or backseat positions (Mousel, Keisuke & Takahashi, 2015). The potential of seatbelt reminder systems to improve wearing rates and reduce occupant injury is such that they now contribute points to the safety ratings of new cars (Mousel et al., 2015) (see Section 3.5.1).

3.4.3 Supplemental Restraint Systems: Airbags

Historically, the non-use of seatbelts by occupants prompted the implementation of a 'supplemental' airbag restraint system that would passively protect unbelted occupants in the event of a collision (Kent & Forman, 2015). Their description as a 'supplemental' restraint is based on the finding that when used alone they have around 26.6% of the efficacy of seatbelts to reduce fatal injury (for driver and front seat passenger) in a direct frontal collision (Levitt & Porter, 2001) but when used in conjunction with a seatbelt can decrease the risk of fatal injury by up to 80% (Crandall, Olson & Sklar, 2001). In addition to front airbags, the fitment of side and curtain airbags can reduce the risk of fatal injury between 30%-50% for SUV drivers involved in a side collision (IIHS, 2006; McCartt & Kyrychenko, 2007) and reduce the risk of

head and thoracic injury by 75% and 68% respectively among drivers and front seat passengers involved in a near-side collision (McGwin, Metzger, & Rue, 2004).

3.5 Testing and rating the safety performance of vehicles in Australia: The identification of Safe Vehicles

In Australasia, information on the safety of new and used vehicles is provided by the *Australasian New Car Assessment Program* (ANCAP) and the *Used Car Safety Ratings* (UCSR). The star ratings provided by these programs define the Safe Vehicle status of vehicles in Australasia. Importantly, both the ANCAP and UCSR programs have promoted the evolving nature of vehicle safety and the availability of safe vehicle choices for consumers looking to purchase a new or used vehicle. A brief overview of the ANCAP and UCSR programs are presented below.

3.5.1 The Australasian New Car Assessment Program

ANCAP was founded in 1992 (Goodwin & Robson, 2017) and is part of the Global New Car Assessment Program (http://www.globalncap.org/). The aim of ANCAP is to provide Australian consumers looking to purchase a new vehicle with information on the occupant safety performance and crash avoidance features of the vehicle. ANCAP ratings are now available for the majority of new vehicles sold in Australia. In 2016, 95% of vehicles tested and rated by ANCAP achieved a 5 star rating (National Road Safety Partnership Program, 2017). For that same year it was estimated that only 8% of new vehicles sold did not have an ANCAP rating; 87% of new vehicles sold were 5 star ANCAP rated, with 4% 4 star rated (Goodwin & Robson, 2017).

The testing and assessment of vehicles to rate their safety

ANCAP determines the comparative safety performance of vehicles from the results of a series of laboratory-based crash tests and an assessment of included crash avoidance or safety assist features. From January 2018, ANCAP rates the level of occupant protection provided to adults and children; the level of protection provided to pedestrians that might be struck, and the types of crash avoidance or safety assist technologies fitted to the vehicle (http://www.ancap.com.au/safety-ratings-explained). The performance and features of the vehicle are rated against the program protocols that define the assignment of star ratings from one to five in each of the assessment areas (http://www.ancap.com.au/safety-ratings-explained). Vehicles must meet a minimum score threshold to achieve the star rating in that area. ANCAP states that to

"…*achieve the maximum 5 star ANCAP safety rating, a vehicle must achieve the highest standards in all tests and feature advanced safety assist technologies (SAT)*" (http://www.ancap.com.au/about-ancap).

The testing/assessment and rating protocols employed by ANCAP have evolved over time, with the most recent evolution resulting in an alignment with EuroNCAP protocols (ANCAP Strategic Objectives 2016-2018; http://www.ancap.com.au/ancap-evolution). One consequence of the continued evolution is that star ratings assigned to vehicles under much earlier protocols are not necessarily consistent with current day protocols and star ratings. Consumers may inappropriately assume that a vehicle model achieving a 5 star rating many years earlier has a comparable level of safety as the most recent model achieving a 5 star rating. While contemporary ANCAP ratings consider secondary safety as per the focus of past testing protocols, they also take into account in a number of crash avoidance technologies which were less readily available during the earlier years of testing (http://www.ancap.com.au/ancap-evolution).

A further issue in relation to the meaningfulness of a given star rating over time is how well the rating, which is mostly based on laboratory-based crash testing of a vehicle, reflects the real-world performance for the protection of occupants (particularly drivers) in the event of a crash. This issue has been the subject of investigation in the Used Car Safety Rating program of research since it and ANCAP both rate the secondary safety of vehicles (Newstead & Scully, 2012). To investigate the relationship between the two scores of secondary safety, Newstead and Scully (2012) considered 69 Australian vehicles tested and rated by ANCAP during the period 1997 to 2007 for which crash and driver injury information was also available. They reported that ANCAP test scores (based on the protocol at the time of initial testing) accounted for 35% of the variance in UCSR scores (which are based on the severity of injury sustained by drivers in the recorded crash). Further analysis of the data after applying weightings to the various component ANCAP measures improved the level of explained variance in UCSR ratings between 55% and 65%. At the time of publication the authors concluded that the "…current ANCAP protocols [of that time] still do not reflect all important real world crash configuration and injury outcomes to body regions" (page 48). These findings affirm the importance of consumers consulting the UCSR program – and not just

historical ANCAP ratings - when considering the purchase of an older, second hand vehicle.

The promotion and use of ANCAP's safe vehicle ratings

Australian attitudes toward vehicle safety have improved over the years in association with increased consumer awareness of the ANCAP brand and their vehicle safety ratings (McIntosh, 2012; ANCAP, 2016). In 2016, approximately 74% of new car buyers in Australia were aware of the ANCAP brand (Goodwin & Robson, 2017). Nowadays, ANCAP ratings are highly visible in the electronic and print media and feature prominently in the advertising on vehicle manufacturers' websites and promotional materials (McIntosh, 2012). In 2016, approximately 44% of a sample of new car buyers surveyed stated they obtained their ANCAP safety rating information via vehicle dealerships more so than digital or print media or the internet - which presumably includes ANCAP's own website (Goodwin & Robson, 2017). An ANCAP ratings option can also be used to 'filter' new and used vehicles listed for sale on www.carsales.com.au and www.gumtree.com.au/cars, Australia's two largest on-line advertisers of new and used vehicle for sale.

ANCAP's own website provides up to date and historical vehicle safety rating reports, including some based on EuroNCAP testing. The site also provides detailed, consumer-focussed information and advice on an array of Advanced Driver Assistance Systems (e.g., ESC, ABS, AEB, ACC, LDW, LKA, BSM). Overall, the ANCAP site provides a high level of information and advice that consumers can consider when purchasing a new vehicle.

The ANCAP site is complemented by the www.howsafeisyourcar.com.au and www.howsafeisyourfirstcar.com.au websites developed and administered by the Victorian Transport Accident Commission. When the former website was first launched it provided information on the safety of over 80% of registered vehicles in Australian with a build date post-1990 (Cockfield, Thompson & Truong, 2011). Both websites incorporate an up to date searchable safety rating database using information from ANCAP and the UCSR program for used cars. The latter website is particularly focussed on the provision of budget-based safe vehicle information to young and novice drivers purchasing their first vehicle.

In previous years, ANCAP had partnered with the state governments of South Australia and Western Australia to trial the promotion of 5 star rated cars through a new car dealership-based program titled 'Stars on Cars' (https://www.ancap.com.au/stars-on-cars). The intent of the program was to provide 'point of sale' information via stickers and tickets on new vehicles advising potential buyers of the safety rating of the vehicle. The trial was supported with a range of on-line, multimedia and community based advertising conveying various messages such as 'Beware of cars with less than four stars' and 'Check the safety rating before you buy' (http://www.abc.net.au/news/2011-03-01/road-safety-minister-tom-kenyon-hopes-stars-on/1961698). Findings from an initial trial of the program in Western Australia found that 15% of showroom visitors were able to recall select Stars on Cars material with 35% indicating that the Stars on Cars had influenced their vehicle purchasing decision (VicRoads, 2009). No information could be found on the effectiveness of this program or when it ceased.

ANCAP has created a high level of brand awareness to market the importance of safety when purchasing a new car (Goodwin & Robson, 2017), which in turn has influenced consumer attitudes toward vehicle safety as a vehicle purchasing feature. In 2012, 25% of Australian consumers ranked safety as their first priority when selecting a vehicle (McIntosh, 2012). By 2014, brand tracking research conducted by ANCAP indicated that safety was the highest ranked priority of a sample of Australian new car buyers (Clarke, Paine, Robson, Smith & Haley, 2015). The importance of vehicle safety was similarly reported in a 2014 survey of 485 Victorian drivers who intended to purchase another vehicle, either new or second hand (The Social Research Centre, 2014). The survey found that vehicle safety was ranked second to the 'condition of the vehicle', with some variance in the rankings provided by males and females and drivers of varying ages (ranging from 18-61+ years). Overall, safety was ranked slightly lower by males and younger age persons.

While safety may be a high priority among some consumers, it may not necessarily mean that ANCAP ratings are the most important and defining priority when selecting a vehicle. A 2011 survey of 3,852 Australian vehicle buyers' attitudes toward vehicle safety (Clark, Hoareau, Newstead, Koppel & Charlton, 2012) reported that 30% of those surveyed considered the vehicle's ANCAP safety rating to be a high priority factor when selecting a vehicle. Approximately 16% of those surveyed were unfamiliar

with the ANCAP rating. Across all participants the ANCAP rating was ranked fourth behind 'price', 'fuel efficiency', and 'reliability' in the list of priorities for selecting a vehicle. Among those 1,004 persons who had recently purchased a vehicle, 24% said the ANCAP rating had been a high priority, with 19% claiming to have no knowledge of ANCAP ratings (Clarke et al. 2012).

The increased importance of vehicle safety and a high level of awareness of the ANCAP brand and its ratings (at least among new car buyers) also does not mean that drivers will necessarily be aware of the safety rating of their own vehicle. Findings from a local survey of RAC WA members in 2016 identified that 68% of the 284 car owners did not know their vehicle's ANCAP rating (RAC WA, 2017). Those that claimed to know their vehicle's rating were not however asked to give the rating and details of their vehicle to validate their claim. In some respects it may be less important to have an understanding of a potentially historical ANCAP rating as opposed to a contemporary UCSR which is derived from injuries sustained by crash involved drivers over an extended period of time.

The promotion of vehicle safety through ANCAP has also influenced fleet purchasing strategies. In 2017 the Australian Government adopted a 5 star fleet purchasing strategy (https://www.finance.gov.au/vehicle-leasing-and-fleet-management/fleet-guidance-and-related-material.html); similarly the Western Australian Government has mandated that Public Sector Bodies purchase 5 star rated vehicles (Government of Western Australia, 2017). Five-star fleet purchasing strategies of this kind will inevitably contribute to a faster uptake of safe vehicle in the private sector through the eventual on-sale of these corporate vehicles (Australian Transport Council, 2011).

Conclusion

ANCAP has evolved to be a significant source of information in Australia about the safety of new vehicles. Its star ratings are now used by manufacturers and consumers alike to promote and inform the purchase of new vehicles, though not all consumers will necessarily rank the ANCAP rating as the most important factor when choosing to purchase a new car. The ANCAP protocols and criteria for ratings new vehicles will understandably continue to evolve with the release and proven effectiveness of new safety technologies. Therefore, historical ratings should be viewed in conjunction with Used Car Safety Ratings (where available) to understand the real world performance of

the vehicle to protect drivers against injury. The Used Car Safety Ratings program is reviewed in the following section.

3.5.2 The Used Car Safety Ratings

The Used Car Safety Ratings evolved out of the program of research investigating the relationship between vehicle age and vehicle crashworthiness undertaken by the Vehicle Safety Research Group (VSRG) (Monash University Accident Research Centre [MUARC], nd). The aim of the UCSR program, which commenced in 1992, is to provide purchasers of *used vehicles* with information on the comparative secondary safety of vehicles to protect crash involved drivers and vulnerable road users (e.g. motorcyclists, cyclists and pedestrians) (Vehicle Safety Research Group, 2017). The most recent update of the safety of used vehicles determined that 48 crash involved vehicles manufactured post-1996 were 5 star rated (Vehicle Safety Research Group, 2017).

Establishing the safety rating of used vehicles

A discussion of the technical and analytic methods underlying the calculation of the UCSR is beyond the scope of this review. Full details of the UCSR methodologies can be found in the most recent update of the safety ratings prepared by Newstead et al. (2016). The following information is provided to highlight the contrasting nature of the UCSR and ANCAP rating systems.

As discussed in Section 3.5.1, ANCAP ratings reflect the crashworthiness of the vehicle based on performance across a range of laboratory-based crash scenarios and an assessment of the level of fitment of various safety assistance technologies. In comparison, the UCSR uses police recorded crash data to estimate the comparative risk of death or serious injury (hospitalisation) for a driver of a particular vehicle. The UCSR also classifies vehicles (the 'Safe Pick') according to their level of aggressivity, that is, the likelihood of causing serious injury to others involved in the crash (e.g., drivers of other vehicles, pedestrians, motorcyclist, cyclists) and the fitment of crash avoidance technologies such as ESC. The most recent update of the UCSR produced by Newstead, Watson & Cameron (2016) analysed over 7.5 million crash records from Australia and New Zealand for the period 1987 to 2014 involving vehicles manufactured during the years 1982 to 2015. The findings from these analyses are then

translated to a form to produce a consumer-friendly star rating system for vehicles by segment segment (e.g., car size and car type such as SUV, commercial).

The promotion and use of the UCSR

The consumer-level output from the most recent update is the *2017-2018 Used Car Safety Ratings Buyer's Guide*. The Guide lists the Make, Model and Year of Manufacture (1988-2015) of select vehicles by market segment and their associated star based driver protection ratings. Vehicles with a 5 star rating provide a comparatively excellent level of driver protection; those with 1 star provide comparatively very poor driver protection. The Guide also informs consumers which 5 star vehicles are also a 'Safe Pick' (Vehicle Safety Research Group, 2017). The *2017-2018 Guide* lists 48 vehicle models across all segments as 5 star, with most also rated as a 'Safe Pick'.

Versions of the *Buyer's Guide* have been produced in various forms since 1992. The *Guide* is readily available for download from government road authorities and motor organisation websites. Unlike the ANCAP ratings however, UCSR do not feature in the sales and marketing material of the www.carsales.com.au and www.gumtree.com.au/cars websites. The UCSR are frequently publicised through the media when updated ratings are released to ensure the public is reminded of the usefulness of the *Guide* and the importance of making a 'safe choice' when selecting a second hand vehicle (e.g., https://www.rsc.wa.gov.au/News/Media-Releases/2017-safety-rating-for-used-car-buyers).

One of the many benefits of the UCSR is that it provides empirically-based information on the comparative safety of 'budget' older vehicles for younger, novice drivers who are typically less able to afford newer vehicles. This is the main marketing point of the www.howsafeisyourfirstcar.com.au site administered by the Victorian Transport Accident Commission. The site provides information on the ANCAP and UCSR 4 and 5 star rated vehicles by approximate price. As noted above, the UCSR also feature prominently in the www.howsafeisyourcar.com.au site. Together, both sites provide up to date consumer information on the safety of vehicles at the time of their release (ANCAP ratings) and their actual safety performance since their release (UCSR).

As per the ANCAP ratings, historical UCSR may create some confusion and misunderstanding about the comparative safety of a used vehicle at a given point in

time. As newer and potentially safer used vehicles enter the ratings program[3] the benchmark standard which vehicles are assessed against may be lowered (which equates to a higher standard of safety), thereby causing the ratings for some older vehicles to fall over time.

> *"Consumers can expect the rating of their vehicle to get worse over time because the ratings reflect the safety of a vehicle in comparison to all others currently in the fleet, a fleet which improves constantly as newer vehicles enter it with on average better safety performance. Consequently, the ratings can be used by people to identify when they can make significant gains in safety by updating to a newer, safer vehicle."*
> (Vehicle Safety Research Group, 2016)

This process highlights the evolving and dynamic nature of the ratings of the UCSR program. Consequently, a high level of public education and promotion is required to keep the motoring public informed of the comparative safety of their vehicle and when it should be updated to maintain an optimal level of protection against injury.

Very little information could be retrieved on Australians' knowledge and use of the UCSR when deciding on a vehicle. The aforementioned Australian survey of prospective vehicle buyers reported by Clarke et al. (2012) noted that nearly one-third rated the UCSR as "…a high priority in their decision making process…" (page 5), though 7% claimed not to know of the UCSR. Among the sample of 1,004 persons who had just recently purchased a vehicle, Clarke et al. (2012) further reported that 21% considered the UCSR to be high priority in their vehicle choice, though overall it was ranked below 'price', 'fuel efficiency' and 'reliability' as priority factors. Among this sample of recent buyers, 11% claimed not to know of the UCSR. A lack of knowledge of the UCSR was also noted in RAC WA survey of vehicle owners (RAC WA, 2017). The analysis of unpublished survey data found that 56% of participants said they did not even know that safety ratings for used cars existed.

Conclusion

The UCSR program has for many years provided Australian consumers with important complimentary information on the safety of used vehicles based on injuries sustained

[3] Newer used vehicles enter the publicised ratings once they have been involved in a minimum number of crashes (around 400), which may occur as early as three to four years of the vehicle's initial release in Australia.

by drivers involved in police reported crashes. Even so, vehicle safety – as defined by the UCSR – appears not to rank highly in the decision making of the majority of potential and recent car buyers. This could be because the UCSR program does not have the same community profile as ANCAP. Sellers of used vehicles do not refer to the UCSR to promote the vehicle but instead will refer to a historical ANCAP rating which provide important but nevertheless historically-based safety information. Other, limited survey information suggests that in Western Australia at least, vehicle owners appear unaware of the existence of the UCSR program.

3.6 The need to promote Safe Vehicles to young novice and rural and remote drivers

Young novice drivers and those who predominantly drive in rural and remote areas of Western Australia have been identified as high priority targets for the promotion of the uptake of Safe Vehicles (https://www.rsc.wa.gov.au/Your-Safety/Safety-Topics/Vehicle-Safety; https://www.rsc.wa.gov.au/Your-Safety/Safety-Topics/Novice-Drivers). This section will provide an overview of the risk of crashing and injury among these vulnerable drivers groups and how Safe Vehicles can help mitigate these risks.

3.6.1 Young novice drivers

Relative to older age and more experienced drivers, young novice drivers (typically aged 17-25 years) are known to have a substantially higher risk of crashing and injury. Overall, the risk of injury among young drivers is five to 10 times that of older age drivers, with highest risk of crashing and injury occurring within the initial months of licensure (Bates, Davey, Watson, King & Armstrong, 2014). Nationally, those aged 17-25 years represent approximately 13% of the Australian population but account for 22% of all drivers fatally injured (Senserrick, 2015). In Western Australia, the most recent statistics for those aged 17-24 years by road user type show that around 15% of drivers killed or seriously injured in 2013 were aged 17-24 years (Bramwell, Bruce, Hill & Thompson, 2014).

Their over-involvement in injury crashes is thought to be due to their relative lack of experience, immaturity, and risk taking (Palamara, Molnar et al., 2013; Oxley et al., 2014) and an increased likelihood of crashing in older, less safe vehicles (Watson & Newstead, 2009). In relation to the latter, Watson and Newstead's (2009) analysis of Australian crashes occurring during the period 1987 to 2005 found that the vehicles of

drivers aged 16-24 years were more likely to be older than the average age of all crash involved vehicles and especially older than those involving older age drivers. For example, on average, 13.3% of crashing vehicles involving younger drivers were 16 years or older at the time of the crash compared with 7.6% of crashed vehicles involving drivers aged 25+ years. Further analysis showed that the average crashworthiness (i.e., drivers' risk of injury) of crashing vehicles involving younger age drivers was poor when compared with the crashworthiness of crashed vehicles involving older age drivers. This was consistent across all vehicle age categories. The finding suggests that even when younger age drivers crash in a vehicle of approximately the same age as one involving an older driver counterpart, the vehicle will still have lower level of crashworthiness, perhaps because it is a lower specified model for the year of manufacture. These findings are generally supportive of those reported internationally of the use by younger age drivers of older, less crashworthy vehicles with fewer crash avoidance technologies such as ESC (Scott-Parker, 2012).

The crash types of young novice drivers also highlight the need for this age group to be driving vehicles with a high level of crash avoidance technologies as per those reviewed in Section 3.3. Australian and international research has identified that younger age drivers are typically involved in single-vehicle, run off road loss of control type crashes (Scott-Parker, 2012; Wundersitz, 2012; Oxley et al., 2014; Buckis, Lenne & Fitzharris, 2015). Based on literature reviewed in Section 3.3, it is clear that these types of crashes may be mitigated by the use of Electronic Stability Control, Lane Departure Warning and Lane Keeping Assist technologies.

In addition to the above crash types, there is concern that young adolescent drivers are at increased risk of involvement in a forward collision crashes because they are more inclined to be 'distracted' by in-vehicle technologies and the use of mobile phones whilst driving (Bingham, 2014). These are the types of crashes which may be mitigated through the use of Autonomous Emergency Braking and possibly Adaptive Cruise Control.

Advanced Driver Assistance (ADAS) technologies such as LDW, LKA, and AEB and standard vehicle stability and control systems such as ABS, ETC and ESC have the potential to compensate and mitigate the skills deficits of young drivers and reduce their overall crash risk (Weiss, Thiel, Sultana, Hannan & Seacrist, 2018). At issue

however, is the levels of knowledge young drivers and their parents have of these technologies and whether they will be readily accepted and adopted. Generally speaking, young people are known for their willingness to embrace and show trust in new technologies (Weiss et al., 2018) but this does not seem to extend to ADAS technologies which have a higher level of automation. The findings from a series of focus groups in the US consisting of young drivers and their parents (Weiss et al., 2018) noted that the former were more sceptical and resistant to the use of ADAS. On the other hand, parents were more willing to embrace the technology because of the perceived potential to improve their child's driving skill and reduce their risk of collision. Both young drivers and parents also considered that youngsters should learn to drive on non-ADAS equipped vehicles so they might initially develop required vehicle handling skills. Unless they did so, there was concern that young drivers might become complacent and develop a "…false sense of safety and become distracted…" (page S123). The final concern expressed by young drivers about ADAS technologies concerned the need to customize these technologies. Young drivers expressed interest in being able to change alert and sensitivity settings to control and modulate the system. If the system was too sensitive or too intrusive, they suggested they might turn the system off altogether.

These focus group study findings, whilst exploratory, provide an important insight of the need to ensure that Safe Vehicle technologies are well promoted and explained to highlight their utility and effectiveness to support young inexperienced drivers to reduce their risk of crash involvement.

At this point in time, no relevant Western Australian information could be located on the use of Safe Vehicles by young Western Australian drivers or their attitudes toward Safe Vehicle technologies and their use.

3.6.2 Rural and remote area drivers

Around a third of all Australians live outside metropolitan or regional areas and yet around a half of all road deaths occur in these regions (CARRS-Q, 2012). These population demographics are similar for Western Australia where approximately 56% of road deaths occurred in 2017 (Road Safety Commission, 2018). Overall, there is strong evidence to conclude that the risk of being killed or hospitalised for persons crashing in regional and remote Australia is 4.2 and 2.3 times respectively that of

persons crashing in urban Australia (CARRS-Q, 2012). Other research sponsored by the WA Road Safety Commission highlights the risk of crashing and injury on Western Australia rural and remote roads. The investigation by Palamara et al. (2013) of crashes occurring 2005-2009 on Western Australian roads found that the risk of a crash involving death or serious injury (hospitalisation) was 4.5 times higher in rural and remote WA compared with metropolitan Perth.

Rural and remote area crashes are more likely to result in death or hospitalisation for a variety of reasons, some which may be mitigated through the increased use of Safe Vehicles and ADAS technologies by drivers in these areas. Crashes occurring in these areas are particularly defined by their run-off road nature. Lower quality roads with narrow and/or unsealed shoulders and poor curve delineation can lead to loss of control crashes (CARRS-Q, 2012). In Western Australia, Palamara et al. (2013) found that off-straight and off-curve crashes during the period 2005-2009 were significantly more likely to occur on regional (45.1% and 25.6% respectively) and remote area roads (25.6% and 25.6%) than on metropolitan Perth roads (17.1% and 8.3%). As for young driver crashes, these crash types can be mitigated through the use vehicle control and stability technologies such as ESC and lateral crash avoidance technologies such as LDW and LKA. The two latter technologies may also be beneficial in reducing the incidence of driver fatigue related crashes which feature among single vehicle loss of control crashes on high speed (i.e., >=80km/hour) regional and remote area roads in Western Australia (see Palamara, 2016).

Two of the many challenges in the promotion of Safe Vehicles in the rural and remote areas of WA relate to the use of ‘fit for purpose’ vehicles and the affordability of Safe Vehicles by residents in these areas. Quasi-commercial vehicles (e.g., utility type vehicles) are frequently used in these areas but have been historically known to be less crashworthy because of unwillingness by ‘commercial customers’ to pay for additional safety features (McIntosh, 2012). While 5 star fleet purchasing decisions are likely to address this in the case of larger scale commercial operators, some smaller scale or single operators in regional and remote areas may be less willing or able to upgrade or update their vehicles to obtain greater levels of safety.

The issue of fit for purpose vehicles that are safe and affordable is also highly relevant to Aboriginal populations who reside in regional and remote areas. These persons are

known to have a high risk of road related injury (Brameld & Meuleners, 2018) which may in part be due to their increased use of older, less safe vehicles (CARRS-Q, 2016). Consultations with Aboriginal communities in South Australia and observations of their travel arrangement show they use older, unsafe, unsuitable and over-crowded vehicles to travel long distances (Helps, Moodie & Warman, 2010). The concern that has been expressed in these communities is that safe vehicles are more expensive and even more costly to service and maintain than cheaper, older vehicles.

Socio-Economic Status (SES), Social Disadvantage and region of residence are broadly correlated; those living in more remote areas tend to be of lower SES and to be more socially disadvantaged (ABS, 2011). Consequently, the affordability of safer, newer cars is a critical issue for persons residing in regional WA and particularly remote WA. The review did note that the Road Safety Commission of Western Australia has produced a consumer guide on safe vehicles suitable for remote and regional Western Australia (https://www.rsc.wa.gov.au/RSC/media/Documents/Resources/Publications/consumer-guide-safer-vehicles) which alludes to the issue of affordability. It provides some guidelines regarding the age of second hand vehicles and the driving conditions these are most suitable for in regional WA.

At this stage there is no other relevant information on the use of Safe Vehicles by drivers in Western Australia's rural and remote areas or other information pertaining to their attitudes toward Safe Vehicles. It is clear however, that the promotion of Safe Vehicles and their uptake by rural and remote areas drivers is a high priority to complement the Safe Speed, Safe Roads and Safe Road Use *Toward Zero* strategies being applied in these areas.

4 RESULTS: ON-LINE SAFE VEHICLE SURVEY

A total of n=660 on-line submissions were received of which n=619 were retained for analysis. Forty-one submissions were excluded from analysis for the following reasons:

- An inability to classify the driver by age and/or region of residence due to missing information.
- Incomplete or missing responses for a large number of survey items.
- The driver did not meet the specified recruitment criteria, i.e., aged 17-25 years residing in Metropolitan Perth or Rural/Remote WA, or aged 26+ years residing in Rural/Remote Perth.

4.1 Description of participating drivers

The demographic, licensing and driving details of the drivers by Age-Region group are presented in Table 4.1. Of the 619 drivers, 47.2% (n=292) were aged 17-25 years and 52.8% (n=327) aged 26+ years. Approximately 25% (n=74) of the sample of younger-age drivers resided in Rural/Remote WA. The sample, across all ages, was biased toward drivers from Rural/Remote WA versus Metropolitan Perth (64.7% *versus* 35.3%). Classification of the residential location (based on reported post-code) of Regional WA drivers was undertaken using the Accessibility and Remoteness Index of Australia (ARIA+) (Australian Bureau of Statistics, 2018). This showed that about a quarter of Regional WA drivers resided in Inner Regional areas; half resided in Outer Regional areas, while the remaining quarter resided in Remote/Very Remote areas.

The median age of older-age drivers from Rural/Remote WA was 49 years (26 years min.; 82 years max.), while the median age of Metropolitan Perth and Rural/Remote younger-age drivers was 20 years and 21.6 years respectively. The difference in the median age of the two younger-age driver groups was statistically significant (Independent Samples Median test, $p < 05$).

Approximately 66% of all drivers were female, with the proportion of females significantly (X^2=9.65, df=2, p< 0.01) higher among younger-age Rural/Remote drivers (75.7%) compared with younger-age Metropolitan Perth drivers (70.8%) and older-age Rural/Remote drivers (60.6%).

Table 4.1 Descriptive information for drivers; by Age-Region group

	Driver Age-Region Group					
	17-25 years Perth (n=218)		**17-25 years Rural/Remote (n=74)**		**26+ years Rural/Remote (n=327)**	
Median Age	20 Years		21.6 Years		49 Years	
	n	%	n	%	n	%
Sex						
-Female	153	70.8	56	75.7	198	60.6
-Male	63	29.2	18	24.3	129	39.4
-All	*216*	*100*	*74*	*100*	*327*	*100*
Driver Licence Type						
-Full unrestricted	127	60.2	50	69.4	323	99.7
-Probationary Red	29	13.7	10	13.9	0	0.0
-Probationary Green	55	26.1	12	16.7	1	0.3
-All	*211*	*100*	*72*	*100*	*324*	*100*
Driving Days Per Week						
-No more than 2 days per week	15	7.1	8	11.1	22	6.8
-3 to 4 days per week	43	20.5	9	12.5	27	8.3
-5 to 7 days per week	152	72.4	55	76.4	275	84.9
-All	*210*	*100*	*72*	*100*	*324*	*100*
Kilometres Driven Per Day						
-Up to 25km	103	49.0	37	51.4	131	40.4
-26 and 50km	76	36.2	21	29.2	85	26.2
-51km or more	31	14.8	14	19.4	108	33.3
-All	*210*	*100*	*72*	*100*	*324*	*100*
Drive with passengers under 17 years of age						
-No	55	27.4	15	21.7	64	20.3
-Yes	146	72.6	54	78.3	251	79.7
-All	*201*	*100*	*69*	*100*	*315*	*100*
Crash involvement in the last three years or since licensure						
-No	138	72.3	51	78.5	270	86.0
-Yes	53	27.7	14	21.5	44	14.0
-All	*191*	*100*	*65*	*100*	*314*	*100*

Nearly all older-age Rural/Remote drivers held a full, unrestricted C-Class drivers' licence (99.7% n=323). Cross-tabulation of the licence types by region of residence for the younger-age drivers showed that nearly seven in ten Rural/Remote area drivers held a full, unrestricted drivers' licence compared with six in ten Metropolitan Perth drivers

(69.4% n=127 *versus* 60.2% n=150). In contrast, Probationary Green licences (post 6 months licensure) were more frequently reported by Metropolitan Perth younger-age drivers (26.1% n=55 *versus* 16.7% n=12). The differences in these proportions was not however, statistically significant. Across the two younger-age groups, ~13.7% (n=29, n=10) of drivers reported holding a Red Provisional licence, meaning they had been licensed for less than six months.

Across the driver Age-Region groups most drivers reported driving 5-7 days per week on average, though this level of driving was reported by a significantly greater proportion of older-age drivers in Rural/Remote WA than either younger-age group (X^2=18.54, df=4, $p < 0.001$). The majority of drivers in each Age-Region group reported driving up to 25 kilometres per day on average, though a significantly greater proportion of older-age drivers in Rural/Remote WA reported driving 51 kilometres or more per day on average (X^2=25.64, df=4, $p < 0.001$).

Rural/Remote area drivers, both older (79.7% (n=253) and younger (78.3% n=78.3), were somewhat more likely than younger-age Metropolitan Perth drivers (72.6% n=72.6) to report driving with passengers less than 17 years of age. The differences in proportions were not found to be statistically significant, however.

The vast majority of drivers across all three Age-Region groups claimed not to have been involved in a crash in the last three years or since licensure (if less than three years). However, crash involvement and Age-Region were found to be significantly associated (X^2=14.48, df=2, $p < 0.001$). A greater proportion of Metropolitan Perth younger-age drivers reported being involved in one or more crashes (27.7% n=53) compared with younger-age Rural/Remote drivers (21.5% n=14) and older-age Rural-Remote drivers (14% n=44).

4.2 Description of the drivers' vehicles

4.2.1 Age of the vehicle most frequently driven

Descriptive statistics for the date of manufacture and age of the vehicle most frequently driven is presented in Table 4.2. Date of manufacture was self-reported by drivers and used to calculate vehicle age (using the January 1st 2018 as the reference date). Across all drivers, the median age of the nominated vehicle was 8 years (minimum age 1 year; maximum age 39 years). The median vehicle age of vehicle was found to significantly

vary (Independent Samples Median Test; p=0.000) across the Age-Region driver groups. Older-age Regional/Remote WA drivers were significantly more likely to report driving a younger age vehicle (md=6 years) compared with younger-age drivers, irrespectively of region of residence (md=10 years for both 17-25 year Age-Region groups).

Table 4.2 Median age of vehicle and Manufacture Year group; by driver Age-Region

	Age and Region Driver Group							
	17-25 years Metro Perth		**17-25 years Regional WA**		**26+ years Regional WA**		**All Drivers**	
Median Age of Vehicle	10 Years		10 Years		6 Years			
MY Group	n	%	n	%	n	%	n	%
MY up to 2001	27	14.4	12	17.4	30	9.6	69	12.1
MY 2002-2006	43	22.9	18	26.1	37	11.8	98	17.2
MY 2007-2011	64	34.0	19	27.5	86	27.4	169	29.6
MY 2012-2017	54	28.7	20	29.0	161	51.3	235	41.2
Total	**188**	**100**	**69**	**100**	**314**	**100**	**571**	**100**

n=48 missing Vehicle Age

Aggregation of the vehicle year of manufacture (MY) in to four groups (based on Australian Bureau of Statistics (ABS, 2017) defined categories) revealed that around three in ten of all drivers drove a vehicle manufactured in the period 2007-2011, with four in ten driving a vehicle manufactured 2012-2017. Vehicle MY group and Age-Region were significantly associated (X^2=35.37, df=6, p=0.000). Younger-age drivers in Metropolitan Perth (37.3% n=70) and Rural/Remote WA (43.5% n=30) were more likely to drive vehicles manufactured prior to 2007 compared with older-age Rural/Remote drivers (21.4% n=67). Older-age Rural-Remote drivers were also more likely than younger-age drivers to drive vehicles manufactured 2012-2017.

4.2.2 Safe Vehicle ratings

Of the n=619 drivers, 11% (n=68) did not provide sufficient information about their vehicle to ascertain either an ANCAP or UCSR safe vehicle rating. In addition, a rating could not be retrieved for the vehicles of another 3.7% of drivers because no rating –

either ANCAP or UCSR - was available. The absence of a vehicle rating (due to missing vehicle information or one not being available) was proportionally higher for drivers aged 17-25 years in Metropolitan Perth (17.8%) compared with driver aged 17-25 years in Rural/Remote WA (13.5%) and drivers aged 26+ years in Rural/Remote WA (12.8%). For the remaining 528 drivers, a relevant UCSR was retrieved for 73% (n=388) of vehicles and a relevant ANCAP rating for 26.5% (n=140) of vehicles.

The distribution of vehicle UCSR ratings is presented in Figure 4.1. Ratings were obtained for vehicles manufactured between 1992 and 2015. Around four in ten of all vehicles (39.7%) had a current (2017/2018) 4-5 Star rating (*Good to Excellent Driver Protection*) with six in ten (60.3%) rated 1-3 Stars (*Very Poor to Marginal Driver Protection*). These proportions varied significantly with the Age-Region group of the driver (X^2=44.54, df=2, p=0.000). The proportion of 1-3 Star rated vehicles was significantly greater among younger-age Metropolitan (78.7%) and Rural/Remote (70.9%) drivers compared with older-age Rural/Remote drivers (43.8%).

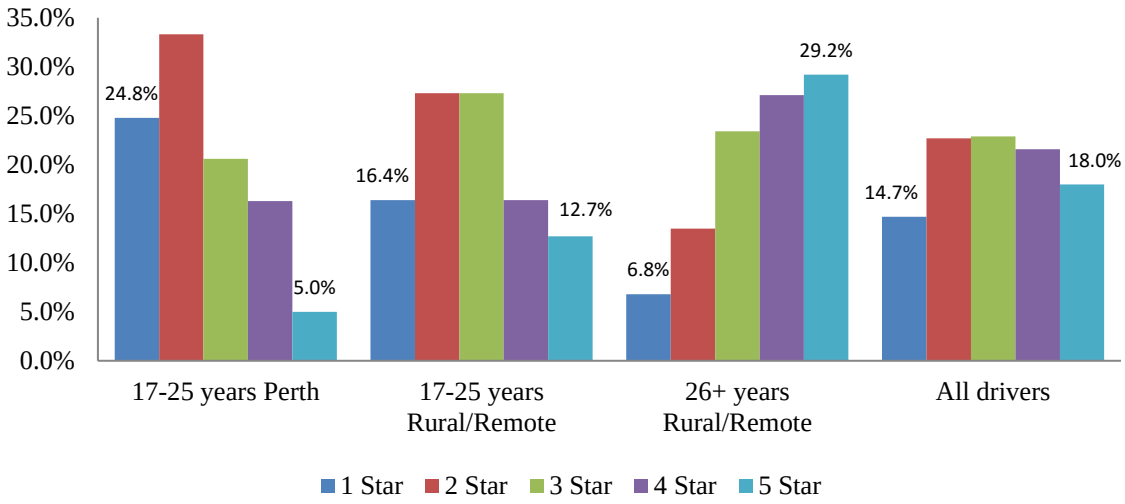

Figure 4.1 Vehicle Used Car Safety Ratings; by driver Age-Region group

The distribution of vehicle ANCAP ratings is presented in Figure 4.2. Ratings were obtained for vehicles manufactured between 2005 and 2017. For all drivers and within all Age-Region groups, the vast majority of cars were rated as 5 Stars. Consequently, no further analysis of this distribution was undertaken

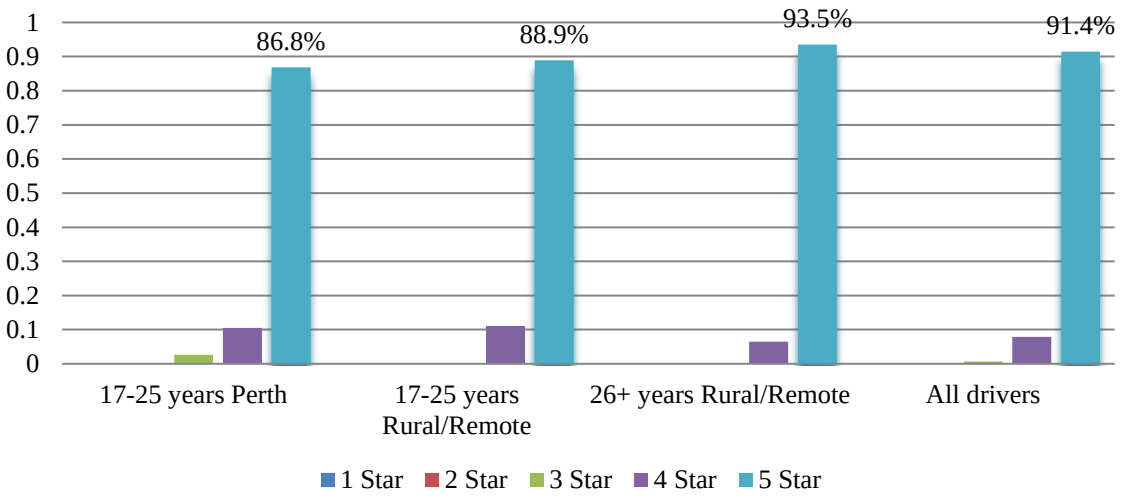

Figure 4.2 Vehicle ANCAP ratings; by driver Age-Region group

Due to the comparatively small number of ANCAP-only rated vehicles, the ratings were merged with the UCSR for further analysis based a 1-3 Star and 4-5 Star grouping representing less safe and most safe vehicles respectively. The combined rating distribution for 1-3 and 4-5 Stars by driver Age-Region is presented in Figure 4.3. The distribution shows a very strong association with driver Age-Region (X^2=57.48, df=2, p=0.000) in that the majority of younger-age drivers, irrespective of region of residence, drive a 1-3 Star rated vehicle.

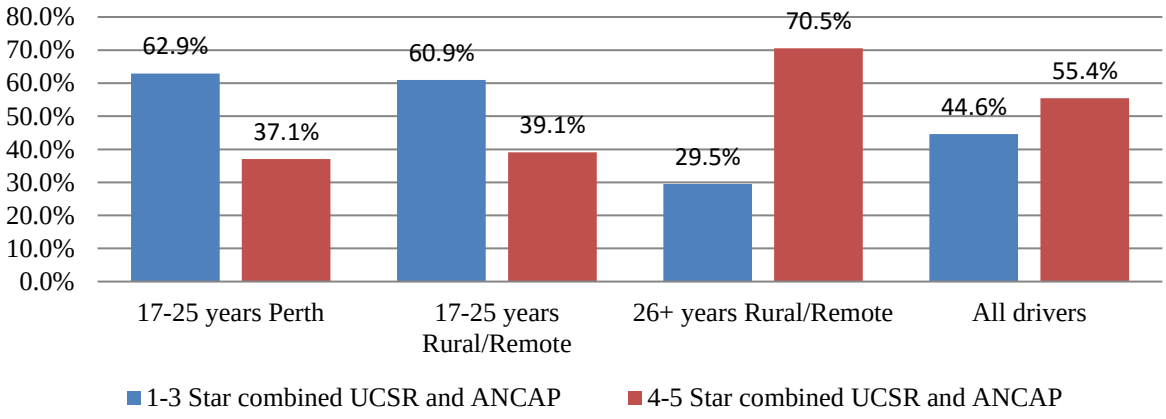

Figure 4.3 Combined UCSR and ANCAP 1-3 Star and 4-5 Star ratings for vehicles; by driver Age-Region group

For younger-age drivers only (given their comparatively lower usage of Safe Vehicles), logistic regression was used to model the use of 4-5 Star rated vehicles using the characteristics of drivers (see Table 4.1) as predictor variables. The findings of the

analysis, adjusted for the driver's region of residence, are presented in Table 4.3. Significant main effects were found for three factors: licensing type, the carriage of passengers younger than 17 years of age, and the drivers' history of previous crash involvement. Compared with younger-age drivers who held a full licence, probationary Red and Green licence holders, had significantly reduced odds of 21.7% (OR=.271) and 44.1% (OR=.441) respectively of driving a 4-5 Star rated car. Younger-age drivers who reported having been involved in one or more crashes in the previous three years (or since licensure) had significantly lower odds (49.2%, OR=.492) of driving a 4-5 star rated vehicle compared with drivers who reported not having been involved in a crash. Lastly, younger-age drivers who sometimes or more frequently drove with passengers aged under 17 years had significantly increased odds (2.2 times, OR=2.21) of driving a 4-5 Star rated car compared with those who did not drive with passengers under 17 years of age. This model correctly predicted 72% of drivers' use of 1-3 Star rated vehicles and 47.6% of drivers' use of 4-5 Star rated vehicles.

Table 4.3 Driver characteristics associated with the use of a UCSR/ANCAP combined 4-5 Star rated vehicle by 17-25 year old drivers

Driver Characteristic	Odds Ratio	95% Confidence Interval	P-value
Licence Type			
Full^	1.00	-	-
Probationary Red	.217	.069-.679	.009
Probationary Green	.441	.212-.919	.029
Previous Crash Involvement			
No^	1.00	-	-
Yes	.492	.252-.960	.038
Driver of passengers under 17 years of age^		-	-
Never	1.00	0.89-3.08	-
Sometimes or more frequently	2.21	1.07-4.60	.032

^ Base level * Adjusted for drivers' region of residence

4.2.3 Acquisition of the vehicle

Information on how drivers in each Age-Region group acquired their car, cross-tabulated by the star rating group of the vehicle, is presented below.

17-25 year old Metropolitan drivers

The means by which 17-25 year old Metropolitan Perth drivers acquired their car cross-tabulated by the combined UCSR/ANCAP rating is presented in Table 4.4. Approximately 55% (n=98) of drivers claimed they bought the car for themselves to drive. Nearly seven in ten vehicles acquired this way were 1-3 Star rated. The purchase of the car by someone else was the next most frequent means of acquisition (18% n=32), with just over half of those cars being 1-3 Star rated. The highest percentage of 4-5 Star rated cars driven by this group was associated with the co-use and ownership of the car with another (66.7% n=6), though these cars accounted for just 5% of vehicles driven. Only 7.3% (n=13) of vehicles were handed down to drivers, free of cost, of which 77% (n=10) were 1-3 Star rated.

Table 4.4 How car was acquired by USCR/ANCAP combined ratings; drivers aged 17-25 years Metropolitan Perth

	Combined UCSR/ANCAP Star Rating					
	1-3 Stars		4-5 Stars		Total Vehicles	
Vehicle Age Group	n	%	n	%	n	%
I bought the car	68	69.4	30	30.6	98	55.4
I share use and ownership of car	3	33.3	6	66.7	9	5.1
Someone else bought the car for me	17	53.1	15	46.9	32	18.1
Someone else owns the car and I share use of it with others	5	55.6	4	44.4	9	5.1
The car was handed to me free of cost for me to drive	10	76.9	3	23.1	13	7.3
It was provided to me by my employer	4	44.4	5	55.6	9	5.1
Other	5	71.4	2	28.6	7	4.0
Total	112	63.3	65	36.7	177	100

n=41 missing Car Acquire

17-25 year old Rural/Remote drivers

The majority of vehicles driven by younger-age Rural/Remote drivers were similarly purchased by themselves (62% n=39), with 61.5% (n=24) of those rated 1-3 Stars

(Table 4.5). The next most common means of acquisition (9.5% n=6) was if the drivers' employer had provided the car (66.7% n=4, 4-5 Star ratings) or someone else had bought the car for them (83.3% n=5, 1-3 Star rating). Counts were low for these cells however.

Table 4.5 How car was acquired by USCR/ANCAP combined ratings; drivers aged 17-25 years Rural/Remote WA

	Combined UCSR/ANCAP Star Rating					
	1-3 Stars		4-5 Stars		Total Vehicles	
Vehicle Age Group	n	%	n	%	n	%
I bought the car	24	61.5	15	38.5	39	61.9
I share use and ownership of car	3	75.0	1	25.0	4	6.3
Someone else bought the car for me	5	83.3	1	16.7	6	9.5
Someone else owns the car and I share use of it with others	2	40.0	3	60.0	5	7.9
The car was handed to me free of cost for me to drive	2	100.0	0	0.0	2	3.2
It was provided to me by my employer	2	33.3	4	66.7	6	9.5
Other	1	61.5	0		1	1.6
Total	39	61.9	24	38.1	63	100

n=11 missing Car Acquire

26+ year old Rural/Remote drivers

Around two-thirds of vehicles driven by 26+ year old Rural/Remote drivers were bought by the driver (54.6% n=154) or provided to the driver by their employer (22.7% n=64). Vehicles provided by their employer were most commonly 4-5 Star rated (87.5% 56). The highest proportion of 1-3 Star rated cars (66.7% n=2) was noted for vehicles that had been purchased for them to drive (though cell counts are very low).

Table 4.6 How car was acquired by USCR/ANCAP combined ratings; drivers aged 26+years Rural/Remote WA

	Combined UCSR/ANCAP Star Rating					
	1-3 Stars		4-5 Stars		Total Vehicles	
Vehicle Age Group	n	%	n	%	n	%
I bought the car	60	39.0	94	61.0	154	54.6
I share use and ownership of car	9	20.0	36	80.0	45	16.0
Someone else bought the car for me	2	66.7	1	33.3	3	1.1
Someone else owns the car and I share use of it with others	3	60.0	2	40.0	5	1.8
It was provided to me by my employer	8	12.5	56	87.5	64	22.7
Other	0	0.0	11	100.0	11	3.9
Total	82	29.1	200	70.9	282	100

n=45 missing Car Acquire

4.2.4 Ranking of the importance of vehicle features

Drivers' rankings of the importance of factors in the selection of their vehicle are presented in Table 4.7. This analysis was restricted to drivers who indicated some level of involvement in the choice of the vehicle (data not presented). *Financial Issues* (e.g., purchase price, running and maintenance costs) were ranked as the most important factor by 28% of all drivers, followed by the *Suitability of the Vehicle* (25.2%), the *Age and Condition of the Vehicle* (15.2%) and then *Vehicle Safety* (e.g., overall safety rating and fitted safety features, 13.8%). These rankings did not significant vary across the three driver Age-Region groups, though *Vehicle Safety* was ranked slightly higher, third, by the older-age drivers residing in Regional/Remote WA, as was the suitability of the vehicle for their driving needs.

Table 4.7 First-ranked factors* for the selection of their vehicle; by driver Age and Region

Factors in the selection of a vehicle	Age and Region Driver Group							
	17-25 years Metro Perth		17-25 years Regional/Remote		26+ years Regional/Remote		All Drivers	
	n	%	n	%	n	%	n	%
Financial Issues	55	32.5	22	40.7	69	23.6	146	28.3
Vehicle Age/Condition	39	23.1	9	16.7	30	10.3	78	15.2
Overall safety and safety features	23	13.6	5	9.3	43	14.8	71	13.8
Suitability of vehicle for driving needs	28	16.6	8	14.8	94	32.2	130	25.2
Performance of the vehicle	4	2.3	3	5.6	7	2.4	14	2.7
Ready availability of the vehicle	1	0.6	1	1.9	8	2.8	10	1.9
The type of vehicle	19	11.3	6	11.0	42	14.5	67	13.1
Total	169	100	54	100	293	100	516	100

*The number and percentage of drivers within the Age-Region Group who selected the factor as *the most important* of the seven factors in the selection of a vehicle.

4.2.5 Knowledge of vehicle safety features

Drivers' knowledge of seven crash avoidance features fitted in their car was cross-checked against the manufacturer's base model specification for the nominated vehicle's Make, Model and Year of Manufacture. Cross-checking of the driver's response yielded one of three possible outcomes:

- *Correct:* The driver correctly identified that the car was or was not fitted with the particular safety technology.
- *Incorrect:* The driver incorrectly identified that the vehicle was or was not fitted with the particularly safety technology.
- *Unsure:* The driver was unsure whether the car was fitted with the particular safety technology when it was or was not fitted.

Presentation of the findings of the drivers' knowledge will be restricted to Electronic Stability Control only. This is because the vast majority of driver vehicles (>90%) were

not fitted with Advanced (Automated) Cruise Control; Autonomous Emergency Braking; Lane Departure Warning and Lane Keeping Assist, or Blind Spot Monitoring technologies. Where any of these features were fitted, 80% or more of all drivers correctly identified the fitment or non-fitment of the technology in their vehicle.

Electronic Stability Control

Based on the manufacturer's specifications it was estimated that 57.5% of driver vehicles were fitted with ESC. Fitment was also found to be significantly associated with the Age-Region of the driver (X^2=31.09, df=2, p < 0.001), where fitment was lowest among the vehicles of Rural/Remote drivers aged 17-25 years (36.4%) and higher among the vehicles of same-aged Metropolitan drivers (48.4%) and Rural/remote older drivers (67.7%).

Driver's understanding of the fitment of ESC did not significantly vary across the Age-Region groups: 53.4%, Metropolitan Perth younger-age drivers; 56.3% Rural/Remote younger-age drivers, and 49.5% Rural/Remote older-age drivers (Figure 4.4). Across all driver Age-Region groups, the majority of those who responded incorrectly on the fitment of ESC believed their car was *not* fitted with the technology when it *was* (ranging between 84% and 93% across the groups).

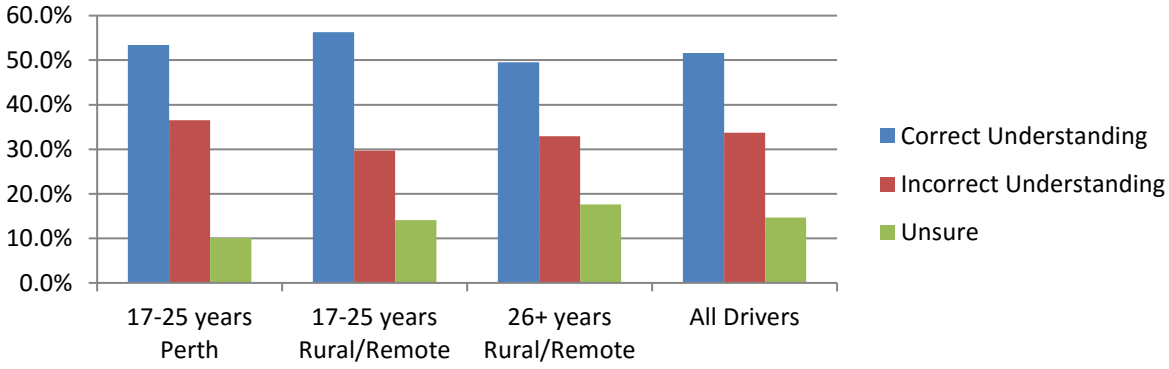

Figure 4.4 Drivers' understanding of the fitment of Electronic Stability Control in their vehicle; by driver Age-Region group

4.3 Attitudes and beliefs about Safe Vehicles

4.3.1 General attitudes and beliefs

Non-vehicle related Safe Vehicle attitudes and beliefs were measured through the drivers' Agreement-Disagreement on a number of general statements about Safe Vehicles. The findings of the analysis of these statements, grouped by topic, are presented below.

Interest in Safe Vehicles

Around one-fifth of all drivers were neutral or indifferent in regards to their interest in Safe Vehicles (Figure 4.5), with around seven in ten drivers having some interest (i.e., Strongly Disagree-Agree) and one in ten having no interest (Agree-Strongly Agree). Expressed interest in Safe Vehicles and safe vehicle technologies did not significantly vary with the Age-Region group of drivers (X^2=8.56, df=8, p=.381).

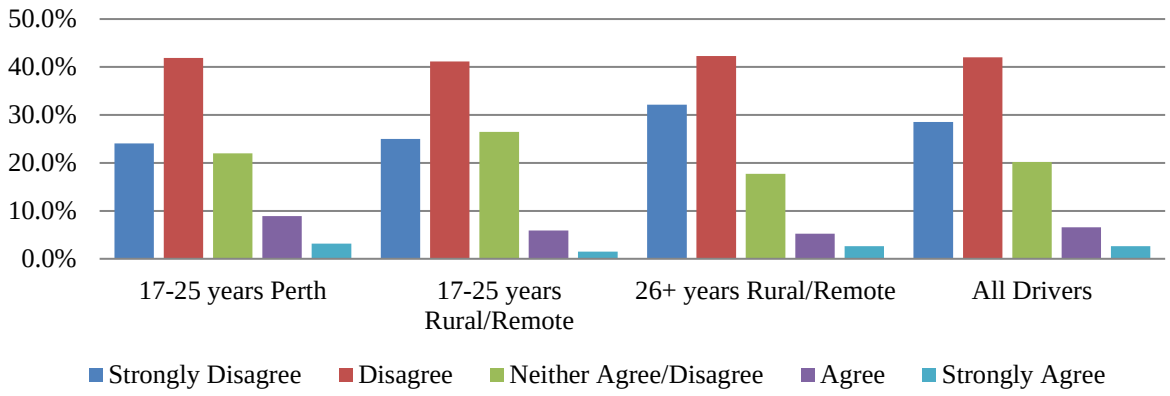

Figure 4.5 Overall, I have no interest in Safe Vehicles and safe vehicle technologies

Benefits of and trust in Safe Vehicles

Drivers' attitudes on the benefits of and trust in Safe Vehicles were measured on four statements. Nearly eight in ten of all drivers Agreed-Strongly Agreed that vehicles with the highest Safe Vehicle ratings would not protect vehicle occupants from being killed or seriously injured if the crash was 'bad enough' (Figure 4.6). While variation in this belief across the driver Age-Region groups was just short of being statistically significant (X^2=15.45, df=8, p=.051), younger-age Metropolitan Perth drivers were more inclined to disagree with the statement (12%) compared with younger-age (7.3%) and older-age (6.2%) Rural/Remote drivers.

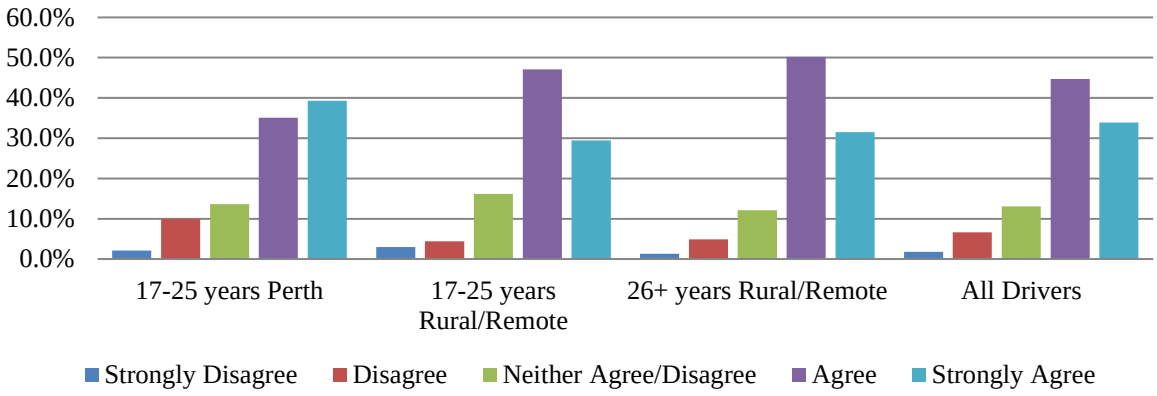

Figure 4.6 **Even cars with the highest safety ratings will never be able to protect drivers and other occupants from being killed or seriously injured if the crash is bad enough**

Around a quarter of all drivers were unsure if they were trusting of safe vehicle technologies that took control of the vehicle away from them, with nearly 60% of all drivers agreeing they would find it difficult to trust the technology (Figure 4.7). The attitude toward automated safe vehicle technology did not significantly vary with the driver Age-Region groups (X^2=8.01, df=8, p=.432), though a greater proportion of younger-age Metropolitan Perth drivers agreed with the statement (61.8%) compared with younger-age (52.9%) and older-age (53.3%) Rural/Remote drivers.

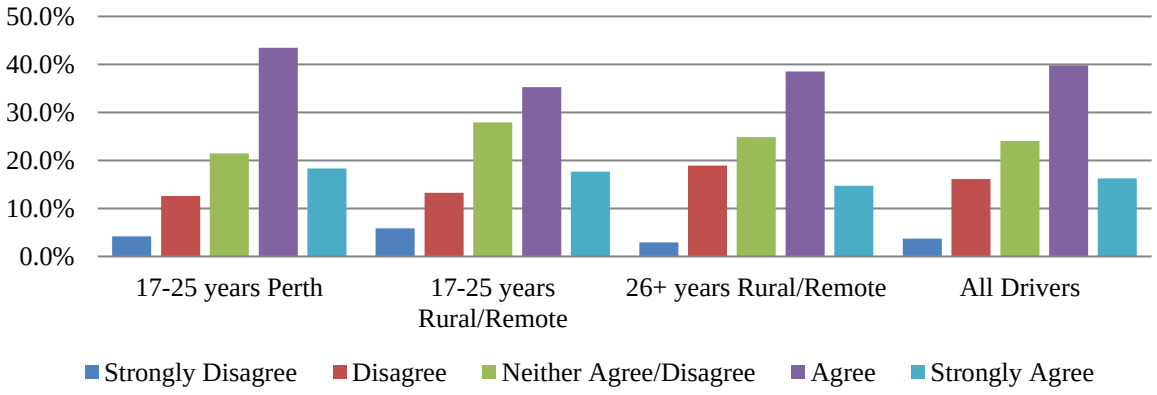

Figure 4.7 **I would find it difficult to trust crash avoidance technologies that take control of the vehicle away from me as the driver**

Most (64.6%) of the driver sample agreed that primary crash avoidance technologies would never be an acceptable substitute for good driving skills, with around 14% disagreeing with the statement (Figure 4.8). The attitude toward primary crash

avoidance technologies and driver skill did not significantly vary with the driver Age-Region groups (X^2=15.05, df=8, p=.058).

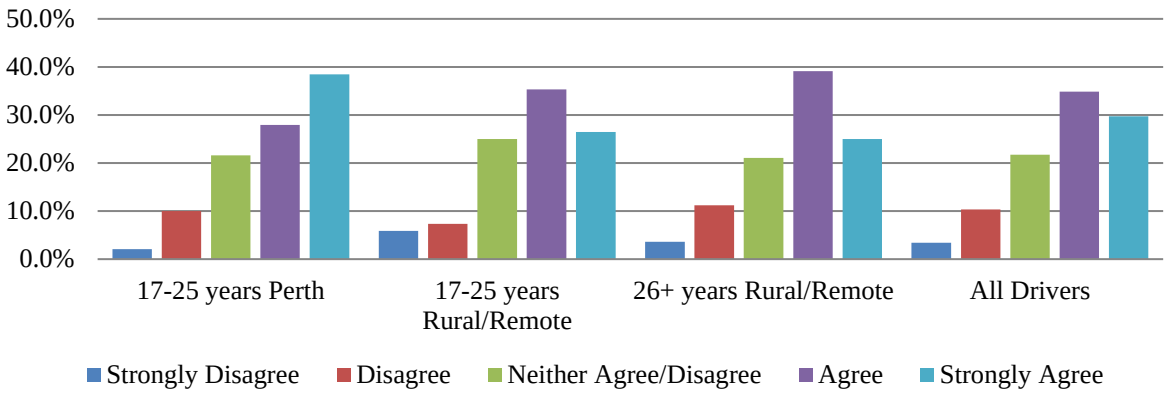

Figure 4.8 Vehicle technologies that help avoid crashes will never be an acceptable substitute for good driving skills

Around four in ten drivers were uncertain about the veracity of the advertised benefits of driving a car with a high safety rating, with just over a third disagreeing with the statement (Figure 4.9). Though the level of agreement/disagreement with this statement did not significantly vary with the Age-Region of the driver (X^2=8.52, df=8, p=.384), a higher proportion of younger-age drivers in Rural/Remote WA were uncertain (48.5%) compared with their Metropolitan Perth counterparts (37.2%) or older-age Rural/Remote drivers (40.3%). The former group were also proportionally less likely than other drivers to disagree with the statement (27.9% *versus* 38.2% and 39.6% respectively).

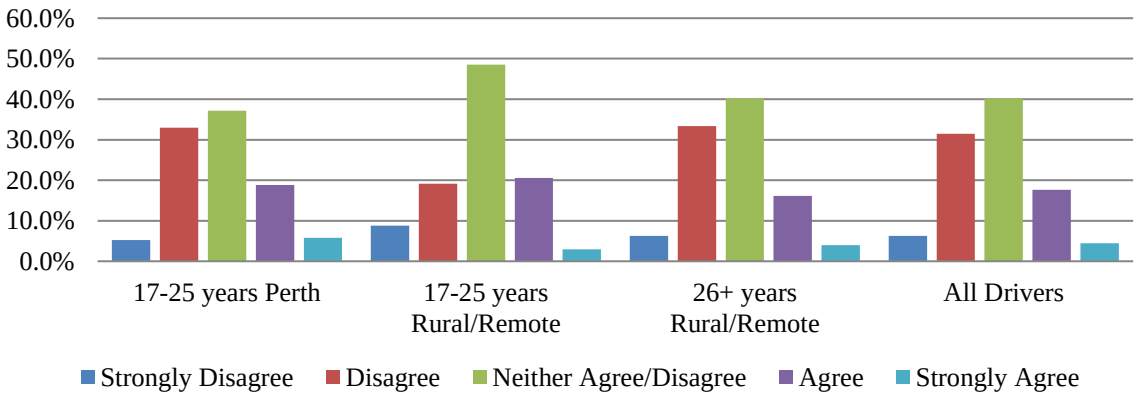

Figure 4.9 I think the advertised benefits of driving a car with a high safety rating are overstated

Cost and affordability of Safe Vehicles

The drivers' attitudes toward the cost and affordability of Safe Vehicles were assessed through their Agreement-Disagreement on three statements. Approximately 63% of all drivers agreed that cars with high safety ratings were typically more expensive and less affordable than cars with lower safety ratings (Figure 4.10). Significant variation was observed in the expressed agreement-disagreement with the statement across the driver Age-Region groups (X^2=16.05, df=8, p=.042). A greater proportion of older-age Rural-Remote drivers (30.5%) neither agreed nor disagreed with the statement compared with younger-age Metropolitan Perth drivers (20.4%) and Rural/Remote drivers (22.1%). The former group of drivers were proportionally less likely to agree with the statement (59%) compared with the latter two groups (68.1% and 66.2% respectively).

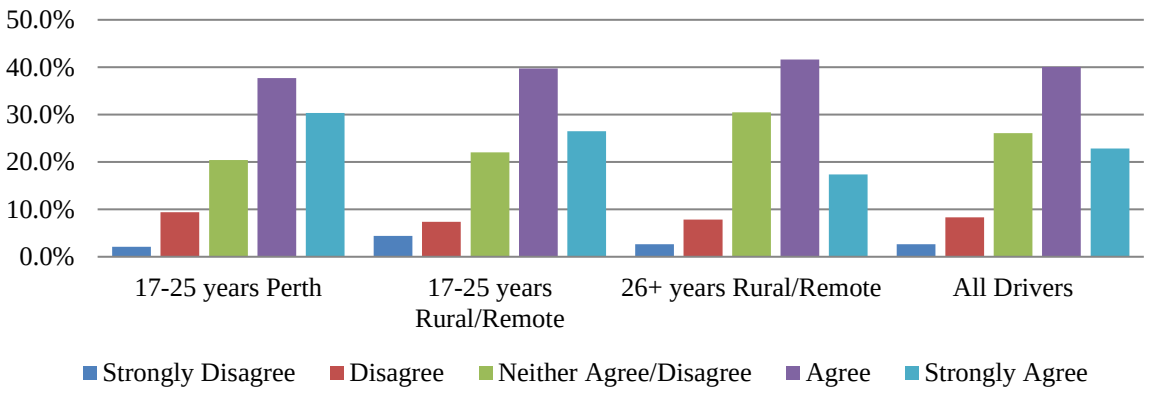

Figure 4.10 Cars with high safety ratings are typically more expensive and less affordable than cars with lower safety ratings

While just under a third of all drivers agreed they could afford to buy a car that has a high safety rating (Figure 4.11) this agreement significantly varied with the Age-Region of the driver (X^2=29.08, df=8, p=.000). A significantly greater proportion of older-age Rural/Remote drivers agreed that they could afford a safe vehicle (37.9%) compared with younger-age Metropolitan Perth drivers (25.2%) and Rural-Remote drivers (23.6%). Conversely, the latter two groups of drivers were more likely to disagree that they could afford to buy a vehicle with a high safety rating: 55.5% and 61.8% respectively compared with 37.3% for older-age Rural/Remote drivers.

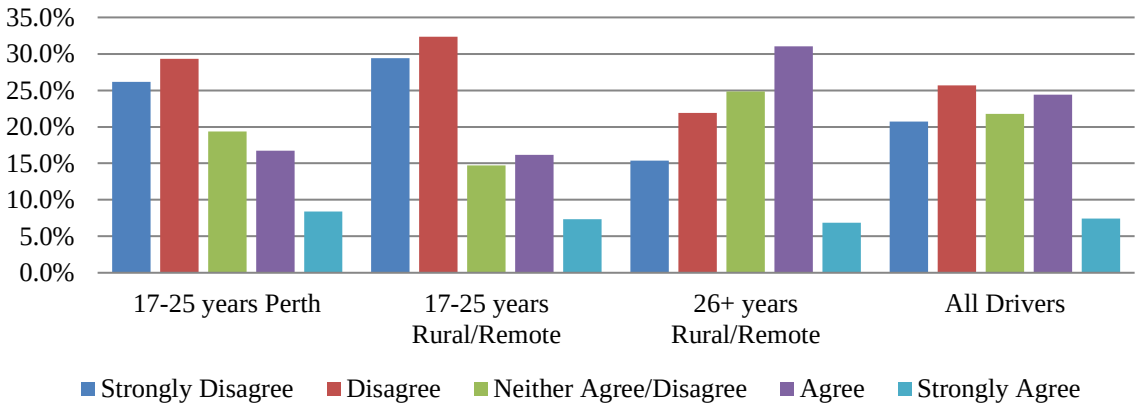

Figure 4.11 I can personally afford to buy a car that has a high safety rating

A strong level of agreement for all drivers (76.7%) and across all driver groups (78.5%, 76.5%, 75.6%) was reported for an insurance incentive to promote the purchase of a vehicle with a high safety rating (Figure 4.12). Agreement-disagreement did not significantly vary across the driver Age-Region groups (X^2=8.89, df=8, p=.351).

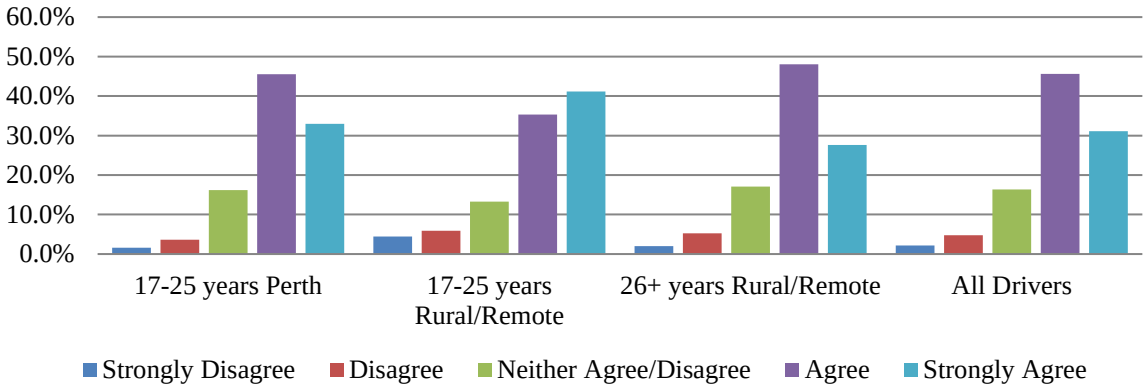

Figure 4.12 I would be more inclined to buy a car with a high safe vehicle rating if insurance companies offered discounted premiums for these cars

Government action to regulate and promote Safe Vehicles

Drivers provided responses to four statements concerned with government action to regulate and promote Safe Vehicles. Across all drivers (62%) and in all Age-Region groups (67%, 70.6%, 57%) a reasonably high level of agreement was expressed for the idea that government should offer financial incentives to promote the purchase of cars with high safety ratings (Figure 4.13). While the variation in agreement-disagreement across the groups fell short of statistical significance (X^2=15.28, df=8, p=.054), there

was a trend for older-age Rural/Remote drivers to be less certain (23.6%) or in disagreement (19.3%) with this government incentive.

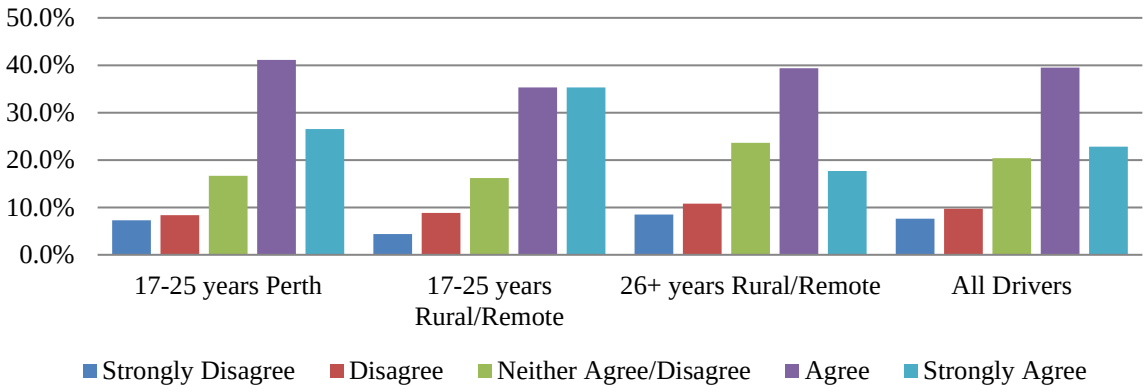

Figure 4.13 Governments should offer financial incentives to purchase cars with high safety ratings

The majority of all drivers (51.7%) and drivers across all Age-Region groups (48.7%, 48.6%, 54.3%) disagreed that safe vehicles could be promoted by increasing the registration costs for cars with low safe vehicle ratings (Figure 4.14). Agreement-disagreement with this proposal did not vary significantly with the Age-Region of the driver (X^2=7.66, df=8, p=.467).

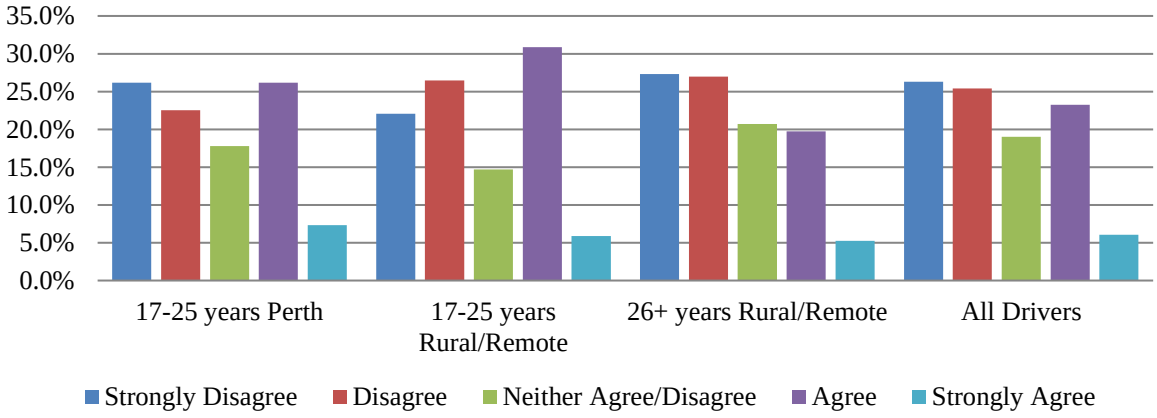

Figure 4.14 One way to promote the use of cars with a high safety rating is to increase the registration costs for cars that have a low safety rating

In contrast to the above government action, the majority of all drivers (73.7%) and across all Age-Region groups (71.7%, 72%, 75.4%) agreed that governments should legislate a minimum safe vehicle rating for the sale of all new cars (Figure 4.15). Around one in ten of all drivers and across all driver Age-Region groups disagreed with

the proposal. Agreement-disagreement with this proposal did not vary significantly with the Age-Region of the driver (X^2=9.86, df=8, p=.275).

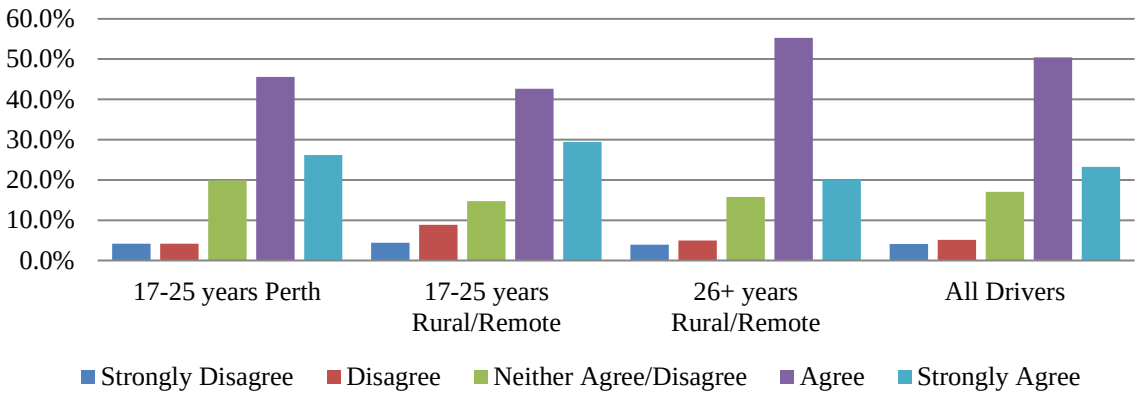

Figure 4.15 Government should legislate a minimum safe vehicle rating for the sale of all new vehicles

Between three and four in ten drivers in all Age-Region groups were unsure whether the government needed to do more to inform the public of the benefits of driving a car that has a high safe vehicle rating (Figure 4.16). The majority however, agreed that government should do more in this area, with the proportion being highest for younger-age Metropolitan Perth drivers (60.6%) compared with their Rural/Remote counterparts (48.5%) and older-age Rural/Remote drivers (49.3%). The trend in these variations was found not be statistically significant (X^2=13.38, df=8, p=.09).

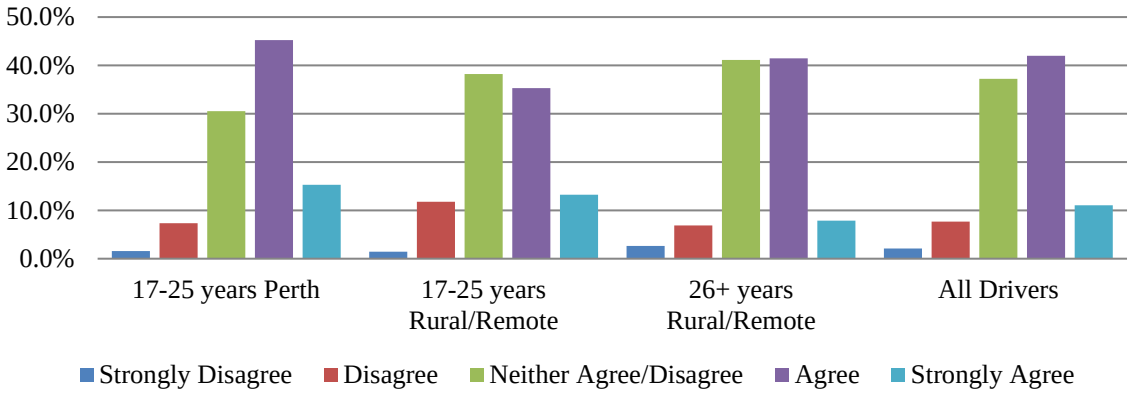

Figure 4.16 Government needs to do more to inform the public about the benefits of driving a car that has a high safe vehicle rating

4.3.2 Vehicle-specific attitudes and beliefs

Vehicle-specific Safe Vehicle attitudes and beliefs were measured through the drivers' level of Agreement-Disagreement on a number of statements relating to their own vehicle. The findings of the analysis of these statements for the driver Age-Region groups, grouped by topic, are presented below. The responses of drivers to selected items relating to primary and secondary safety were also cross-tabulated by the vehicle's safety rating (1-3 Stars; 4-5 Stars) and are summarised for reporting.

Primary Safety (7)

Approximately 47% of drivers believed their car had enough of the right safety features to reduce their chances of having a crash (Figure 4.17). This belief was significantly lower (X^2=19.01, df=8, p=.015) among younger-age Rural/Remote drivers (37.7%) compared with their Metropolitan counterparts (47%) and older-age Rural/Remote drivers (48.9%).

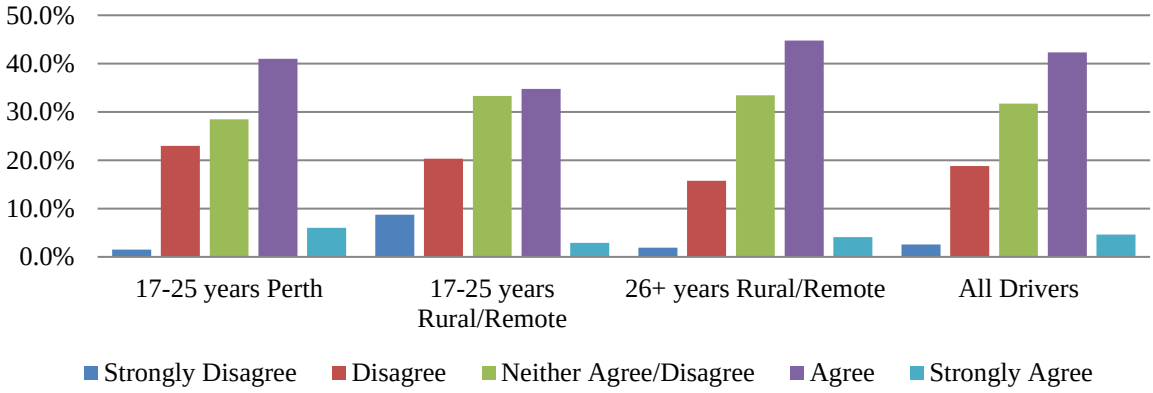

Figure 4.17 My car has enough of the right safety features to reduce my chances of having a crash

Around a quarter to a third of drivers across the Age-Region groups who drive 1-3 Star rated cars believed their car had enough of the right safety features to reduce their chances of having a crash, with a further 30%-40% being unsure if it did.

Secondary Safety

Around six in ten drivers believed their car had secondary safety features to reduce their chances of being killed or seriously injured should they crash (Figure 4.18). This belief was significantly lower (X^2=19.72, df=8, p=.011) among younger-age

Rural/Remote drivers (49.2%) compared with their Metropolitan counterparts (55%) and older-age Rural/Remote drivers (66.2%).

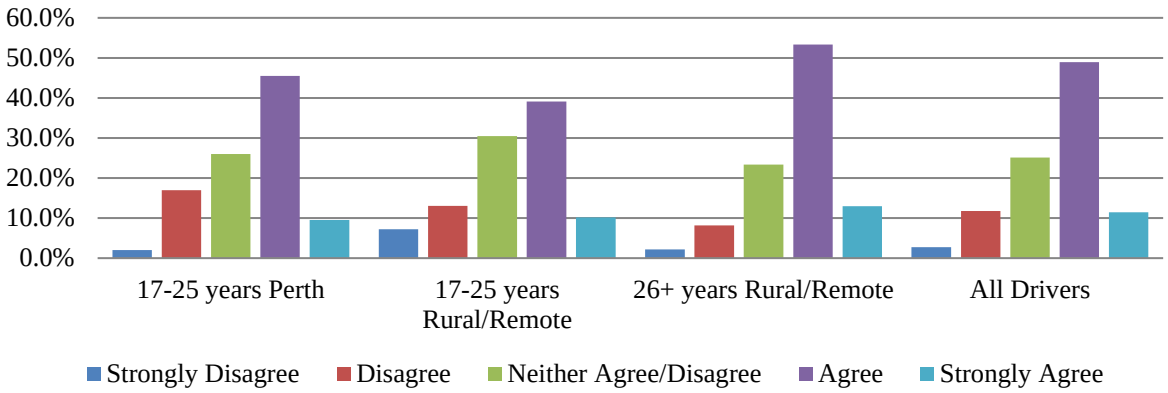

Figure 4.18 Overall, my car has enough safety features to minimise my chances of being killed or seriously injured if I were to have a crash

Nearly one-quarter of younger-age drivers across the regions who drove 1-3 Star rated cars believed their car did not have enough safety features, compared with 16% of older-age Rural/Remote drivers who drove 1-3 Star rated cars.

The majority of drivers (45.1%) considered that their car had sufficient safety features to reduce their passengers' chances of being killed or injured (Figure 4.19). However, roughly a quarter of all drivers and drivers within each Age-Region groups indicated they were unsure. Overall, the drivers' ratings did not significantly across the Age-Region group (X^2=2.77, df=8, p=.947).

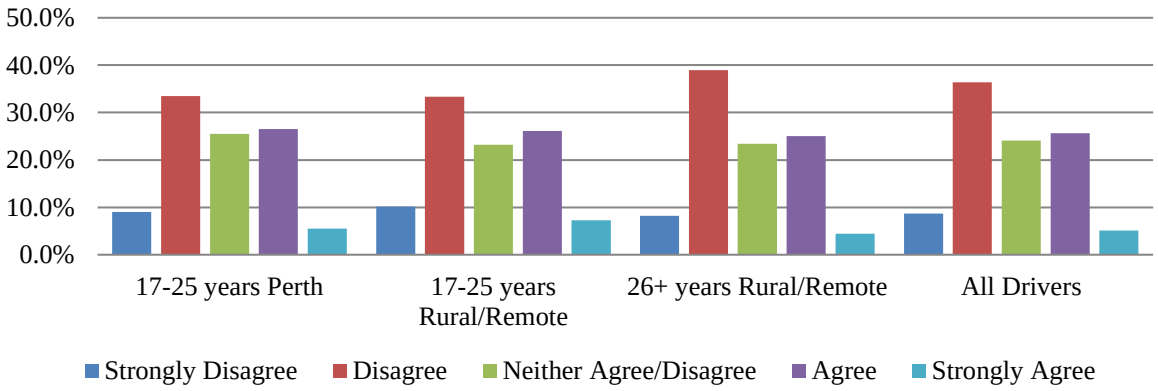

Figure 4.19 Overall, my car has insufficient safety features to minimise my passengers' chances of being killed or seriously injured if I were to have a crash

Around a third of drivers across the Age-Region groups who drive 1-3 Star rated cars disagreed with the statement and otherwise believed their car does have sufficient safety features to minimise the passengers' chances of injury.

Significant variation was reported in the drivers' belief in relation to their chances of being injury given the safety of their car and the type of crash (X^2=19.45, df=8, p=.013) (Figure 4.20). The majority (58.1%) of all drivers considered the risk of injury was related more to the type of crash than the safety features of their car. This perception was highest among younger-age Metropolitan drivers (61.1%) and older-age drivers Rural/Remote drivers (59.3%) and lowest for younger-age Rural/Remote drivers (43.1%).

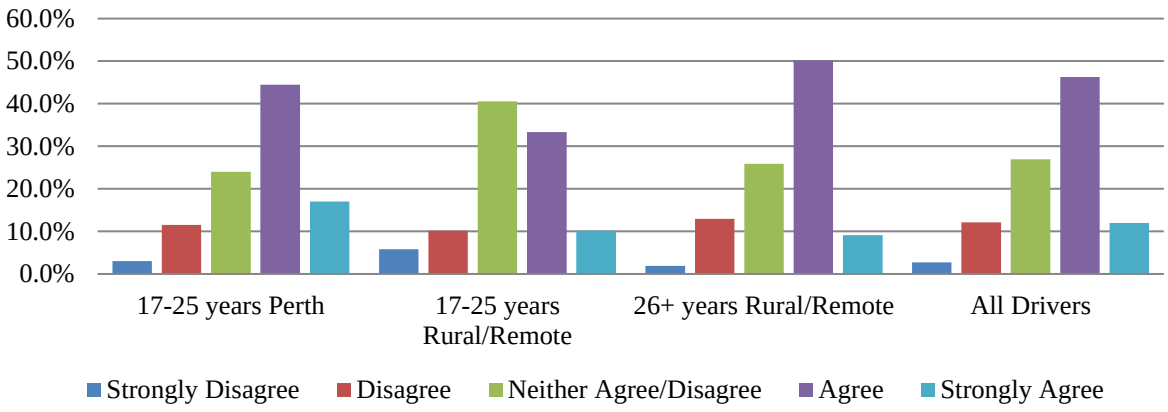

Figure 4.20 My chances of being killed or seriously injured whilst driving my car have more to do with the type of crash I have than the safety of my car

Satisfaction with the safety of current car

While 62% of all drivers agreed they did not need to replace their car with another that had additional safety features (Figure 4.21). This belief was lowest among younger-age Metropolitan Perth (57%) and Rural/Remote drivers (55%) compared with older-age Rural/Remote drivers (66.6%) (X^2=15.70, df=8, p=.047).

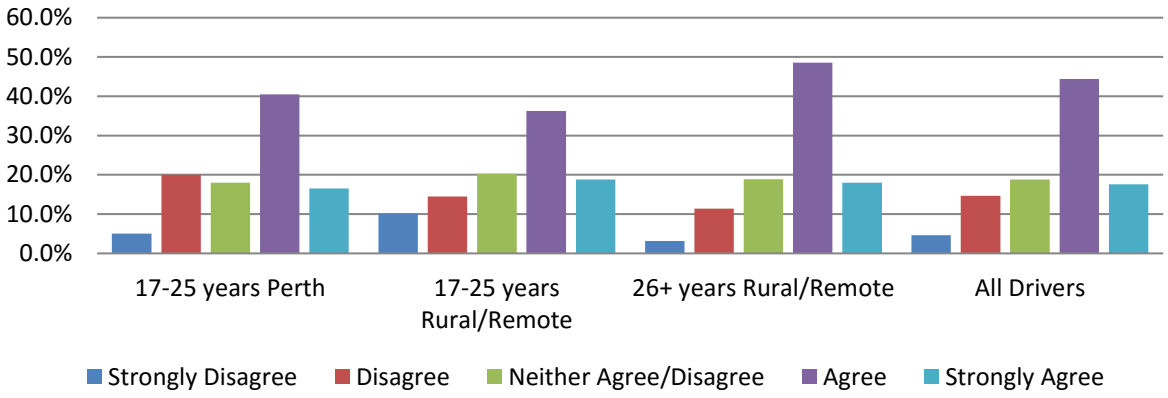

Figure 4.21 I don't see the need to replace my car with another that has additional safety features

Overall, around eight in ten of all drivers stated they were happy with the level of safety of their current car (Figure 4.22), though this belief was somewhat lower among younger-age drivers in Rural/Remote WA (73.9%) compared with Metropolitan Perth young drivers (78.9%) and older-age Rural/Remote drivers (83.3%) (X^2=18.59, df=8, p=.017).

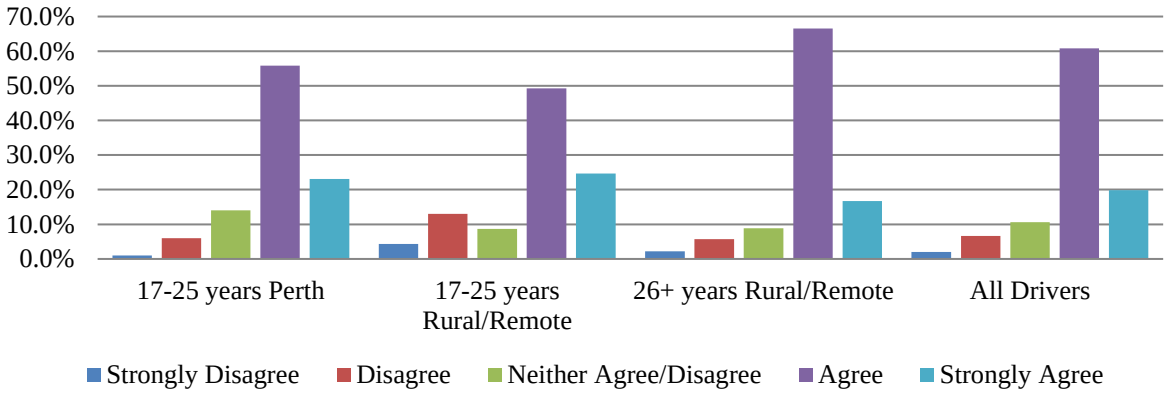

Figure 4.22 Overall, I am happy with the level of safety of the car I drive most often

Importance of the car's safety

Around one in five drivers agreed that other features about their car were more important that the car's overall level of safety (Figure 4.23). This belief was somewhat higher among younger-age Metropolitan Perth (25.5%) and Rural/Remote (24.6%) than older-age Rural/Remote (17.5%) drivers, of whom 36% neither agreed or disagreed with the statement (X^2=17.08, df=8, p=.029).

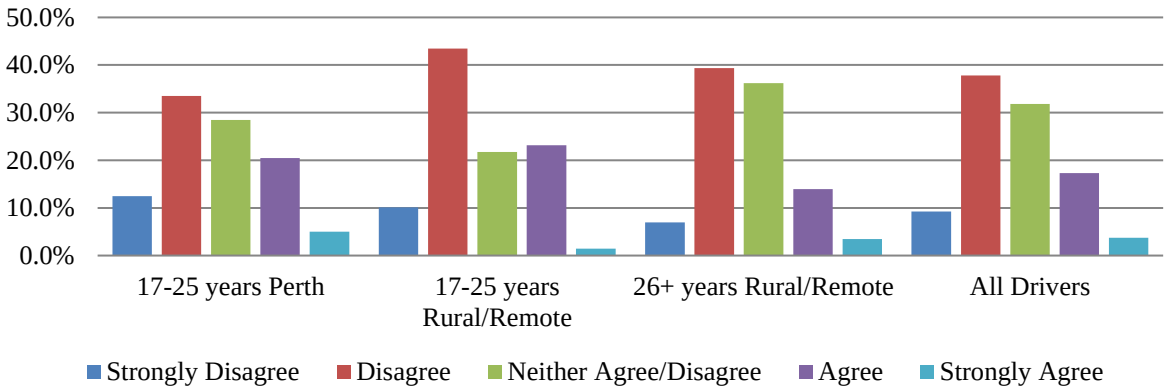

Figure 4.23 Other features about my car are more important to me than its overall level of safety

The majority of drivers (48.6%) did not consider the safety features of their car to be the main reason for its selection (Figure 4.24). While nearly a quarter to a third of drivers across the Age-Region groups were non-committal about the role of safety in their choice of vehicle, older-age Rural/Remote (24.3%) and younger-age Metropolitan Perth drivers (19%) were more likely than younger-age Rural/Remote (15%) drivers to state that safety was a main factor for the selection of the car (X^2=28.20, df=8, p=.000).

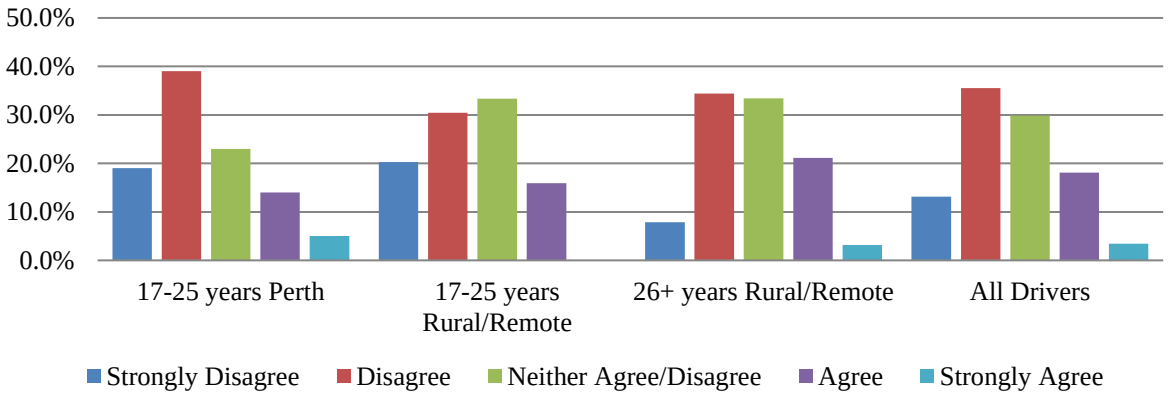

Figure 4.24 One of the main reasons I drive my current car is because of its safety features

Driving skill and vehicle safety

Nearly 70% of all drivers agreed that their driving skill would more likely influence their chances of crashing and being injured than the safety features of their car (Figure 4.25). This perception was highest among younger-age Metropolitan Perth drivers (75.5%) compared with younger-age (66.7%) and older-age (64.7%) Rural/Remote drivers (X^2=18.80, df=8, p=.016).

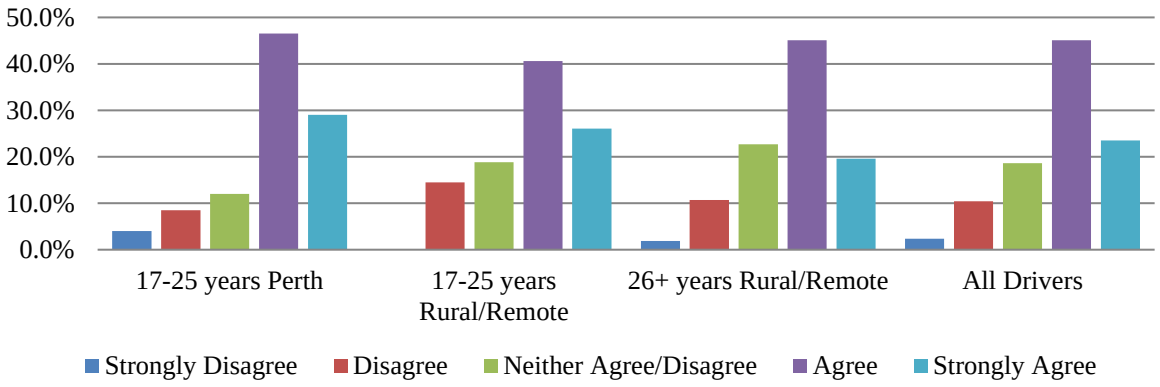

Figure 4.25 My chances of crashing and being injured have more to do with my skills as a driver than the safety features of my car

4.4 Safe Vehicle resources

4.4.1 Self-rated knowledge of Safe Vehicles

The drivers' self-rated knowledge of Safe Vehicles (in relation to their features and performance to minimise crash involvement and injury) is presented in Figure 4.26. Around a quarter of all drivers claimed to have "a lot of knowledge" to "a great deal of knowledge" about features and performance of Safe Vehicles. This proportion was reasonably consistent across the Age-Region groups, though slightly higher among younger-age Rural/Remote drivers (31.5%) compared with their Metropolitan Perth counterparts (21%) and older-age Rural/Remote counterparts (22.2%). Fewer than one in ten of all drivers and across all Age-Region groups claimed to have no knowledge of the features and performance of Safe Vehicles. The variation across the groups in self-rated knowledge was not statistically significant (X^2=11.74, df=8, p=.163).

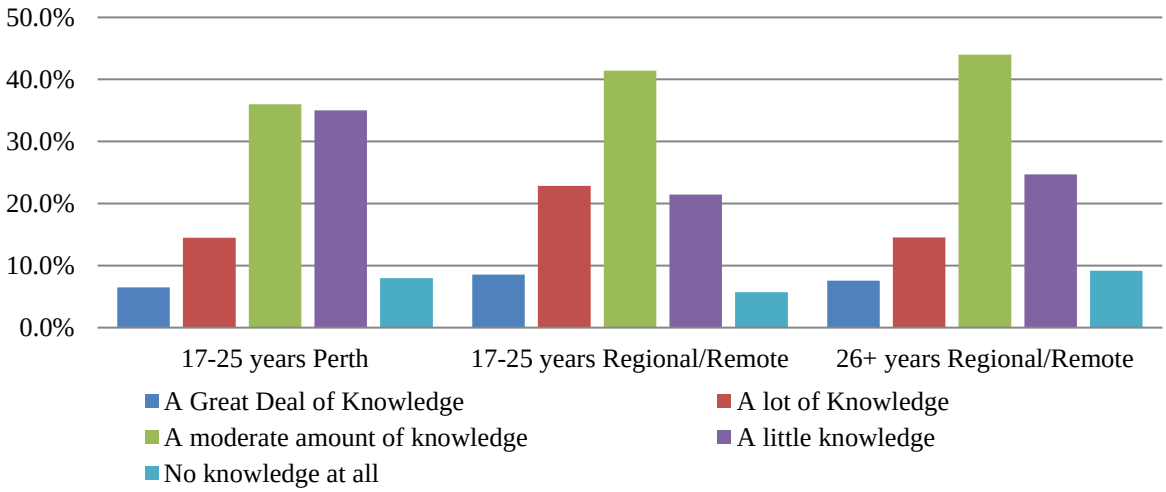

Figure 4.26 Self-rated knowledge of Safe Vehicles; by driver Age-Region group

4.4.2 Awareness of Safe Vehicle resources

Drivers' awareness (Yes/No) of seven Safe Vehicles resources is presented in Table 4.2. Only three of the resources – ANCAP (57.6% n=335), UCSR (48.9% n=284), and the Stars on Cars (37% n=216) program – were acknowledged by a third or more of all drivers. Awareness of these three programs was found not to vary significantly across the three driver Age-Region Groups: X^2=4.00, df=2, p=.135 (ANCAP); X^2=3.57, df=2, p=.167 (UCSR); X^2=2.95, df=2, p=.228 (Stars on Cars).

Table 4.8 Awareness of Safe Vehicle resources; by driver Age-Region group

	Age and Region Driver Group							
	17-25 years Metro Perth		17-25 years Regional WA		26+ years Regional WA		All Drivers	
	n	%	n	%	n	%	n	%
ANCAP								
-No	93	46.5	33	47.8	121	38.7	247	42.4
-Yes	107	53.5	36	52.2	192	61.3	335	57.6
-Total	*200*	*100*	*69*	*100*	*313*	*100*	*582*	*100*
Stars on Cars program								
-No	133	66.5	38	55.1	196	62.4	367	63.0
-Yes	67	33.5	31	44.9	118	37.6	216	37.0
-Total	*200*	*100*	*69*	*100*	*314*	*100*	*583*	*100*
UCSR Guide								
-No	97	48.5	30	43.5	170	54.5	297	51.1
-Yes	103	51.5	39	56.5	142	45.5	284	48.9
-Total	*200*	*100*	*69*	*100*	*312*	*100*	*581*	*100*
Howsafeisyourcar.com.au								
-No	150	75.4	53	76.8	268	86.5	471	81.5
-Yes	49	24.6	16	23.2	42	13.5	107	18.5
-Total	*199*	*100*	*69*	*100*	*310*	*100*	*578*	*100*
EuroNCAP								
-No	178	89.4	62	89.9	276	89.0	516	89.3
-Yes	21	10.6	7	10.1	34	11.0	62	10.7
-Total	*199*	*100*	*69*	*100*	*310*	*100*	*578*	*100*
WA RSC Consumer Guide to Safer Vehicles – Remote/Regional WA								
-No	166	83.0	53	76.8	266	85.5	485	83.6
-Yes	34	17.0	16	23.2	45	14.5	95	16.4
-Total	*200*	*100*	*69*	*100*	*311*	*100*	*580*	*100*
Howsafeisyourfirstcar.com.au								
-No	173	86.9	58	84.1	292	94.8	523	90.8
-Yes	26	13.1	11	15.9	16	5.2	53	9.2
-Total	*199*	*100*	*69*	*100*	*308*	*100*	*576*	*100*

Although the overall awareness of the two major websites – howsafeisyourcar.com.au and howsafeisyourfirstcar.com.au – was low (18.5% n=107and 9.2% n=53 respectively), awareness of the sites was significantly higher among younger-age Metropolitan Perth drivers (24.6% n=49, 13.1 n=26) and Rural/Remote drivers (23.2% n=16, 15.9% n=11) compared with older-age Rural/Remote drivers (13.5%, n=42 5.2% n=16): X^2=10.99, df=2, p=.004 (howsafeisyourcar.com.au), X^2=13.22, df=2, p=.001 (howsafeisyourfirstcar.com.au).

The total number of Safe Vehicle resources drivers claimed to have awareness of was found to be significantly related to their self-rated level of Safe Vehicle knowledge (B=.330, p=.000) [F (1, 567)=206.79, p<.000]. The number of resources a driver was aware of accounted for a significant 26.7% of the variance in self-rated knowledge scores.

4.4.3 Past use of Safe Vehicle resources and their usefulness

Analysis of the past use of the resources and their usefulness was restricted to the ANCAP and UCSR programs as these two provided a sufficient number of drivers for a meaningful interpretation of the results. Of the drivers who were aware of the ANCAP resource, 55.5% of all drivers claimed to have used the resource (Figure 4.27). This proportion did not vary significantly across the respective Age-Region groups (X^2=2.20, df=2, p=.332): 55.7%; 66.7%, 53.2%.

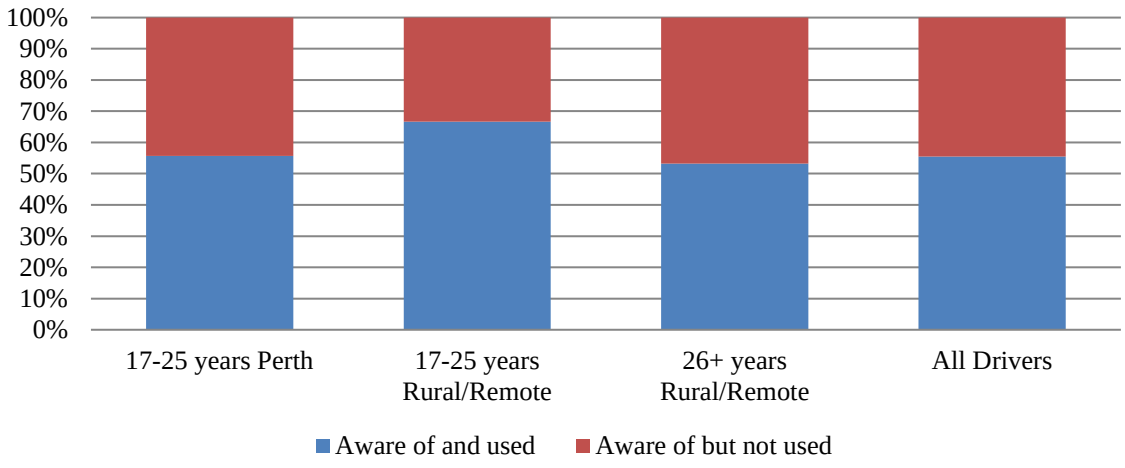

Figure 4.27 Past use of the ANCAP resource; by driver Age-Region group

Overall awareness and use of the USCR resource was somewhat lower at 41.8% of all drivers compared with that recorded for the ANCAP resource (Figure 4.28). This

proportion did not vary significantly across the three Age-Region groups (X^2=.302, df=2, p=.860): 41.2%; 38.5%, 43.2%.

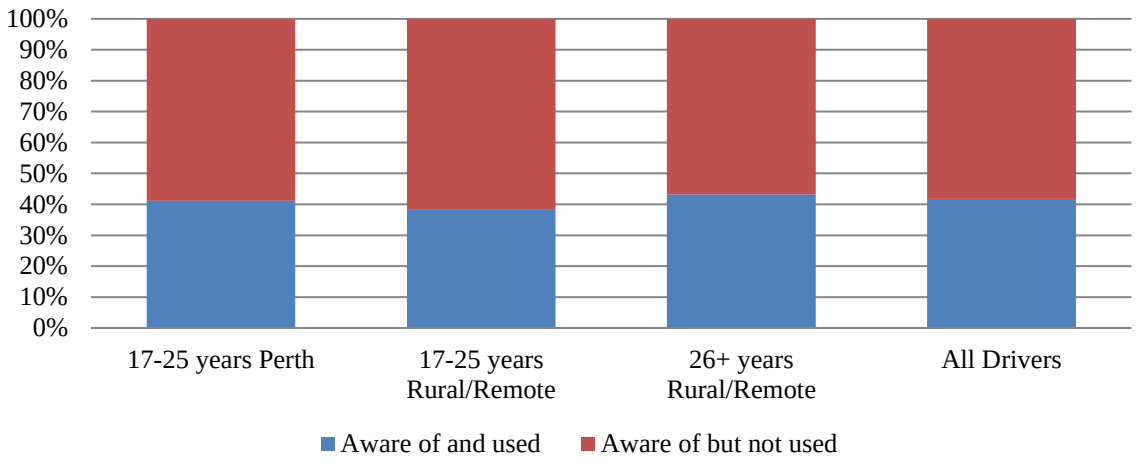

Figure 4.28 Past use of the UCSR resource; by driver Age-Region group

Drivers who had used both the ANCAP and UCSR program resources rated them highly in regards to their usefulness (Figure 4.29 and Figure 4.30). More than half of all drivers and in each Age-Region group who used ANCAP resources considered they were very useful to exceptionally useful. Significant variation was found however, in the ratings, with a higher proportion of younger-age Metropolitan Perth drivers rating the program more highly (66.1% Very Useful- Exceptionally Useful) compared with younger-age counterparts in Rural/Remote WA (56.5%) and older-age Regional/Remote drivers (55.1) (X^2=15.69, df=8, p=.047). Caution must be exercised in the interpretation of this result as nearly 33.3% of the cross-tabulation cells had expected counts of less than five cases.

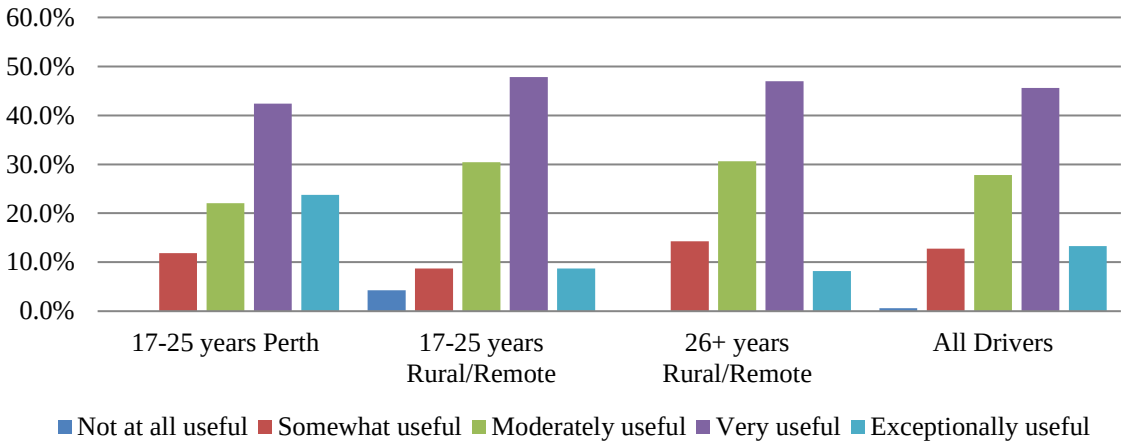

Figure 4.29 Perceived usefulness of the ANCAP resource; by driver Age-Region group

The UCSR resource was not as favourably rated as the ANCAP resource by all drivers and those in each Age-Region group. Around 46% of all drivers considered the resource to be Very Useful-Exceptionally Useful, with significant variation in the ratings across the groups. Though the total counts are small, proportionally more younger-age Rural/Remote drivers (66.6%) considered the resource to be Very Useful-Exceptionally Useful compared with 49.5% of younger-age Metropolitan Perth drivers and 34.5% of older-age Rural/Remote drivers (X^2=20.89, df=8, p=.007). Caution must be exercised in the interpretation of this result as nearly 50% of the cross-tabulation cells had expected counts of less than five cases.

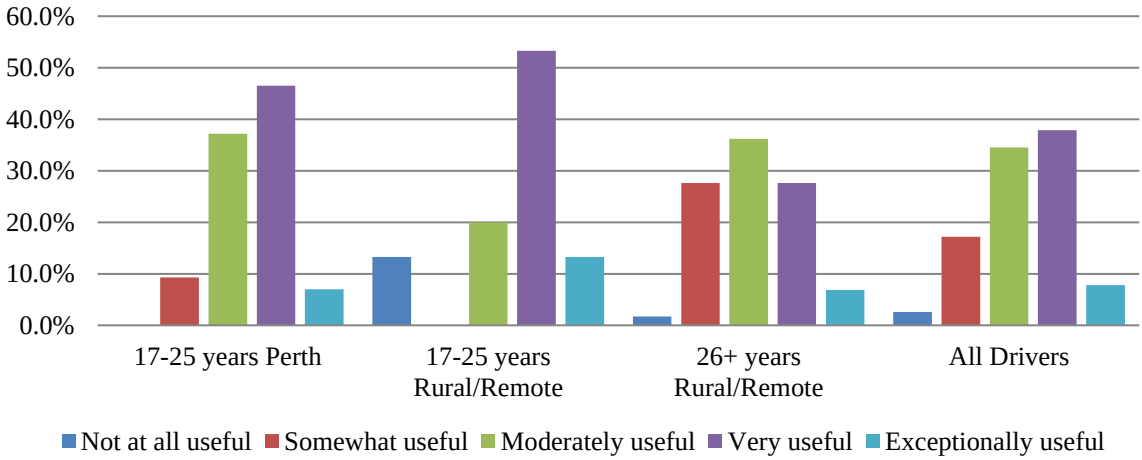

Figure 4.30 Perceived usefulness of the UCSR program resource; by driver Age-Region group

4.4.4 Drivers' knowledge of the Safe Vehicle rating of their vehicle

Drivers who stated they had used ANCP resources and/or UCSR resources were asked to indicate if they knew the respective ratings for their vehicle, and secondly, to give the rating if known. Drivers' claimed knowledge of their vehicle's ANCAP rating (where available) did not vary significantly across the Age-Region groups (X^2=4.91, df=8, p=.086) though there was a trend toward proportionally more older-age Rural/Remote (61.2%) and younger-age Metropolitan Perth (50.8%) drivers to know their vehicle's rating (Figure 4.31).

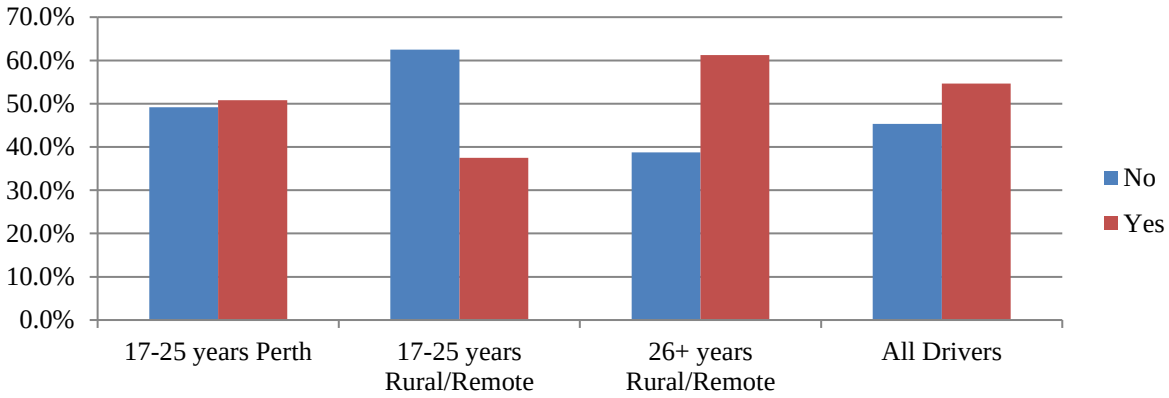

Figure 4.31 **Percentage of drivers who claimed to know and not know the ANCAP rating of their current car; by driver Age-Region group**

Drivers' claimed knowledge of their UCSR rating (where available) was particularly low. Less than one in five of all drivers who claimed to have used the UCSR resources stated that they knew the rating for their car (Figure 4.32). This proportion did not significantly vary across the Age-Region groups though was slightly lower among younger-age Rural/Remote drivers (13.3%) compared with younger-age Metropolitan drivers (18.2%) and older-age Rural/Remote drivers (21.7%) (X^2=.593, df=8, p=.743). This finding should be interpreted with caution as only 119 drivers across the three groups provided useable responses for analysis.

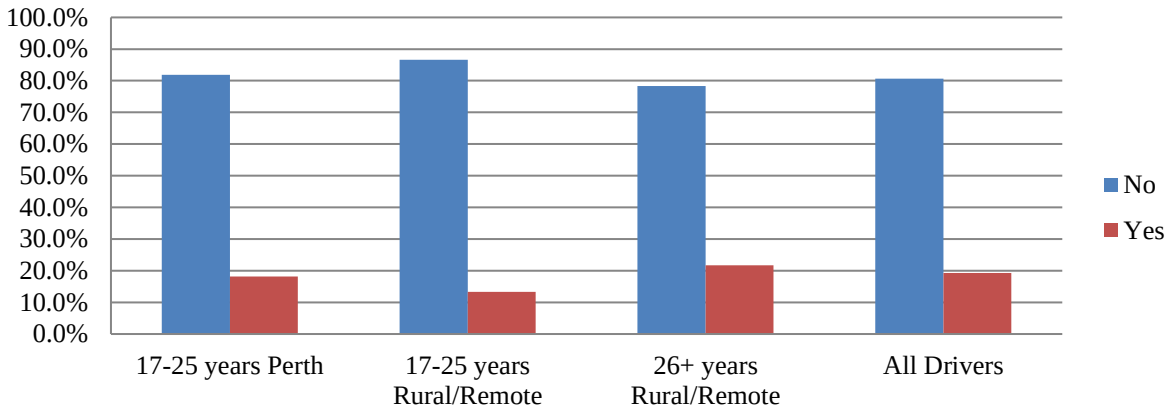

Figure 4.32 Percentage of drivers who claimed to know and not know the UCSR rating of their current car; by driver Age-Region group

No analysis was undertaken of the accuracy of the vehicle safety ratings provided by drivers due to an insufficient number of responses (n=35 UCSR ratings; n=124 ANCAP ratings).

4.4.5 Drivers' preferences for accessing information about Safe Vehicles

The preference ratings of drivers for accessing information on safe vehicles across a range of mediums are graphically presented in Figures 4.33 to 4.43. Across all drivers and driver Age-Region groups, there was strongest support (i.e., "prefer a great deal") for information to be provided 'at the point of sale' (i.e., on the windscreen of the car) at the dealer for both new cars (29% all drivers) (Figure 4.39) and second hand cars (28.6% all drivers) (Figure 4.35). Around a quarter of all drivers also expressed a strong preferences for safety information to be included in all 'for sale advertising' of the cars sold by dealers (Figure 4.40). The use of a 'smart phone application' (Figure 4.37) and internet websites (Figure 4.42) was also preferred a great deal by around one in five drivers but also not preferred by a similar proportion of all drivers.

The mediums least preferred (i.e., 'do not prefer') across all driver Age-Region groups for accessing information included, older, traditional methods such as commercials on free to air television (Figure 4.33) (~25% of all drivers); newspaper advertising (Figure 4.34) (~35% of all drivers), and commercials on local radio stations (Figure 4.41) (~35%).

Significant variation in preferences for some mediums was noted across the Age-Region groups. While both younger-age Metropolitan and Rural/Remote driver groups had a strong preference for receiving updated information about nominated vehicles via

SMS and email alerts (Figure 4.43) (29% for both groups), older-age Rural/Remote drivers (54%) did not prefer this medium (X^2=42.16, df=8, p=.000). Similarly, younger-age Perth (20.2%) and Rural/Remote (27.9%) drivers expressed a stronger preference for roadside billboard advertising (Figure 4.38) compared with older-age Rural/Remote drivers (51.5%) who do not prefer their medium (X^2=60.62, df=8, p=.000).

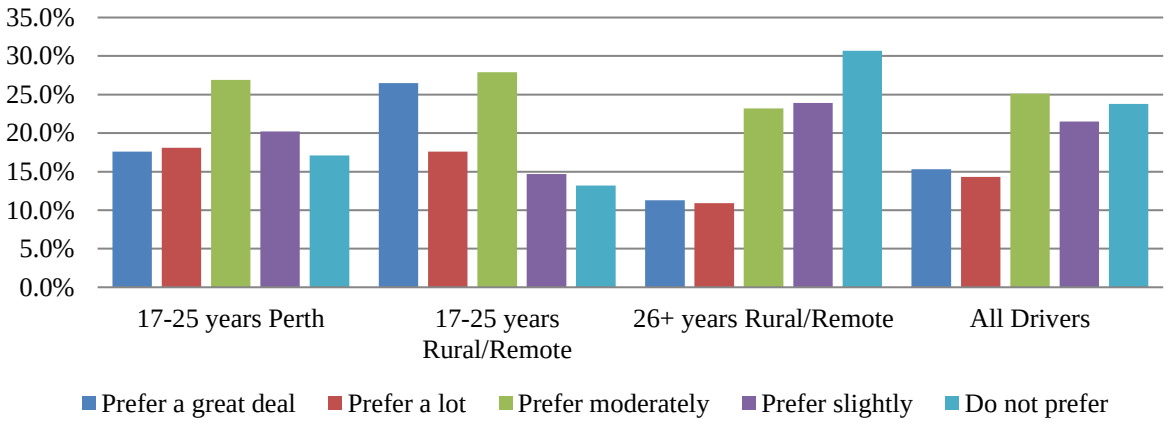

Figure 4.33 Preference ratings for commercials on free to air television; by driver Age-Region group

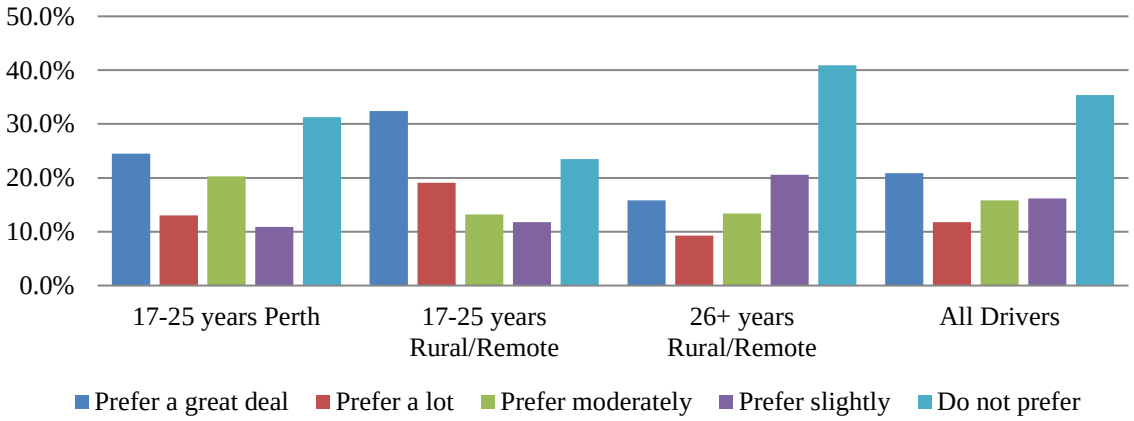

Figure 4.34 Preference ratings for advertising features in daily newspapers; by driver Age-Region group

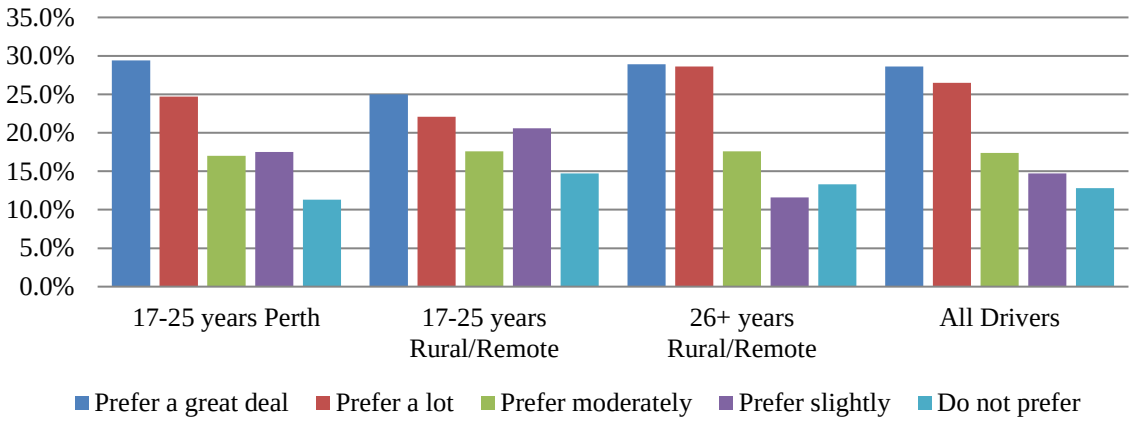

Figure 4.35 **Preference ratings for the display of the relevant safety rating on the windscreen of all second hand cars for sale by dealers; by driver Age-Region group**

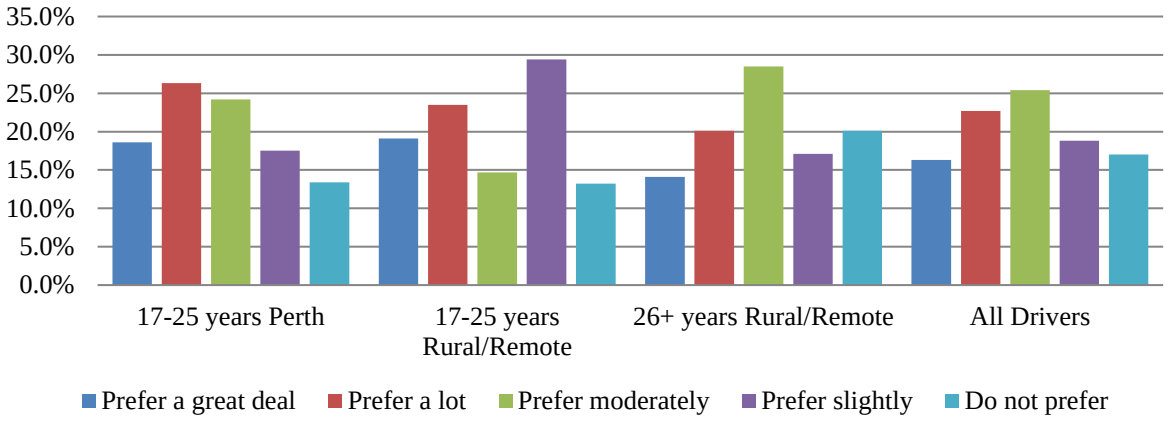

Figure 4.36 **Preference ratings for website information mailed with vehicle registration renewal papers; by driver Age-Region group**

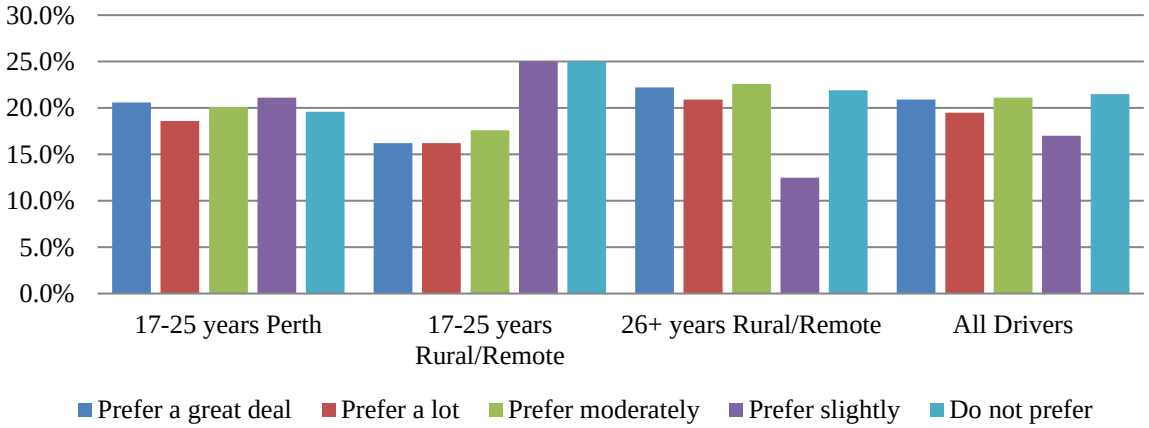

Figure 4.37 **Preference ratings for a smart phone application to retrieve vehicle safety ratings; by driver Age-Region group**

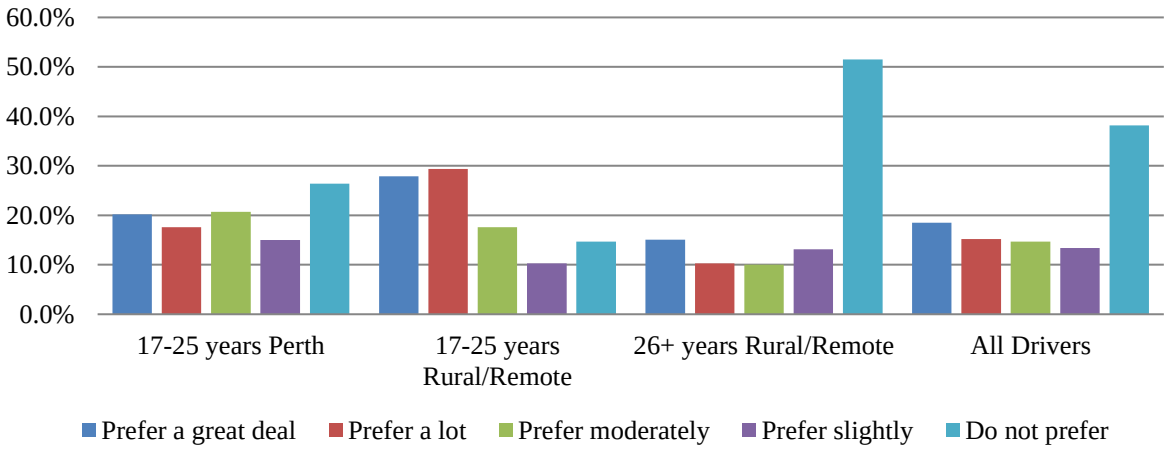

Figure 4.38 **Preference ratings for roadside billboard advertising; by driver Age-Region group**

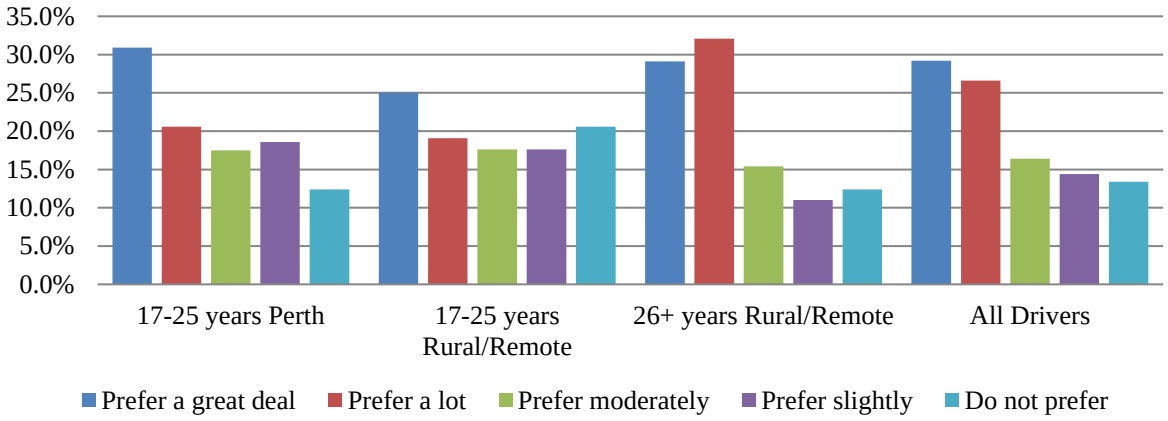

Figure 4.39 **Preference ratings for the display of the ANCAP safety rating on the windscreen of all new cars for sale by dealers; by driver Age-Region group**

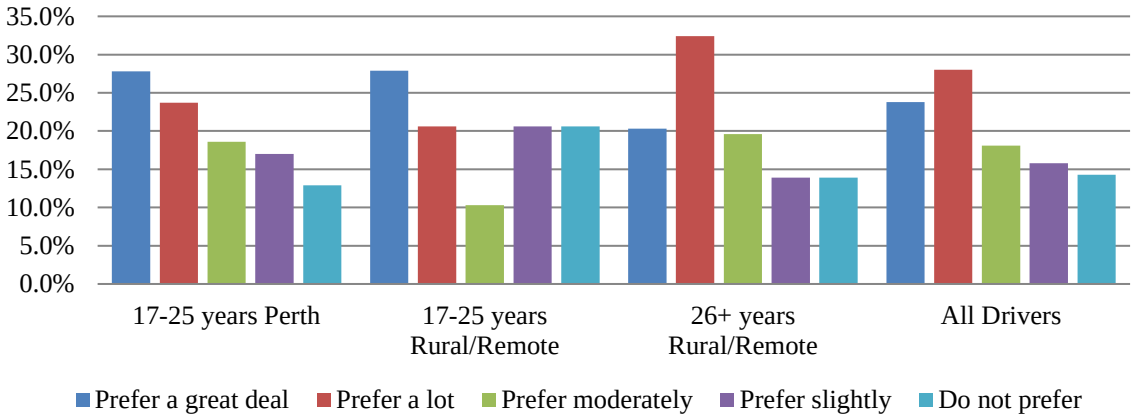

Figure 4.40 **Preference ratings for the inclusion of safety rating information in all 'for sale' advertising by dealers; by driver Age-Region group**

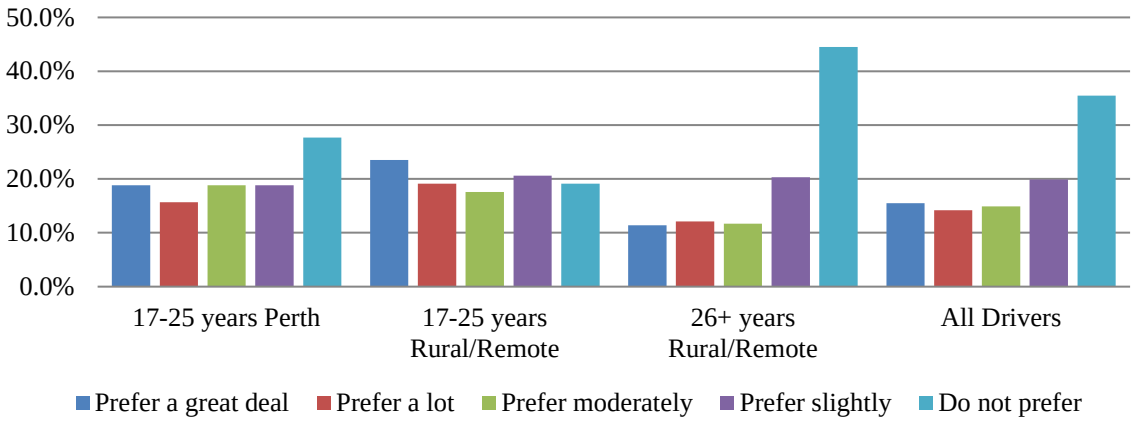

Figure 4.41 **Preference ratings for commercials on local radio stations; by driver Age-Region group**

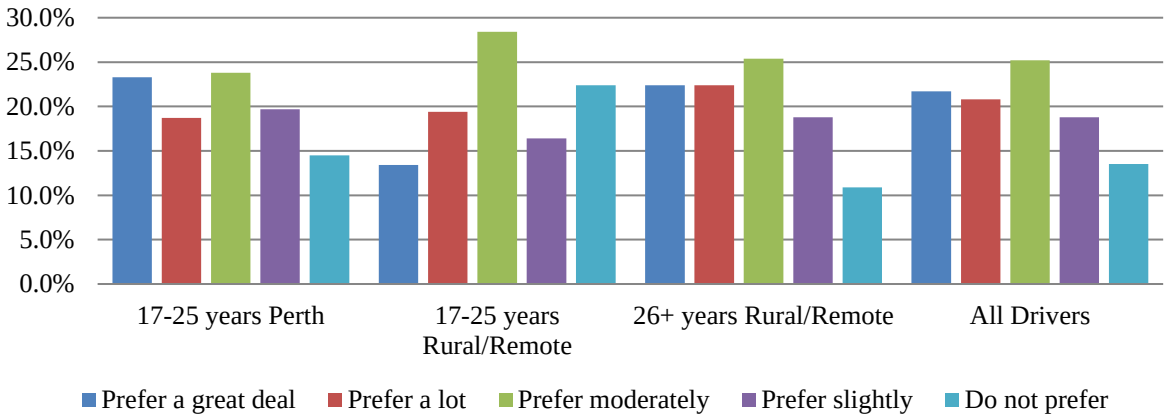

Figure 4.42 **Preference ratings for accessing information on safe vehicles via websites; by driver Age-Region group**

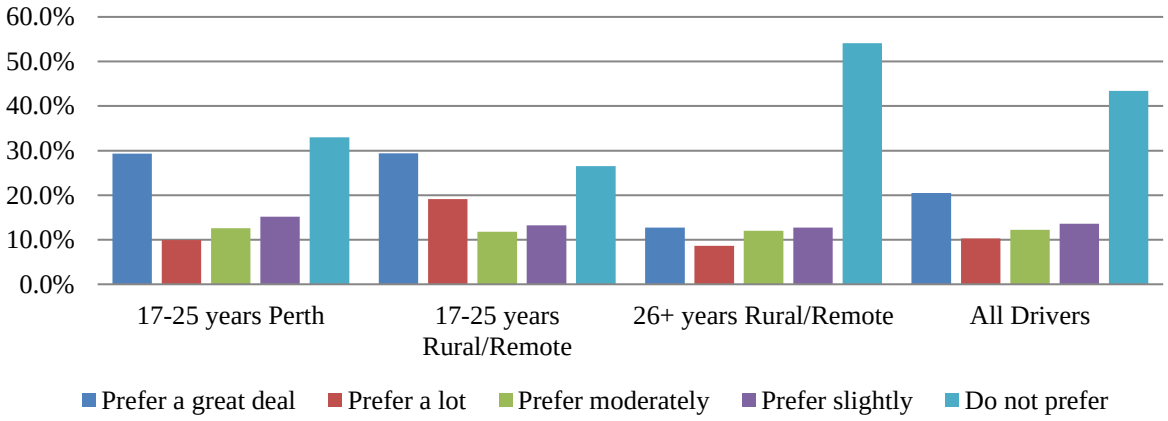

Figure 4.43 **Preference ratings for receiving SMS or email alerts for updated information on nominated vehicles; by driver Age-Region group**

4.5 Drivers' behavioural intention to replace their car

Just under a third of all drivers reported that it was likely to very likely they would replace their current car within the next two years (Figure 4.44). Significant variation across the driver groups was found in the level of behavioural intent (X^2=21.36, df=2, p < 0.006). Younger-age Metropolitan Perth (43%) and Rural/Remote (42%) drivers were proportionally more likely to agree they would replace their car compared with older-age Rural/Remote drivers (31.6%).

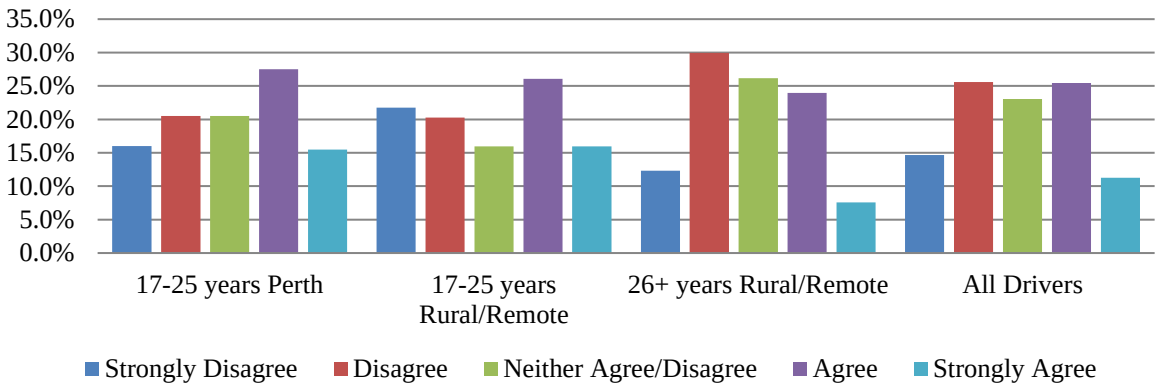

Figure 4.44 It's very likely that I will replace my current car with a safer one, either new or second hand, in the next two years

Multiple linear regression analysis was undertaken to identify the factors associated with the variation in drivers' intention to replace their car in the next two years. Separate modelling was undertaken for all younger-age drivers (regional groups combined) and all Rural/Remote area drivers (age groups combined). The following variables were simultaneously entered for analysis and progressively removed if non-significant until only significant variables remained:

- Driver demographics.
- Driving behaviour (kilometres driven per day; driving with passengers under 17 years; crash involvement in the last three years).
- Means of acquisition of the current vehicle.
- First ranked priority factors in the selection of a car.
- Safe Vehicle attitudes and beliefs about the driver's current car.
- Selected general Safe Vehicle attitudes and beliefs.

- Self-rated knowledge of Safe Vehicles.
- Knowledge of ANCAP and UCSR Safe Vehicle resources.
- Vehicle Age[4].

For the young-age driver model (adjusted for region), two factors – drivers' perception of the need to replace their car with a safer one and the age of the driver's current vehicle - were found to account for a modest but significant 13.8% (R^2) of the variance in intention to replace the current vehicle in the next two years [F (3, 245)=13.03, p<0.001] (Table 4.9). As the drivers' perception of the need to replace their current car with another that has additional safety features (B=.347), so did their intention to replace the car. In association with this, the increasing age of the driver's vehicle (B=.039) was associated with an increasing intention to replace the vehicle within the next two years.

Table 4.9 Multiple regression model for the intention to replace current vehicle in the next two years; younger-age drivers

Variable	B	Std.Error	95% Confidence Interval		p-value
			Lower	*Upper*	
(Constant)	1.81	.228	1.36	2.26	
Perceived need to replace current car with another that has additional safety features	.347	.071	.208	.486	.000
Age of current vehicle	.039	.014	.011	.067	.006

*Model adjusted for Driver Region

Modelling of the intentions of Rural/Remote area drivers (adjusted for driver age) revealed that three factors accounted for a modest but significant 12.8% (R^2) of the variance in intention to replace the driver's current vehicle in the next two years [F (4, 367)=13.45, p<0.001] (Table 4.10). Increasing interest in Safe Vehicles (B=.152) was associated with an increasing intention to replace an existing car. Similarly, as the driver's perception of the need to replace their current car with a safer model increased, so did their intention to replace the vehicle within two years (B=.384). Finally, drivers' who increasingly perceived that their risk of crashing and injury had more to do with their driving skills than the safety of their current car, expressed an increasing intention to replace their car (B=.199).

[4] The age of the vehicle rather than the vehicle's identified Safety Rating was included since the majority of drivers were unaware of the vehicle's rating. However, as vehicle age and the safety of the vehicle are strongly correlated (Newstead et al., 2016) the inclusion of age serves as a reasonable proxy for vehicle safety.

Table 4.10 Multiple regression model for the intention to replace current vehicle in the next two years; Rural/Remote area drivers

Variable	B	Std.Error	95% Confidence Interval		p-value
			Lower	*Upper*	
(Constant)	.610	.420	-.215	1.463	
Interest in Safe Vehicles	.152	.061	.032	.272	.013
Perceived need to replace current car with another that has additional safety features	.384	.058	.270	.498	.000
My chances of crashing and being injured have more to do with my skills as a driver than the safety of my car	.199	.062	.077	.321	.002

*Model adjusted for Age of Driver

5 DISCUSSION

This aim of this research was to investigate opportunities for the promotion of vehicles that have a high level of primary and secondary safety to the vulnerable driver groups of young novice drivers and Rural/Remote area drivers. The survey responses of a sample of drivers from these groups have provided information which highlights the factors that potentially enable and dissuade the use of Safe Vehicles and further. A discussion of the findings in relation to the specific objectives of the investigation is provided in the following sections. In Chapter 6, a series of recommendations is provided to framework the educational, promotional, policy and practice initiatives that may be useful in promoting the uptake of Safe Vehicles by the vulnerable driver groups and others.

5.1 The prevalence of Safe Vehicles and safe vehicle technologies

A major objective of this study was to determine the best operational definition for the measurement of a vehicle's safety to estimate the prevalence of Safe Vehicles in the sample of 17-25 year old and Rural/Remote WA area drivers. The review of the existing research literature and other information confirmed that two sources of information, discussed below, could be used to identify the prevalence of the use of Safe Vehicles.

The first of these is the age of the vehicle (determined from the date of vehicle manufacture) which has been found to be strongly associated with the risk of injury to the driver (Newstead et al., 2016) and the risk of fatality to all occupants (ANCAP, 2017). Vehicles with a more recent manufacture date are on average, safer because of a number of factors. Over time the structural integrity of vehicles has improved (Kent & Foreman, 2015) as has the fitment of airbags in the front, side and rear to supplement the injury reduction benefits associated with the use of seat-belts (Kent & Foreman, 2015). Newer vehicles are also more likely to be fitted with crash avoidance features such as Electronic Stability Control (compulsory for all new vehicles sold in Australia since 2011) which is highly effective in reducing the incidence of run off road, single vehicle crashes and associated injury (Scully & Newstead, 2010). The second source of information about the safety of vehicles is provided by the safety rating systems for new (ANCAP) and used (UCSR) vehicles. In particular, vehicles with a safety rating of

1 to 3 Stars were considered to be comparatively less safe than those with a 4 to 5 Star rating.

For this study, we identified the prevalence of use of Safe Vehicles in our sample of drivers based on both the *age of manufacture* and an available ANCAP or UCSR. Both sources are relevant for use as a number of older series vehicles, as identified by the UCSR (2017/2018 Buyers Guide), continue to provide an excellent level of protection (i.e., 5 Star) against injury for the driver. Examples of these vehicles include Audi A3 models manufactured 2004-2013 (5 Star); X-Type Jaguar manufactured 2002-2010 (5 Star), and Lexus IS350 and 250 series manufactured 2005-2013. Many of these vehicles were manufactured prior to 2011 which is the mandatory date for the fitment of ESC in new vehicles sold in Australia.

The calculated median vehicle age of our sample across all drivers was eight years, which is two years younger than average age of 10 years for the WA light passenger vehicle fleet (ABS, 2017). The younger average age of our sample is due to the 6 year average age of vehicles driven by older-age drivers in Rural/Remote WA. In contrast, the median age (10 years) of vehicles driven by both groups of younger-age drivers was consistent with the WA light passenger fleet age (ABS, 2017). Based on crashworthiness data provided by Newstead et al. (2016), these median ages are associated with a serious injury rate[5] of 2.21 (95%CI 2.06-2.36) for a 2011 vehicle and 2.49 [95%CI 2.39-2.59] for a 2007 vehicle.

Analysis of the retrieved current UCSR or assigned ANCAP ratings further highlighted the increased risk of injury for younger-age drivers, irrespective of region of residence. It was estimated that around six in ten vehicles of younger-age drivers had a star rating between 3 and 1[6]. For those with an UCSR, this indicates the vehicle offers *Marginal to Poor* driver. This level of protection is lower than the generally promoted lower level of 4 Stars (*Good* driver protection) for used vehicle. In contrast, around six in ten Rural/Remote area drivers, some of whom were younger age drivers, drove 4-5 Star rated cars. This increased to around seven in ten when only those aged 26+ years in Rural/Remote WA were considered.

[5] Serious injury rate per 100 crash involved drivers for year of vehicle manufacture as calculated by Newstead et al. (2016).
[6] Of the Star ratings between 1 and 3, 35% were historic ANCP ratings, 65% were current UCSR ratings.

Both the age of the vehicle and the safety ratings data show there are substantial and significant differences by age of driver on the use of Safe Vehicles by. Clearly, the majority of both Metropolitan and Rural/Remote younger-age drivers have an increased risk of injury. However, there is additional reason to conclude that the risk of crashing and injury is even greater for younger-age Rural/Remote area drivers because of the low rate of fitment of ESC in their cars. This was estimated to be 36.4% compared with 48.4% for young-age Metropolitan Perth drivers and 67.7% for older-age Regional/Remote drivers. This is an important finding given that ESC – a primary crash avoidance feature - has been demonstrated to significantly reduce the likelihood of single vehicle run off road crashes (Scully and Newstead, 2010). ESC is a substantially important feature of the vehicles of drivers who travel at high speed on rural and remote areas roads. Single vehicle run off road and roll over crashes are predominant crash types in these locations (CARRS-Q, 2012; Palamara et al., 2013) and the former is a common crash type for younger-age drivers (Scott-Parker, 2012; Oxley et al., 2014). Moreover, when crashes occur in rural and remote areas they are significantly more likely than urban area crashes to result in a fatality or hospitalisation (Zwerling, Peek-Asa, Whitten, Choi, Sprince & Jones, 2005; Palamara et al., 2013). For these reasons, it is vitally important that the vehicles of rural and remote area drivers, particularly younger-age drivers, are fitted with ESC as well as having a high level of crashworthiness (i.e., higher Star rating) to protect occupants in the event of a crash.

ESC was the most common Safe Vehicle crash avoidance feature identified in the vehicles of drivers. Overall, the vast majority of the vehicles lacked emerging forward collision mitigation technologies (e.g., Advanced (Automated) Cruise Control, Forward Collision Warning; Autonomous Emergency Braking) or lateral collision mitigation technologies (e.g., Lane Departure Warning; Lane Keeping Assist; Blind Spot Monitoring). The very low prevalence of these crash avoidance features in the sample of vehicles is unsurprising given their emerging status and their typically ‘optional’ fitment until recent. For example, around three percent of new cars offered for sale in Australia in 2015 were fitted with AEB as a standard feature. By March 2018 this proportion had risen to 31% (ANCAP, 2018a). From 2018, ANCAP will introduce performance testing of lane keeping support technologies and AEB for the rating of new vehicles (ANCAP, 2018b). This move will inevitably mean that vehicles fitted with these technologies will become increasingly available and in time, filter through to

the second hand market to increase the affordability and reach of these effective technologies.

5.2 Factors associated with the use of Safe Vehicles

A number of factors other than age and regional residence were identified at the univariate and multivariate level to be associated with the use of Safe Vehicles. Firstly, for younger age drivers the use of a 4-5 Star vehicle was lowest among those in the earliest period of licensure, that being the Red and Green provisional licensure period (up to two years post-licensure). As the majority of younger-age drivers bought their own car, it is very likely that these youngest and least experienced drivers had limited finances to purchase a safer, newer vehicle compared with their slightly older fully licenced cohort. Indeed, the study found that the majority of younger-age drivers reported they were unable to afford a car with a higher safety rating which they also perceived to cost more than cars with lower safety ratings. Whilst newer cars may on average be more expensive than older cars, there is an opportunity to educate drivers on differences between safe and less safe vehicles of an equivalent price. This opportunity could be taken at the pre and initial post licensing period during which time the risk of crashing and injury is highest (Scott-Parker, 2012). This education should also be supported by initiatives to lessen the financial burden associated with the purchase of a Safe Vehicle.

How the vehicle was acquired proved to be an important issue in relation to driving a newer, safer vehicle. The prevalence of 4-5 Star rated cars was highest among older-age Rural/Remote drivers who had been provided with a car by their employer, and then those who shared ownership and use of the car with another. The former finding is encouraging and perhaps reflects the positive impact of general 5 Star fleet purchasing policies as promoted by the National Road Safety Strategy and the WA Government. The finding also suggests that Safe Vehicle fleet purchasing policies should be highly promoted and opportunities created to provide fleet owners with additional financial incentives to purchase Safe Vehicles for their employers. This is particularly important for commercial buyers in Rural/Remote WA where Advanced Driver Assist Technologies such as Lane Departure Warning or Lane Keeping Assist would benefit drivers in maintaining their lateral position rather than running off road or colliding head-on.

The higher prevalence of use of Safe Vehicles among older-age drivers who share ownership and use of the vehicle highlights their ability to finance the purchase a safer vehicle. Unsurprisingly, the majority of drivers in this Age-Region group did not rank financial issues as the most important factor in the selection of a vehicle. Most of these drivers also stated that they could personally afford to purchase a Safe Vehicle.

For younger age drivers, the relationship between the safety rating of their car and how the vehicle was different to that for older-age Rural/Remote drivers. Overall, the prevalence of 1-3 Star rated cars was highest when the driver purchased their own, or it had been handed down to them, free of cost, or it had been bought for them. These finding are likely to be associated with the ready availability of the vehicle and/or limited finances of the driver or another to purchase a safer vehicle.

There was also some evidence to suggest, although based on low numbers, that the use of a 4-5 Star rated car was higher when the younger-age driver shared a vehicle owned by another (e.g., a family owned and controlled car). The additional benefit of this scenario is that young novice drivers who share a family-owned vehicle are known to have a significantly reduced (20%) risk of involvement in a police-reported crash, even after controlling for exposure and risk-taking behaviour (Chen, Palamara, Senserrick, Stevenson & Ivers, 2012). The higher incidence of 4-5 Star rated vehicles among a presumably family owned and shared vehicle may partly explain why younger-age drivers in this study who sometimes and more frequently drove with passengers under 17 years were also found to have an increased likelihood of driving a 4-5 Star rated vehicle. Perhaps the use of the safer family vehicle (or the part financing by parents of a Safe Vehicle) is accompanied by responsibilities to transport younger-age siblings.

Finally, the finding for younger-age drivers of a significant relationship between previous crash involvement and the reduced likelihood of driving a safe vehicle is troubling on two fronts. Firstly, their crash may have been related to the use of their current less safe vehicle. Previous research has identified that when younger-age drivers who crash are more likely to be driving an older, less safe vehicle (Watson & Newstead, 2009). Secondly, their involvement in a crash places them at higher risk of a subsequent crash and injury in their current 1-3 Star rated vehicle. This is because young drivers who are involved in a prior non-injury crash are up to 25 times more

likely to be involved in a subsequent injury or fatal crash compared with those who have not previously crashed (Malchose & Valchal, 2011).

5.3 Knowledge of Safe Vehicles and the use of Safe Vehicle resources

Drivers' Safe Vehicle related knowledge was assessed in relation to the correct identification of the crash avoidance features fitted to their car and their awareness of Safe Vehicle resources such as ANCAP and UCSR. As detailed above, the vast majority of the driver's vehicles were not fitted with Advanced Driver Assist Technologies such as AEB, FCW, LKA, LDW or BSM. Around eight in ten drivers correctly understood these features were not fitted to their vehicle. The high percentage of correct answers may be because the action of these technologies – from the description provided of them in the survey –could be easily determined as being available or otherwise in their car. For example, drivers did not experience audible warnings, a flashing light, or an automated action. On the other hand, drivers were considerably less able to determine the correct fitment of ESC, most likely because this is an 'invisible', automated technology which many drivers might never experience the operation of compared with FCW, AEB, LKA, LDW or BSM. One positive aspect of the drivers' incorrect appraisal of the fitment of ESC is that the majority believed their car *was not fitted with ESC* though the manufacturer's specifications for the nominated vehicle indicated it *was*. From a signal detection point of view this represents a 'false negative' (a 'no' response when the correct answer was 'yes'). This is preferable to drivers believing their vehicle was fitted with this crash saving technology when it was not (i.e, a 'false positive') which might otherwise influence their behaviour or appraisal of the safety of their vehicle.

The majority of drivers surveyed, across all age and region groups, claimed to have some knowledge of Safe Vehicles and their technology. Fewer than one in ten self-reported that they had no knowledge. The level of awareness of ANCAP by at least half of drivers across ages and regions rivals the 44% of new car buyers in 2016 who claimed to have consulted ANCAP (Goodwin & Robson, 2017) but is lower than a previously reported 84% of new car buyers who claimed knowledge of the ANCAP rating program (Clarke et al., 2012). The awareness of the ANCAP star ratings in this study may be related to the frequent presentation of the star ratings in the advertising of cars for sale on high profile on-line resources such as carsales.com.au and

gumtree.com.au, and in newspaper and television advertising for new cars. Somewhat interestingly however, drivers claimed to have awareness of the *Stars on Cars* program, which was generated by ANCAP and promoted in WA, South Australia and New South Wales, which ceased around six to seven years ago. This program provided star rating information at the point of sale. Clearly the program title has been a memorable one for some of the surveyed drivers.

Our sample of drivers similarly had a reasonable awareness of the UCSR even though UCSR are not promoted as widely and publicly as ANCAP ratings are. The proportion of drivers in this study who were unaware of the UCSR was however substantially higher than the 7%-10% reported by Clarke et al. (2012) based on their survey of intending and recent Australian car buyers. Interestingly however, our drivers' lack of awareness of the UCSR is similar to that identified in a recent survey of WA drivers conducted by the RAC WA (2017). Of the two ratings systems, more should be done to promote the use of UCSR, particularly to younger-age drivers who are more likely to purchase a second hand vehicle. The UCSR *Buyer's Guide* provides valuable information on the crashworthiness of second hand vehicles, within vehicle segment, to distinguish between safe and less safe vehicles.

Unfortunately, less than one in five drivers claimed to have awareness of the WA Road Safety Commission's *Consumer Guide to Safe Vehicles for Remote/Regional WA*. More importantly, awareness of the program was lowest among 26+ year old drivers in Rural/Remote WA. Clearly more needs to be done to promote this resource to the group of driver it is intended for.

Whilst many drivers claimed to have awareness of ANCAP and UCSR resources this did not necessarily translate to a high level of use of these resources in the past. Most of those that did regarded the resource as useful. This finding could be used to help market UCSR as an important consumer tool. Among those who had used ANCAP or UCSR rating, less than half claimed to know their vehicle's ANCAP rating, while fewer than one in ten claimed to know their vehicle's UCSR rating. The finding for the ANCAP raging differs to a recent RAC WA survey (2017) which found that 68% of drivers' surveyed claimed to know their vehicle's rating, though the accuracy of the rating was not confirmed. Similarly this study was not able to confirm the accuracy of the ratings that were reported by a small group of drivers.

There are a number of reasons why many drivers may not have used the ANCAP and UCSR resource and others (apart from having no need to). This study noted most drivers were uncertain about the contemporary nature of Safe Vehicle information, while others believed it quickly became 'out dated'. There is some accuracy in these perceptions since older ANCAP ratings do not reflect current rating criteria; similarly, UCSR ratings for vehicles do change over time (i.e., get worse) as new and potentially safer vehicles enter the rating system. Despite this, 60% of all drivers (though significantly fewer 17-25 year old Rural/Remote drivers) stated it was likely they would consult a Safe Vehicle resource when next considering a new or second hand vehicle. It is particularly important then to widely promote these resources, and secondly, to educate vehicle buyers on the meaning, limitations, and appropriate use of the Safe Vehicle ratings. Another initiative to counter concerns about the contemporary nature of the information might be to set 'sunset clauses' to restrict the dissemination of rating information that is outdated or superseded.

Drivers' preferences for accessing Safe Vehicle information was also investigated with the results showing clear preferences for the attainment of this information. The strongest preference across all drivers was recorded for 'point of sale' information for both new and used cars. This was the initiative of the *Stars on Cars* for new cars which existed until around 2011. It was also supported by a strong marketing campaign - "Consult the Stars". A number of drivers in this study claimed to have awareness of the *Stars on Cars* initiative. In respect to UCSR, it may prove particularly difficult to achieve voluntary compliance among dealers for the display of these ratings, particularly among those who specialise in 'low budget' vehicles which are typically older and less safe. These dealers may have less interest in the promotion of a 'safe' product.

Drivers were also reasonably consistent in their lack of preference for accessing Safe Vehicle information via older, more traditional medias such as free to air television, radio and daily newspapers. Instead, drivers – particularly younger-age drivers – understandably preferred to access information via more contemporary and immediate means of communication and information retrieval via smart phone applications, SMS and email alerts.

It is particularly important to tailor the delivery and accessibility of Safe Vehicle media to meet the needs and preferences of the intended target groups. This will hopefully ensure a higher level of engagement with the information.

5.4 Safe Vehicle related attitudes

As previously highlighted, vehicle safety was not the highest ranked factor for drivers when it came to the selection of their current car (for those drivers who claimed to have input or say in the selection process). Consistent with this, most drivers in all age and regional groups did not identify safety as the main reason for driving their current car. This is realistic response for many young drivers given they mostly drive older, 1-3 Star rated cars.

Financial issues and the suitability of the vehicle were the highest ranked factors across the three driver groups. These ranking reflect the importance of both the economic circumstances of the driver and the need to purchase a vehicle that meets their driving requirements. The lower ranking of safety reported here is broadly consistent with rankings of safety reported by Clarke et al. (2012) from a survey of intending and recent buyers of vehicles in Australia. It is lower however, than the 25% of new car buyers in Australia who ranked safety as the highest priority (McIntosh, 2012).

The perceived higher cost of Safe Vehicles and the ability of drivers to afford them (though less so for older-age drivers in Rural/Remote WA) was strongly identified from the responses of drivers. Unsurprisingly, drivers strongly endorsed initiatives that would provide financial incentives for the purchase of a Safe Vehicle (e.g., reduced insurance premiums, government sponsored incentives). All drivers were less supportive however, of initiatives that would likely penalise drivers for continuing to drive less safe vehicles (e.g., higher registration costs). It is also clear that drivers are happy for government intervention to control the availability of less safe vehicles by mandating a minimum Safe Vehicle rating. In many respects this function has been adopted by ANCAP who continues to set higher standards for the achievement of a 5 Star rating (e.g., the fitment of AEB and lane keeping assist technologies from 2018 onwards).

Whilst drivers appeared to endorse measures to ensure that Safe Vehicles were more readily available and affordable, they on average endorsed statements which suggested

they were also wary or cautious about Safe Vehicles and some technologies. For example, most drivers were sceptical about the ability of Safe Vehicles to protect vehicle occupants against injury in all crash scenarios. They were also distrusting of technology that took control away from them. They similarly felt that crash avoidance technologies would never be an acceptable substitute for good driving skills. These themes highlight potential barriers to the uptake of Safe Vehicles and the need to counter them with education and marketing to promote the functionality and benefits of Safe Vehicles and crash avoidance technologies. This will hopefully encourage the uptake of vehicles with crash avoidance technologies and reduce the likelihood of drivers disabling certain driver-assist features as has been previously identified (Monticello, 2017; Reagan et al., 2017) because of a distrust of the technology.

The attitudes of drivers toward the primary and secondary safety functionality of their cars highlighted that some drivers of 1-3 Star rated vehicles across the age and region groups held views which were not necessarily consistent with the probable primary and secondary safety performance of their vehicle given its age and safety rating. Equally concerning was that the drivers of these 1-3 Star rated vehicles were mostly happy with the level of safety of their car. The reasons for these perceptions can only be inferred. Their attitude may be related to a sense of optimism about their risk of crashing and injury, a lack of knowledge of vehicle safety, or a lack of appreciation of the functional safety of their car because they have not been involved in a collision. These attitudes are potential barriers to the uptake of Safe Vehicles which might otherwise be addressed through initiatives that aim to raise awareness and understanding of the risks associated with lower rated vehicles and the safety benefits of higher rated vehicles.

5.5 Intention to purchase a safe vehicle

Around a third of all drivers indicated that it was likely they would replace their current vehicle with a safer one in the next two years. This intention was significantly higher across younger-age drivers (around four in ten) compared with older-age Rural/Remote drivers. Within each Age-Region group, at a univariate level the intention did not significantly vary with the 1-3 and 4-5 Star group rating of driver's vehicles. In other words, drivers of 4-5 Star rated vehicles were equally as likely as drivers of 1-3 Star rated vehicles to intend to upgrade their vehicle.

The findings of the multivariate linear regression of the intention to replace the vehicle provided some insight of the factors that might contribute to this intention (bearing in mind these models accounted for a modest but significant percentage of the variation in intention to replace the vehicle). The regression models for both younger-age drivers and Rural/Remote drivers found that drivers' intention to replace their vehicle increased in association with the perception of the need to replace their current vehicle with another that has additional safety features. This finding highlights the importance of keeping drivers aware of the functional safety of their car. For some drivers, particularly of 4-5 Star vehicles, this intention could be motivated by their interest in and desire or need to drive a vehicle with the latest driver assist technologies – as opposed to believing their current vehicle was 'unsafe'. This interpretation has some merit, particularly for Rural/Remote driver (the majority of who were older in age) because of the combination of contributing factors in their regression model. The model for this group also identified the contribution of the attitude concerning their skills as a driver and their risk of crashing and injury (i.e., their risk of crashing and injury had more to do with their *[potentially declining]* driving skills than the safety of their car). The model also identified that self-rated interest in Safe Vehicles and technology was positively associated with the increasing intention to replace their vehicle. For younger-age drivers, the age of the vehicle was also predictive of the intention to replace their vehicle: drivers of older age vehicles were increasingly likely to intend to replace the vehicle. As vehicle age and safety are highly correlated, the combination of contributing factors in the younger-age driver regression model might reflect a stronger understanding of the safety risk associated with their current vehicle and the need to replace it.

The regression models provide some insight of the possible complexity of factors that likely influence a drivers' intention to replace their vehicle with another with additional safety features.

5.6 Limitations

There are a number of limitations associated with this study that potentially undermine the reliability and validity of the findings to meet the study objectives and secondly, to permit generalisability of the findings.

5.6.1 Sampling and recruitment of drivers and vehicles

This study employed a non-probability convenience sampling method. This entails the risk of recruiting drivers who are motivated to participate because of their interest in the topic which has the potential to bias the results. Secondly, it proved difficult to recruit younger-age drivers from Rural/Remote WA compared with the recruitment of same-aged driver in Metropolitan Perth. Consequently the sample of drivers under-represents this population of drivers and thus biases the composition of the all-region younger-age driver group and the all-age Rural/Remote driver group.

The collection of valid and reliable information on the year of manufacture of the vehicle is central to achieving one of the main objectives of this study. Based on the year of manufacture reported by the drivers and motor vehicle census figures for 2017 reported by the ABS (2017), our sample under-represents vehicles manufactured prior to 2007 (by around 13.5%) and over-represents vehicles manufactured 2012-2017 (by around 12.4%). Our sample of vehicles manufactured 2007-2011 (29.6%) is however, similar to the registered WA light passenger fleet (28.3%) in 2017 (ABS, 2017). Unfortunately, no data could be readily located on the median age of vehicles registered to persons residing in Metropolitan Perth and Rural/Remote WA or to persons by age group to better understand the representativeness of our sample of vehicles by age. This is an important consideration given the identified strong relationship between vehicle age and safety (Newstead et al, 2016; ANCAP, 2017).

5.6.2 The validity and reliability of data

The need to maintain the anonymity of driver responses meant that it was also not possible to implement processes to validate information provided by drivers. This is particularly pertinent to the information drivers provided on the Make, Model and Year of Manufacture. The potential limitation of this is compounded by the need to restrict the retrieval of manufacturer's specifications and vehicle safety rating to the base model variant of the vehicle. Secondly, no data was collected on the 'test-retest' reliability of the drivers' responses to the survey items.

6 RECOMMENDED FRAMEWORK TO PROMOTE THE USE OF SAFE VEHICLES IN WESTERN AUSTRALIA

6.1 Introduction

Promoting the use of Safe Vehicles is a key component of the State's *Toward Zero Road Safety Strategy 2008-2020* to reduce the incidence of road injury (Western Australian Office of Road Safety, 2008). Safe Vehicles not only provide vehicle occupants with a higher level of protection against injury in the event of a crash, but select crash avoidance technologies can also mitigate the occurrence of certain crash types in particular locations targeted by the *Toward Zero* strategy. Features that maintain vehicle control (Electronic Stability Control), lane position (Lane Departure Warning; Lane Keeping Assist; Blind Spot Monitoring) and safe headway distance (Forward Collision Alert; Autonomous Emergency Braking; Adaptive Cruise Control) can help reduce the incidence of 'priority crash types' such as singe vehicle run off road and head-on crashes in Rural and Remote areas and rear-end crashes at Metropolitan intersections. In addition, the *Toward Zero* strategy recognises the pivotal role Safe Vehicles can play in reducing the incidence of crashes and injury among young, novice drivers who are least experienced (Oxley, Charlton, Starkey & Isler, 2014) and typically drive older, less safe vehicles (Watson & Newstead, 2009).

6.2 Goal of the Safe Vehicle Promotion Framework

The goal of the Safe Vehicle Promotion Framework is to support the State's *Toward Zero Road Safety Strategy 2008-2020* to increase the use of Safe Vehicles on Western Australian roads, particularly among identified vulnerable drivers.

6.3 Priorities

The priorities of the Safe Vehicle Promotion Framework are to:

- Especially target the promotion of Safe Vehicles to those drivers who have a comparatively higher risk of crash involvement and injury.
- Make use of existing opportunities as well as propose new opportunities to promote the use of Safe Vehicles among the identified target driver groups.
- Propose actions to reduce the barriers to the use of Safe Vehicles by the target driver groups.
- Reduce the use of vehicles that have low Safe Vehicle ratings and lack critical safety technologies by the identified target driver groups.

- Reduce the incidence of death and serious injury among the identified target driver groups associated with the use of vehicles that have low Safety Ratings or lack critical safety technologies.

6.4 Target driver groups

The Safe Vehicle Promotion Framework specifically targets two vulnerable drivers groups who have a comparatively high risk of crashing and/or serious injury. These groups are (i) young, novice drivers aged 17-25 years and, (ii) those that reside and drive in Rural and Remote areas of Western Australia. It is expected that the Framework will also positively impact the vehicle purchasing decisions and vehicle use of the broader population of Western Australian drivers.

Young, novice drivers

Relative to older age and more experienced drivers, young novice drivers aged 17-25 years are known to have a substantially higher risk of crashing and injury. Overall, the risk of injury among young drivers is five to 10 times that of older age drivers, with highest risk of crashing and injury occurring within the initial months of licensure (Bates, Davey, Watson, King & Armstrong, 2014). In Western Australia, the most recent statistics for those aged 17-24 years by road user type show that around 15% of drivers killed or seriously injured in 2013 were aged 17-24 years (Bramwell, Bruce, Hill & Thompson, 2014). Younger-drivers also have a higher likelihood of crashing in older, less safe vehicles (Watson & Newstead, 2009). Even when younger-age drivers crash in a vehicle of approximately the same age as one involving an older driver counterpart, their vehicle typically has a lower level of crashworthiness, perhaps because it is a lower specified model for the year of manufacture. Young novice driver crashes are characterised by a loss of a control (Scott-Parker, 2012) and distraction (Bingham, 2014). These crash types can be mitigated by various lateral and forward Advanced Driver Assist Technologies such as Lane Keeping Assist and Autonomous Emergency Braking.

Rural and Remote area drivers

Around a third of all Australians reside outside metropolitan or regional city areas and yet around a half of all road deaths occur in these regions (CARRS-Q, 2012). These population demographics are similar for Western Australia; approximately 56% of road deaths in 2017 occurred outside Metropolitan Perth (Road Safety Commission, 2018).

Western Australian research has found that crashes occurring in Rural and Remote areas compared with Metropolitan Perth are 4.5 times more likely to result in death or hospitalisation and to involve a run off road crash either on a straight or curved section of road (Palamara, Kaura & Fraser, 2013). These crash types can be mitigated through the use of vehicle control and stability technologies such as Electronic Stability Control and lateral Advanced Driver Assist technologies such as Lane Departure Warning and Lane Keeping Assist. The two latter technologies may also be beneficial in reducing the incidence of driver fatigue related crashes which feature among single vehicle loss of control crashes on high speed (i.e., >=80km/hour) Rural and Remote area roads in Western Australia (Palamara, 2016).

6.5 Principles guiding the promotion of the use of Safe Vehicles

A number of principles guide the Framework to promote Safe Vehicles.

The promotion of Safe Vehicles requires a broad, multisector approach across the driving life-span

A number of government and non-government agencies and community groups have carriage of the *Toward Zero* strategy and its action plan. The promotion of Safe Vehicles must utilise the opportunities these agencies and groups present and also seek new opportunities to collaboratively engage these stakeholders and others in the promotion process. The level and timing of stakeholder engagement in the promotion process will vary in accord with the target driver's status (e.g., a learner or novice driver purchasing a first vehicle *versus* a small business owner-driver or Fleet Purchasing Officer). Notwithstanding this point, it is important to maintain stakeholder engagement in the promotion process across the 'life-span' of driving and vehicle purchases.

The use of Safe Vehicles should be approached and promoted as a positive health-related behaviour

The use of Safe Vehicles should be approached and promoted as a positive health-related behaviour akin to the promotion of other health-enhancing behaviours such as anti-smoking, the responsible consumption of alcohol, and diet and exercise. Like the latter behaviours, the use of Safe Vehicles has the potential to prevent adverse health conditions (e.g., injury, disability) and even death. Lessons for the promotion of the use of Safe Vehicles can be learned from past promotions and campaigns around seat-belt use and drink-driving. Whilst legislation and enforcement have been key drivers of the

positive changes in these two areas of safe road use behaviour, mass-media and educational campaigns have played an important role in addressing the knowledge, attitudes and behavioural barriers around these behaviours to produce positive change (Fleiter, Lewis & Watson, 2013). The promotion of Safe Vehicles must similarly address and counter the underlying knowledge deficits, negative attitudes and behaviours that have been identified as potential barriers to the use of Safe Vehicles. These include, for example, a lack of knowledge and use of Safe Vehicle educational resources; a lack of belief in the effectiveness of Safe Vehicles to minimise crash involvement and injury, and a perceived an inability to afford a Safe Vehicle (Palamara, 2018).

Access and equity issues are key issues in the promotion of Safe Vehicles

Health and the practice of health-related behaviours have strong social determinants. Factors such as income, wealth and education have been found to impact the development of diseases and the practice of the potential behavioural causes of these disease states (Braveman & Gottlieb, 2014). Similarly, a driver's socioeconomic circumstances can have a bearing on their ability to access Safe Vehicles. Until more recently, access to vehicles offering both high levels of occupant protection and crash avoidance technologies was restricted to those who could afford higher priced imported or luxury vehicles. The importance of access and equity to Safe Vehicles is exemplified by the finding that younger-age drivers, who most likely have access to fewer financial resources, are more likely to drive older, less safe vehicles (Palamara, 2018). This group of drivers are also more likely than older-age drivers to consider that Safe Vehicles are more expensive and that they are less able to afford such a vehicle (Palamara, 2018). In addition to younger-age drivers, some drivers who reside in Rural and Remote regions may also have difficulty accessing Safe Vehicles. Those who reside in more remote areas tend to have lower socioeconomic status and to be more socially disadvantaged (ABS, 2011). Consequently, the affordability of safer, newer cars that are suitable to the driving conditions of their region may prove critical issue for these drivers. Actions to promote the use of Safe Vehicles must provide 'disadvantaged' vulnerable drivers with the knowledge of Safe Vehicle options that are more affordable and opportunities to subsidise the initial purchase and ongoing running costs of a Safe Vehicle.

Drivers will have unique vehicle requirement that must be considered in the promotion of Safe Vehicles

Further the above principle, the promotion of the use of Safe Vehicles must acknowledge that drivers select a particular vehicle for a range of reasons. The safety of the vehicle is not a high priority for the majority of younger-age and Rural-Remote area Western Australian drivers. Rather, financial issues and the suitability of the vehicle for their driving needs are ranked higher by a greater proportion of these driver groups (Palamara, 2018). Whilst the Framework must promote the benefits of using a Safe Vehicle per se it must also educate drivers (and Fleet Purchasing Officers) on how to select a vehicle within budget constraints and the Safe Vehicle options within their required market segment (e.g., 4WD; sedan; commercial vehicle; van; people mover). This is particularly important for younger-age drivers who may have a limited budget to purchase and maintain a 'first vehicle' and Rural and Remote area drivers given the type of roads and driving conditions they are subject to. The issue of fit for purpose vehicles that are safe and affordable is particularly pertinent to Aboriginal populations who reside in Rural and Remote areas. Aboriginal persons have a high risk of road related injury (Brameld & Meuleners, 2018). This is perhaps because they travel long distances in older, unsafe, unsuitable, and over-crowded vehicles (Helps, Moodie & Warman, 2010).

6.6 Domains for action to promote the use of Safe Vehicles

The domains for action for the promotion of the use of Safe Vehicles share similarities with the domains specified for the State's health promotion framework (Chronic Disease Prevention Directorate, 2017). The relevant domains and examples of interventions for the promotion of Safe Vehicles are specified below.

Legislation and Policies

Legislation and supporting government policies have played an important role in the promotion of safe road use behaviours such as the use of seat-belts and to counter substance impaired driving. Similarly, Australian Design Rules have initiated minimum national standards for various aspects of vehicle safety, for example, the mandatory fitment of Electronic Stability Control in new vehicles. These initiatives, plus changes in the criteria employed by the Australian New Car Assessment Program for a 5 Star rating, have over time improved both the crash avoidance and occupant protection features offered in new vehicles sold in Australia. In addition to these national

initiatives, the Western Australian government has the opportunity to introduce policies to ensure that the least safe vehicles are removed from the vehicle fleet and thus less accessible to vulnerable drivers. This might entail the 'sun-setting' of the registration of the most unsafe vehicles (e.g., vehicles with a 1 to 2 star Used Car Safety Rating) over a period of time. Alternatively, the state government could prohibit the registration and use by younger-age drivers of vehicles which lack safety critical technologies, such as airbags and Electronic Stability Control.

The state government could also work with the federal government to introduce minimum safety standards for commercial vehicles through Safe Vehicle fleet purchasing policies. To be eligible for tax concessions for the purchase and operation of commercial vehicles, operators would need to procure and operate vehicles which meet Safe Vehicle standards (e.g, fitted with minimum safety features; achieving a minimum ANCAP or Used Car Safety Rating).

Education and marketing communications to promote Safe Vehicles

Engaging the community in the discussion of Safe Vehicles through education and marketing strategies provides an opportunity to increase the awareness of and understanding of Safe Vehicles and their benefits. It also provides an opportunity to challenge the beliefs and behaviours that are potential barriers to the uptake of Safe Vehicles. Engaging the community can be achieved through existing opportunities and through the creation of others, such as a devoted marketing campaign. Examples of these opportunities are presented below.

<u>The DRIVE SAFE handbook and the Learner Driver theory test</u>

The Drive Safe handbook is an important source of information on driving safely and is often the first point of engagement for many younger-age persons in the learning to drive process. It is also likely to be the time when youngsters (and their parents) are considering what car they might drive once licensed. The Handbook addresses a number of Safe System elements yet it does not address Safe Vehicles in any form. There is an opportunity via the Handbook to introduce the Safe Vehicles concept. This could include coverage of the elements of primary safety technology and their effectiveness and how secondary safety systems work. The ANCAP and UCSR programs could also be introduced and explained. Other additional Safe Vehicle resources such as howsafeismycar.com.au and howsafeismyfirstcar.com.au could be

referenced to inform drivers of the availability of resources to make informed purchasing decisions – particularly since most younger-age drivers purchase their own car.

The Learner-Driver theory test also provides an opportunity to formally assess rudimentary knowledge of Safe Vehicles. Assessment of the material will likely reinforce the notion that an understanding of Safe Vehicles and their use is an important component of safe driving.

The SDERA Keys for Life Program

The Keys for Life program also provides an opportunity to reinforce the Safe Vehicle message to students and parents alike in the pre-licensing, pre-vehicle purchase/use period. There are opportunities across the ten-week classroom-based program to integrate Safe Vehicle concepts, particularly on the functionality of primary safety technologies, with topics such as speed, stopping distances, and distraction. However, Lesson Nine of the program, which addresses 'My Safe Dream Car', provides an opportunity to draw the material together to strengthen the message regarding the identification of safer vehicles. Activities for this could include assigning students a budget and requiring them to search for and identify examples of safe and less safe vehicles for sale and to retrieve relevant safety rating information.

The accompanying Parent-Student workshops also provide an opportunity to strengthen the take-home messages on the importance of Safe Vehicles and their features. The workshop can be used to inform parents of Safe Vehicle resources and how these can be used to identify safe and budget-minded vehicles and how parents can help guide their child in the selection of a safer vehicle (given that most younger-age drivers purchase their own car). The workshop could also focus on the benefits of the younger-age driver sharing a safe, family owned vehicle in preference to the novices' exclusive use of an older, cheaper and less safe vehicle they have purchased for themselves.

The *Roadwise* local government road safety program

The regional *Roadwise* program and its road safety officers are an excellent resource and provide an opportunity to promote the concept of Safe Vehicles to rural and remote area drivers through their engagement with local Roadwise committees and other local community groups. Roadwise could also be engaged to develop and co-ordinate a program of Safe Vehicle activities for their communities. These activities could include

talks on Safe Vehicles and roadside checking-station style opportunities to provide community members with an understanding of the Safe Vehicle rating of their car and key Safe Vehicle features. The fitment and operation of ESC should feature strongly in these activities.

WA Road Safety Commission *Guide to Safe Vehicles – Regional and Remote WA*

There is an opportunity for the Road Safety Commission to review and redevelop the *Guide* in terms of the material and how best to disseminate it. One possible option is for the Road Safety Commission to sponsor a travelling regional area 'show and tell' style program. The program could highlight Safe Vehicles and features such as ESC and lateral collision avoidance technologies using 'interactive' experiential activities.

Development of an education and marketing campaign

Findings from a survey of younger-age drivers and drivers from Rural and Remote areas of Western Australia indicated there is an opportunity to improve their awareness of Safe Vehicles and particularly the usefulness of the Used Car Safety Rating program as a Safe Vehicle resource (Palamara, 2018). Second to this, the findings indicated that some drivers of older, less safe 1- 3 Star rated cars (which offer less than optimal protection to the driver against injury) hold optimistic beliefs regarding the function safety of their which do not necessarily align with the vehicle's potential performance. It is recommended that a campaign brief be developed to promote the availability and use of the key Safe Vehicle resources and address the various attitudinal barriers identified in that research. Communicating these messages should consider the 'mediums' endorsed by the various younger-age and Rural/Remote driver groups. The campaign could address:

- The use of Safe Vehicle resources like ANCAP UCSR, and howsafeismycar.com.au to create awareness of the safety functionality of the driver's car and of the need to purchase another with improved safety performance and how best to identify that car or to choose between options.
- The scepticism of the ability of Safe Vehicle to protect occupants.
- How Advanced Driver Assist technologies can supplement driver skill and control over the vehicle rather than undermine that control. This marketing could have an additional focus on older-age drivers who feel their skills have declined

(e.g., reaction time to avoid a forward collisions) and place them at higher risk of crashing.

- Use of the UCSR to identify budget-wise safe, used vehicles.
- The particular importance of Red and Green Provisionally licensed drivers accessing Safe Vehicles.
- 'Know your ESC" – to highlight driver awareness of the functionality of ESC and the importance of its fitment. This would have a particular focus on drivers in Rural/Remote WA using older 4WD vehicles which have a higher likelihood of rolling over because of their higher tipping point.
- Safe Vehicle information communication packages which are specific to the needs of Rural/Remote drivers and culturally relevant and appropriate for Aboriginal persons.

Another initiative that could be considered is the marketing of Safe Vehicles at the *Point of Sale*. The survey of Western Australian drivers conducted by Palamara (2018) noted a strong preference for accessing Safe Vehicle information at the 'point of sale' for new and used cars. In relation to new cars, further research should be undertaken to determine how much information (i.e., Australian New Car Assessment Program star ratings) is provided at new car dealerships and thus, the need for a formalised 'point of sale' program along the lines of the earlier Stars on Cars initiative. While it would be more difficult to promote UCSR at the 'point of sale', there may be opportunities to encourage certain dealers of select used cars to use advertise UCSR on cars as a marketing advantage. The feasibility of this should be explored initially with dealers of premium used cars which are more likely to achieve and retain a high Safe Vehicle rating.

Addressing the financial barriers to the use of Safe Vehicles

Research showed that younger-age drivers and some older-age Rural/Remote drivers in Western Australia identified financial issues as a major barrier for accessing Safe Vehicles (Palamara, 2018). This barrier could be addressed through a range of initiatives such as those detailed below.

- Reduced vehicle registrations costs for 4 and 5 Star vehicles owned by younger-age drivers and drivers residing in disadvantaged Rural and Remote areas of Western Australia.
- Reductions in insurance premiums for 4 and 5 Star vehicles owned and insured by young-age drivers and drivers residing in disadvantaged Rural and Remote areas of Western Australia.
- Lowered crash excess charges on 4 and 5 Star vehicle insurance policies which include a 'nominated' younger-age driver on the policy.
- A negotiated vehicle servicing package to provide discounted servicing for younger-age drivers who own a 4 or 5 Star rated vehicle.
- Reductions in vehicle transfer costs for drivers purchasing second-hand cars that are 5 Star rated.
- Additional incentives to promote the purchase of 5 Star rated (new and second hand) vehicles by small business operators.
- The development of Safe Vehicle philanthropy program to provide safe second-hand vehicles to (program approved) young drivers from low socioeconomic backgrounds and disadvantaged areas.

While these initiatives will help produce marginal gains in the uptake of Safe Vehicles, their effectiveness will be dependent on the level of financial investment that government and commercial operators are prepared to offer that can be accommodated within their business models. The financial incentives are likely to be less effective if they are perceived not to offset the higher cost of purchasing and maintaining a Safe Vehicle versus a less safe vehicle.

Another difficulty with some of these financial initiatives, particularly in the case of vehicles with a UCSR, is that the discounts and benefits might only apply for the duration the vehicle retains its rating. This would encourage potential buyers to research vehicles that have maintained a stable rating for some time. The Vehicle Safety Research Group at MUARC could assist with this by developing and including in the Buyer's Guide a 'time at rating' indicator (i.e., that is, how long the vehicle has maintained its rating).

Framework References

Australian Bureau of Statistics. (2011). *Measures of Socioeconomic Status: Information paper. 1244.0.55.001*. Canberra, Australia: Author.

Bates, L. Davey, J. Watson, B., King, M. & Armstrong, K. (2014). Factors contributing to crashes among young drivers. *Sultan Qaboos University Medical Journal*, *14*, e297-305.

Bingham, C. (2014). *Current knowledge of adolescent driver distraction*. Journal of Adolescent Health, 54, S1-S2.

Brameld, K. & Meuleners, L. (2018). *Aboriginal Road Safety: A review of issues, interventions, and needs in Western Australia: Phase 1. Report to the Road Safety Commission.* Perth: Curtin-Monash Accident Research Centre.

Braveman, P. & Gottlieb, L. (2014). The social determinants of health: It's time to consider the causes of the causes. *Public Health Reports, 129* (Supplement 2), 19-31.

Bramwell, J., Hill, D. & Thompson, P. (2014). *Reported road crashes in Western Australia 2012*. Perth, Western Australia: Road Safety Council of Western Australia.

CARRS-Q. (2012). *Rural and remote road safety: State of the road fact sheet*. Brisbane, Queensland. Author, Queensland University of Technology.

Chronic Diseases Prevention Directorate. (2017). *Western Australian Health Promotion Strategic Framework 2017-2021*. Perth, Western Australia: Department of Health, Western Australia.

Fleiter, J., Lewis, I. & Watson, B. (2013). *Promoting a more positive traffic safety culture n Australia: Lessons learnt and future directions*. Paper presented to the Australasian College of Road Safety Conference, Adelaide, Australia 7th-8th November.

Oxley, J., Charlton, J., Starkey, N. & Isler, R. (2014). *Understanding novice driver behaviour: Review of the literature*. Melbourne, Victoria: Monash University Accident Research Centre and TARS, University of Waikato.

Palamara, P. (2016). *The application of a proxy measure to estimate the incidence of driver fatigue in Western Australian motor vehicle crashes.* Perth, Western Australia. Curtin-Monash Accident Research Centre. RR 16-003

Palamara, P. (2018). *Promoting Safe Vehicles to vulnerable drivers*. Perth, Western Australia: Curtin-Monash Accident Research Centre. RR 18-06

Palamara, P., Kaura, K., Fraser, M. (2013). *An investigation of serious injury motor vehicle crashes across metropolitan, regional and rural Western Australia.* Perth, Western Australia: Curtin-Monash Accident Research Centre. RR 09-001

Road Safety Commission. (2018). *2017 Preliminary summary of fatalities on Western Australian roads*. Perth, Western Australia: Author.

Scott-Parker, B. (2012). *A comprehensive investigation of the risky driving behaviour of young novice drivers.* Unpublished PhD. thesis. Brisbane, Queensland: Queensland University of Technology.

Watson, L. & Newstead, S. (2009. *Vehicle safety and young drivers – Stage 1: Profile of young driver vehicles.* Melbourne, Victoria: Monash University Accident Research Centre.

Western Australian Office of Road Safety (2008). *Toward Zero: Road safety strategy to reduce road trauma in Western Australia 2008-2020*. Perth, Western Australia: Government of Western Australia.

REFERENCES

Allianz Australia. (2018). *Evolution of car safety*. Retrieved from https://www.allianz.com.au/car-insurance/news/evolution-of-car-safety.

Anderson, R. & Baldock, M. (2008). *Vehicle improvements to reduce the number and severity of rear-end crashes*. Adelaide, South Australia: Centre for Automotive Safety Research, The University of Adelaide. CASR052.

Anderson R. & Searson D. (2014). Use of Age-Period-Cohort models to estimate effects of vehicle age, year of crash and year of vehicle manufacture on driver injury and fatality rates in single vehicle crashes in New South Wales, 2003-2010. *Accident Analysis & Prevention, 75,* 202-210.

Australian Automobile Association [AAA). (2017). *Benefits of reducing the age of Australia's light vehicle fleet*: Summary Report. Canberra, ACT: Author.

Australian Bureau of Statistics. (2011). *Measures of Socioeconomic Status: Information paper. 1244.0.55.001*. Canberra, Australia: Author.

Australian Bureau of Statistics. (2017). *Motor Vehicle Census, Australia 2017. (No. 9309DO001).* Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/products/28861A19CCDB9441CA25753D001B59DA?OpenDocument.

Australian New Car Assessment Program [ANCAP]. (2014). ANCAP rating road map 2011-2017. Retrieved from https://www.ancap.com.au/technical-protocols-and-policies

Australian New Car Assessment Program [ANCAP]. (2016).*ANCAP Submission: New Car retailing Industry – a market study by the Australian Competition & Consumer Commission*. Retrieved from https://s3.amazonaws.com/cdn.ancap.com.au/app/public/assets/9f3a24fd46ee75aad2462f4309b4e243a7f0ce39/original.pdf?1480627097

Australian New Car Assessment Program [ANCAP]. (2018a). *Availability of Autonomous Emergency Braking (AEB) in Australia.* Retrieved from https://s3.amazonaws.com/cdn.ancap.com.au/app/public/assets/2319c7b28926eeae8efd067996d95a800cae9aa5/original.pdf?1529017528.

Australian New Car Assessment Program [ANCAP]. (2018b). *Future Requirements*. Retrieved from https://www.ancap.com.au/future-requirements.

Australian New Car Assessment Program [ANCAP]. (2018). *New analysis: Fatality rate four times higher in an older vehicle*. Retrieved from http://www.ancap.com.au/media-and-gallery/releases/.

Australian Transport Council. (2011). *National Road Safety Strategy 2011-2020*. ACT, Australia: Author.

Bates, L. Davey, J. Watson, B., King, M. & Armstrong, K. (2014). Factors contributing to crashes among young drivers. *Sultan Qaboos University Medical Journal*, *14*, e297-305.

Bellis, M. (2018). *The history of airbags: The inventors that pioneered airbags.* Retrieved from https://www.thoughtco.com/history-of-airbags-1991232

Bingham, C. (2014). *Current knowledge of adolescent driver distraction*. Journal of Adolescent Health, 54, S1-S2.

Brameld, K. & Meuleners, L. (2018). *Aboriginal Road Safety: A review of issues, interventions, and needs in Western Australia: Phase 1. Report to the Road Safety Commission.* Perth: Curtin-Monash Accident Research Centre.

Bramwell, J., Hill, D. & Thompson, P. (2014). *Reported road crashes in Western Australia 2012*. Perth, Western Australia: Road Safety Council of Western Australia.

CARRS-Q. (2012). *Rural and remote road safety: State of the road fact sheet*. Brisbane, Queensland. Author, Queensland University of Technology.

CARRS-Q. (2016). *Indigenous road safety: State of the road fact sheet*. Brisbane, Queensland. Author, Queensland University of Technology.

Chen, H., Palamara, P., Senserrick, T., Stevenson, M. & Ivers, R. (2012). *Access to vehicle and the risk of crash in novice drivers: Results from the DRIVE study.* Paper presented to the Australasian Road Safety Research, Policing and Education Conference, 4th-6th October, Wellington, New Zealand.

Cicchino, J. (2017a). Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash rates. *Accident Analysis and Prevention*, *99*, 142-152.

Cicchino, J. (2017b). *Effects of lane departure warning on police-reported crash rates*. Virginia, USA: Insurance Institute for Highway Safety.

Cicchino, J. (2017c). *Effects of blind spot monitoring systems on police-reported lane-change crashes.* Virginia, USA: Insurance Institute for Highway Safety.

Clarke, N., Paine., M., Robson, R., Smith, J. & Haley, J. (2015). *Improving vehicle safety in Australia and New Zealand: The role of ANCAP*. Paper presented to the 24th Enhanced Safety of Vehicles Conference, 8th-11th June, Gothenburg, Sweden

Cockfield, S., Thompson, J. & Truong, J. (2011). *Improving the safety performance of Australia vehicles – A consumer focussed approach*. Paper presented to the 22nd International Technical Conference on the Enhanced Safety of Vehicles. Washington, DC, USA, 13th – 16th June.

Corben, B., Logan, D., Fanciulli, L., Farley, R. & Cameron, I. (2010). Strengthening road safety strategy development 'Toward Zero' 2008-2020 – Western Australia's

experience scientific research on road safety management SWOV workshop 16 and 17 November 2009. *Safety Science, 48,* 1085-1097.

Crandall, C., Olson, L. & Sklar, D. (2001). Mortality reduction with air bag and seat belt use in head-on passenger car collisions. *American Journal of Epidemiology, 153,* 219-224.

Davidekova, M. & Gregus, M. (2017). Nice, Berlin, London – if every car had autonomous emergency braking system for forward collision avoidance. *Procedia Computer Science, 110,* 386-393.

Delaney, A., Newstead, S., Corben, B., Langford, J. & Daley, P. (2002). *Roadside environment safety: A statistical analysis of collisions with fixed roadside objects in Victoria.* Paper presented to the Australasian Road Safety Research, Policing and Education Conference, 3rd-5th November, Adelaide, South Australia.

Dang, J. (2004). *Preliminary results analysing the effectiveness of electronic stability control (ESC) systems.* Washington, DC: National Highway Traffic Safety Administration. Evaluation Note DOT HS 809 790.

Department of Infrastructure, Regional Development and Cities [DIRDC]. (2018a). *Australian Design Rules*. Retrieved from https://infrastructure.gov.au/vehicles/design/

Department of Infrastructure, Regional Development and Cities [DIRDC]. (2018b). *Australian Design Rule development program and public comment*. Retrieved from https://infrastructure.gov.au/vehicles/design/adr_comment.aspx

Doyle, M., Edwards, A. & Avery, M. (2015). *AEB real world validation using UK motor insurance claims data*. Paper presented to the 24th Enhanced Safety of Vehicles Conference, 8th-11th June, Gothenburg, Sweden.

Du Bois, P., Chou, C., Fileta, B., Khalil, T., King, A., Mahmood, H., Mertz, H. & Wismans, J. (2004). *Vehicle crashworthiness and occupant protection*. Southfield, Michigan: American Iron and Steel Institute.

Driverless Car Market Watch. (2018). Retrieved from http://www.driverless-future.com.

Eichelberger, A. & McCartt, A. (2016). Toyota drivers' experiences with Dynamic Radar Cruise Control, Pre-Collision System, and Lane-Keeping Assist. *Journal of Safety Research, 56,* 67-73.

Federal Chamber of Automotive Industries [FCAI]. (2018). *Electronic Stability Control*. Retrieved from https://www.fcai.com.au/Safety/electronic-stability-control

Fildes, B., Keall, M., Lie, A., Page, Y., Pastor, C., Pennisi, L., Rizzi, M., Thomas, P. & Tingvall, C. (2015). Effectiveness of low speed autonomous emergency braking in real-world rear-end crashes. *Accident Analysis and Prevention, 81,* 24-29.

Gargett, D., Cregan, M. & Cosgrove, D. (2011). *The spread of technologies through the vehicle fleet*. Paper presented to the Australasian Transport Research Forum, 28th-30th September, Adelaide, Australia.

Goodwin, J. & Robson, R. (2017). *Communicating the value and maintaining relevance of a five star safety rating to consumers and industry*. Paper presented to the 25th International Technical Conference on the Enhanced Safety of Vehicles. Michigan, USA, 5th – 8th June.

Government of Western Australia Department of Finance. (2017). *WA Government Fleet Policy and guidelines Effective: 8th September 2017*. Perth, Western Australia: Author.

Helps, Y., Moodie, D., & Warman, G. (2010). *Aboriginal people travelling well: Community report*. Melbourne, Victoria: The Lowitja Institute.

Hutchinson, P. & Anderson, R. (2011). *Newer cars: Much safer?* Paper presented to the Australasian Transport Research Forum, 28th-30th September, Adelaide, Australia.

Insurance Institute for Highway Safety [IIHS]. (2007). Side airbags are reducing driver deaths in both cars and SUVs. *IIHS Status Report, 41*, (8) October 7th.

Insurance Institute for Highway Safety [IIHS]. (2016). Autonomous vehicles. *IIHS Status Report, 51*, (8) November 10th.

Insurance Institute for Highway Safety [IIHS]. (2018). *Automation and crash avoidance*. Retrieved from http://www.iihs.org/iihs/topics/t/automation-and-crash-avoidance/qanda#driving-automation.

International Transport Federation [ITF]. (2008). *Towards Zero: Ambitious road safety targets and the Safe System approach*. Paris, France: OECD Publishing.

International Transport Federation [ITF]. (2016). *Zero road deaths and serious injuries: Leading a paradigm shift to a Safe System*. Paris, France: OECD Publishing.

Jansch, M. (2017). *Lane Keeping Assist systems, European Road Safety Decision Support System, developed by the H2020 project SafetyCube*. Retrieved from Uwww.roadsafety-dss.eu.

Kahane, C. (2015). *Lives saved by vehicle safety technologies and associated Federal Motor Vehicle Safety Standards, 1960 to 2012 – Passenger cars and LTVs – With reviews of 26 FMVSS and the effectiveness of their associated safety technologies in reducing fatalities, injuries, and crashes.* (Report No. DOT HS 812 069). Washington, DC: National Highway Traffic Safety Administration.

Keegan, M. (2018). *How blind spot monitoring systems work*. Retrieved from http://knowhow.napaonline.com/blind-spot-monitoring-systems-work/

Kent, R. & Forman, J. (2015). Restraint system biomechanics. In N. Yoganandan et al. (eds). *Accidental injury: Biomechanics and prevention*. New York: USA. Springer Science+Business Media.

Kessler, C., Etemad, A., Alessandretti, G., Heinig, K., Selpi, Brouwer, R., ... Benmimoun, M. (2012). *European Large-scale Field Operational Tests on In-vehicle Systems Deliverable 11.3: Final Report*. Germany: euroFOT Consortium.

Khalil, T. (2015). Introduction. In N. Yoganandan et al. (eds). *Accidental injury: Biomechanics and prevention*. New York: USA. Springer Science+Business Media.

Lanford, J. & Oxley, J. (2006). Using the safe system approach to keep older drivers safely mobile. *IATSS Research, 30*, 97-109.

Larsson, A. (2012). Driver usage and understanding of adaptive cruise control. *Applied Ergonomics, 43*, 501-506.

Lee, J., McGehee, D., Brown, T. & Marshall, D. (2008). *Rear-End Crash Avoidance System (RECAS) Algorithms and Alerting Strategies: Effects of Adaptive Cruise Control and Alert Modality on Driver Performance*. Washington, DC, USA: National Highway Traffic Safety Administration. DOT HS 810 981.

Levitt, S. & Porter, J. (2001). Sample selection in the estimation of air bag and seat belt effectiveness. *The Review of Economics and Statistics, 83*, 603-615.

Lund, A. (2015). *Vehicle safety: Where it's been and where it's heading.* Presentation to the Washington Automotive Press Association. Washington DC, USA. January 15th.

Lund, A. (2016). *Maximising safety on the (slow) road to autonomous vehicles.* Paper presented to the Automotive Safety Council Annual Meeting. 18th March, Tucson, Arizona, USA.

Mackenzie, J. & Anderson, R. (2009). *The effects of Electronic Stability Control interventions on rural road crashes in Australia: A simulation of real world crashes.* Canberra, ACT: Department of Infrastructure, Transport, Regional Development and Local Government. RSRG 2009-05.

McCartt, A. & Kyrychenko, S. (2007). Efficacy of side airbags in reducing driver deaths in driver-side car and SUV collisions. *Traffic Injury Prevention, 8*, 162-170.

McCowen, D. (2017). *The breakdown: Autonomous Emergency Braking*. Retrieved from https://www.drive.com.au/motor-news/the-breakdown-autonomous-emergency-braking

McGwin, G., Metzger, J. & Rue, L. (2004). The influence of side airbags on the risk of head and thoracic injury after motor vehicle collisions. *Journal of Trauma and Acute Care Surgery, 56*, 512-517.

McIntosh, L. (2012). *Changing attitudes to vehicle safety in Australia*. Paper presented to the Australasian College of Road Safety Conference, Sydney, Australia 9th-10th August.

Malchose, D. & Vachal, K. (2011). *Identifying factors that predict teen driver crashes*. North Dakota, USA: Rural Transportation Safety and Security Centre, North Dakota State University.

Mehler, B., Reimer, B., Lavalliere, M., Dobres, J. & Coughlin, J. (2014). *Evaluating technologies relevant to the enhancement of driver safety*. Washington, DC: AAA Foundation for Traffic Safety.

Meuleners, L., Harding, A., Lee, A. & Legge, M. (2006). Fragility and crash over-representation among older drivers in Western Australia. *Accident Analysis and Prevention*, *38*, 1006-1010.

Milne, P. (1985). *Fitting and wearing of seat belts in Australia: The history of a successful countermeasure.* Canberra, ACT: Federal Office of Road Safety, Department of Transport.

Monash University Accident Research Centre (n.d). *Vehicle Safety Research Group*. Retrieved from https://www.monash.edu/muarc/research/research-areas/transport-safety/injury-analysis-and-data/vehicle-road-safety-research-group

Monticello, M. (2017). *Guide to Blind-Spot Warning: How this technology improves safety by monitoring your vehicle's flanks*. Retrieved from https://www.consumerreports.org/car-safety/blind-spot-warning-guide/

Mooren, L., Grzebieta, R. & Job, S. (2011). *Safe System – Comparison of this approach in Australia.* Paper presented to the Australasian College of Road Safety Conference, Melbourne, Australia 1st-2nd September.

Mosquet, X., Andersen, M. & Arora, A. (2015). *A roadmap to safer driving through Advanded Driver Assistance Systems*. Massachusetts, USA: Boston Consulting Group.

Mousel, T., Keisuke, U. & Takahashi, M. (2015). *Advanced seat belt reminder systems for rear seat passengers.* Paper presented to the 24th International Technical Conference on the Enhanced Safety of Vehicles. Gothenburg, Sweden, 8th – 11th June.

National Road Safety Strategy 2011-2020. (2017). Retrieved from http://roadsafety.gov.au/nrss/

National Road Safety Partnership Program. (2017). *ANCAP: Not all 5-star cars are created equal: Future requirements and fleet considerations.* Retrieved from https://www.nrspp.org.au/resources/ancap-not-5-star-cars-created-equal-future-requirements-fleet-considerations/

Newstead, S., Delaney, A. & Watson, L. (2003). *Vehicle safety ratings estimated from combined Australian and New Zealand real crash data: Pilot study: Stage 5*. Melbourne, Victoria: Monash Accident Research Centre. Report No. 203.

Newstead, S., Delaney, A., Watson, L. & Cameron, M. (2004). *A model for considering the 'total safety' of the light passenger vehicle fleet*. Melbourne, Victoria: Monash Accident Research Centre. Report No. 228.

Newstead, S. & Scully, J. (2012). *Predicting the Used Car Safety Ratings crashworthiness rating from ANCAP scores*. Melbourne, Victoria: Monash Accident Research Centre. Report No. 309.

Nguyen, T. & Hilliard, J. (2017). *ANCAP hits Ford Mustang with surprise two-star safety rating.* Retrieved from https://www.carsguide.com.au/car-news/ancap-hits-ford-mustang-with-surprise-two-star-rating

Oxley, J., Charlton, J., Starkey, N. & Isler, R. (2014). *Understanding novice driver behaviour: Review of the literature*. Melbourne, Victoria: Monash University Accident Research Centre and TARS, University of Waikato.

Page, Y., Cuny, S., Zangmeister, T., Kreiss, J., & Hermitte, T. (2009*).* The evaluation of the safety benefits of combined passive and on-board active safety applications. *Annals of Advances in Automotive Medicine*, *53*, 117-127.

Phan, V. (2017). *Electronic Stability Control (ESC): European Road Safety Decision Support System developed by the H2020 project Safety Cube*. Retrieved from www.roadsafety-dss.eu.

Painted Dog Research. (2013). *Safer Vehicles (ESC) campaign evaluation- Summary report for the Office of Road Safety*. Perth, Western Australia: Author.

Palamara, P., Molnar, L. Eby, D., Kopinanthan, C., Langford, J., Gorman, J. & Broughton, M. (2013). *Review of young driver risk taking and its association with other risk taking behaviours*. Perth, Western Australia: Curtin-Monash Accident Research Centre and the Michigan Centre for Advancing Safe Transportation Throughout the Lifespan. RR 001.

Palamara, P., Kaura, K., Fraser, M. (2013). *An investigation of serious injury motor vehicle crashes across metropolitan, regional and rural Western Australia.* Perth, Western Australia: Curtin-Monash Accident Research Centre. RR 09-001

Palamara, P., Scata, L., Gaynor, D. & Meuleners, L. (2016). *Automated vehicles and the readiness of Western Australian roads*. Perth, Western Australia. Curtin-Monash Accident Research Centre. RR 16-002.

Palamara, P. (2016). *The application of a proxy measure to estimate the incidence of driver fatigue in Western Australian motor vehicle crashes.* Perth, Western Australia. Curtin-Monash Accident Research Centre. RR 16-003

Papelis, Y., Watson, G. & Brown, T. (2010). An empirical study of the effectiveness of electronic stability control systems in reducing loss of vehicle control. *Accident Analysis and Prevention, 42*, 929-934.

Patel, V., Griffin, R., Eberhardt, A. & McGwin, G. (2013). The association between knee airbag deployment and knee-thigh-hip fracture injury risk in motor vehicle collisions: A matched cohort study. *Accident Analysis and Prevention, 50*, 964-967.

RAC-Q Retrieved from https://www.racq.com.au/cars-and-driving/cars/buying-a-car/used-car-safety-ratings#tab-

RAC WA. (2017). *Low awareness of car safety ratings*. Retrieved from https://rac.com.au/car-motoring/info/low-awareness-of-car-safety-ratings

Road Safety Commission. (2018). *2017 Preliminary summary of fatalities on Western Australian roads*. Perth, Western Australia: Author.

Reagan, I., Cicchino, J., Kerfoot, L. & Weast, R. (2018). Crash avoidance and driver assistance technologies – Are they used? *Transportation Research Part F, 52*, 176-190.

Rizzi, M., Kullgre, A. & Tingvall, C. (2014). *Injury crash reduction of low-speed Autonomous Emergency Braking (AEB) on passenger cars*. Paper presented to the International Research Council on the Biomechanics of Injury Conference, 10th-12th September, Berlin, Germany.

Safety Research and Strategies Inc. (2004). *A brief history of Electronic Stability Controls and their applications.* Retrieved from http://www.safetyresearch.net/blog/articles/brief-history-electronic-stability-controls-and-their-applications

Scott-Parker, B. (2012). *A comprehensive investigation of the risky driving behaviour of young novice drivers.* Unpublished PhD. thesis. Brisbane, Queensland: Queensland University of Technology.

Scully, J. & Newstead, J. (2010). *Follow-up evaluation of Electronic Stability Control effectiveness in Australasia*. Melbourne, Victoria: Monash University Accident Research Centre. Report No. 306.

Searson, D., Ponte, G., Hutchinson, T., Anderson, R. & Lydon, M. (2014). *Emerging vehicle safety technologies and their potential benefits in Australia.* Melbourne, Victoria: Royal Automobile Club of Victoria (RAC) Ltd. RAC Research Report 14/03.

Senserrick, T. (2015). *Young driver crashes: the myths and facts*. Retrieved from http://theconversation.com/young-driver-crashes-the-myths-and-facts-49877

Somers, A. & Weeratunga, K. (2015). *Automated vehicles: Are we ready?* Perth, Western Australia: Main Roads Western Australia.

The Social Research Centre. (2014). *The Transport Accident Commission Road Safety Monitor: Wave 15 report*. Melbourne, Victoria: Author.

Thompson, J., Mackenzie, J., Dutschke, J., Baldock, M., Raferty, S. & Wall, J. (2018). A trial of retrofitted advisory collision avoidance technology in government fleet vehicles. *Accident Analysis and Prevention, 115*, 34-40.

Tracy, D. (2013). *This is how ABS, ESC and Traction Control work.* Retrieved from https://jalopnik.com/thi s-is-how-abs-esc-and-traction-control-work-513807036

van Ratingen, M., Williams, A., Lie, A., Seeck, A., Castaing, P., Kolke, R., Adriaenssens, G. & Miller, A. (2016). The European New Car Assessment Program: A historical overview. *Chinese Journal of Traumatology*, *19*, 63-69.

Vehicle Safety Research Group. (2016). *Used Car Safety Ratings 2016 update: Summary and highlights.* Retrieved from https://www.monash.edu/__data/assets/pdf_file/0011/590096/2016-Used-Car-Safety-Ratings-Highlights-and-QA

Vehicle Safety Research Group. (2017*). Use Car Safety Ratings Buyer's Guide 2017-2018*. Retrieved from https://www.monash.edu/__data/assets/pdf_file/0020/1032680/

VicRoads. (2009). *Stars on Cars Reference Group*. Melbourne, Victoria: Author.

Victor, T., Dozza, M., Bärgman, J., Boda, C., Engström, J., Flannagan, C., ... Markkula, G. (2015). *Analysis of naturalistic driving study data: Safer glances, driver inattention, and crash risk. SHRP 2 Report S2-S08A-RW-1*. Washington, DC: Transportation Research Board of the National Academies.

Ward, D. (2105). *Connectivity and competitiveness for sustainable lives*. Presentation to the 66th ECE Commission, 14th-16th April, Geneva.

Watson, L. & Newstead, S. (2009. *Vehicle safety and young drivers – Stage 1: Profile of young driver vehicles.* Melbourne, Victoria: Monash University Accident Research Centre.

Weiss, E., Thiel, M., Sultana, N., Hannan, C. & Seacrist, T. (2018). Advanced driver assistance systems for teen drivers: Teen and parent impressions, perceived need, and intervention preferences. *Traffic Injury Prevention*, *19*, S120-S124.

Western Australian Office of Road Safety (2008). *Toward Zero: Road safety strategy to reduce road trauma in Western Australia 2008-2020*. Perth, Western Australia: Government of Western Australia.

Wood ABC http://www.abc.net.au/news/2017-09-26/the-safest-most-dangerous-used-cars-on-our-roads-rated/8987270

Wundersitz, L. (2012). *An analysis of young drivers involved in crashes using in-depth crash investigation data*. Adelaide, South Australia: Centre for Automotive Safety Research, The University of Adelaide. CASR101.

Xiao, L. & Gao, F. (2010). A comprehensive review of the development of adaptive cruise control systems. *Vehicle Systems Dynamics*, *48*, 1167-1192.

Zwerling, C., Peek-Asa, C., Whitten, P., Choi, S., Sprince, N. & Jones, M. (2005). Fatal motor vehicle crashes in rural and urban areas: decomposing rates into contributing factors. *Injury Prevention*, *11*, 24-28.

APPENDIX 1

ON-LINE SAFE VEHICLE SURVEY

.

INFORMATION SHEET

Western Australian Safe Vehicles Survey

Dear Participant

This survey is for people **who currently hold a valid motor car drivers' licence**.

On behalf of the Western Australian Road Safety Commission, the Curtin-Monash Accident Research Centre is conducting a survey to better understand car drivers' knowledge, attitudes and behaviour related to buying and driving what is known as 'Safe Vehicles'. Safe vehicles have features that reduce your chances of crashing, and secondly, features and build quality that reduce the chances of you and your passengers being killed or seriously injured if you do crash.

The promotion and use of safe vehicles is an important component of the Western Australia's *Toward Zero* road safety strategy to reduce crashes and injuries. The findings of the survey will provide the WA Road Safety Commission with information regarding the need for education programs on the benefits of safe vehicles and how best to promote the purchase and use of safe vehicles.

The survey will take approximately 15 minutes and can be completed anonymously. You **DO NOT** have to provide your name or contact details. All answers will be combined and reported in a way that cannot lead to the identification of an individual participant. Most of the survey questions about safe vehicles will require you to select an answer from a number of options; a few questions will require you to write a short response.

INFORMED CONSENT
Curtin University Human Research Ethics Committee (HREC) has approved this study (HRE2017-0615). Should you wish to discuss the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) *9266 7093 or email hrec@curtin.edu.au. Otherwise, for further information about the study please contact: Peter Palamara, (08) 9266 2304, Research Fellow, Curtin-Monash Accident Research Centre. p.palamara@curtin.edu.au.*

Your rights as a participant in the research are as follows:

Your participation in the study is voluntary; you may withdraw your participation at any stage.

You have the right to anonymity.

You are NOT required to provide your name and contact details. Consequently, your responses cannot be identified. Individual responses will NOT be provided to the WA Road Safety Commission.

You have the right to receive information on the outcomes of the study. At the conclusion of the study the WA Road Safety Commission will disseminate the findings in a way to ensure that those who may have participated in the study will be advised of the outcomes. This may done via the Commission's website.

I have read the Information Sheet for the study and understand my rights as a participant. Any questions I may have had about the study and my participation have been asked and have been answered to my satisfaction.

. I hereby consent to participate in the Western Australian Safe Vehicles survey

- (•) Yes
- ( ) No - I do not wish to participate in the survey

.

SECTION ONE:

In this first section please tell us a little about yourself as a 'driver'

1. **What is your sex?**

- (•) Female
- ( ) Male
- ( ) Other

2.

How old are you?

Please write your age in years in the space below

22

3.
Which one of the following statements best describes where you live?

Please select one of the following options

- (•) I live most if not all of the time in the greater metropolitan Perth area
- ( ) I live most if not all of the time in the regional or remote areas of Wester Australia
- ( ) I live part of the time in metropolitan Perth and part of the time in regional or remote Western Australia
- ( ) Other (please provide details in the space below)

4.
What is the name of the suburb (or town if you live outside metropolitan Perth) in which you live most often?

Please write your suburb (or town) name in the space below

Canning Vale

5.
What is the four digit post-code of the area in which you live most often?

Please write the post-code in the space below

6155

6. **Do you currently hold a valid motor car drivers' licence?**

- (•) Yes
- ( ) No

7.
Which of the following motor car drivers' licence types do you currently hold.

Please select one option

- (•) Full, unrestricted C-Class motor vehicle drivers licence
- ( ) Probationary RED p-plate C-class motor vehicle drivers licence
- ( ) Probationary GREEN p-plate C-Class motor vehicle drivers licence
- ( ) Extraordinary restricted E-plate C-Class motor vehicle drivers licence

8.
On average, how often do you drive a motor car?

Please select one of the following options

- ( ) I drive about 5-7 days a week
- ( ) I drive about 3-4 days a week
- (•) I drive about 1-2 days a week
- ( ) I drive less than 1 day a week
- ( ) Other *(please give details)*

9.
What would be the average number of kilometres you would drive on the days you do drive?

Please select one of the following options

- ( ) Up to 25 kilometres per day on average
- (•) Between 26 and 50 kilometres per day on average

- ( ) Between 1 and 100 kilometres per day on average
- ( ) More than 100 kilometres per day on average

10.
On the days you do drive, how frequently do you have passengers (i.e., family, friends) in your car?

Please select one of the following options.

- ( ) Never
- ( ) Rarely
- ( ) Sometimes
- (•) Often
- ( ) Always

11.
When you do drive with passengers (i.e., family, friends) in your car, are any of those passengers under 12 years of age?

Please select one of the following options.

- ( ) Never
- (•) Rarely
- ( ) Sometimes
- ( ) Often
- ( ) Always

The next two questions are about crashes you may have had as a driver.

If answering these questions is likely to cause you distress you can skip the questions by selecting the 'skip question' option.

If you select this option you will then be directed to the next section of the survey.

If you would like information or confidential fee-free support to deal with road trauma please contact ***Road Trauma Support WA*** (http://rtswa.org.au/counselling/) or toll-free 1300-004-814

- ( ) I would like to skip the questions on driving and crashes
- (•) Show me the questions on driving and crashes

12.
In the last three years, or since you got your drivers' licence if you are still on p-plates, how many crashes have you been involved in as the 'driver'?

Please select one of the following options. If you have been involved in a crash as the driver, the term 'crash' you were shown includes all crashes, whether it was reported or not reported or resulted in someone being injured or not.

- (•) I have not been involved in a crash as a driver over the last three years
- ( ) I have been involved in one or more crashes as a driver over the last three years
  (please write the total number of crashes in the space below)

13.
Thinking about all the crashes you have been involved in as the driver over the last three years, was any person injured in these crashes?

Please select the options that apply

This question was not displayed to the respondent.

SECTION TWO:

In this next section can you please answer questions about the car you drive most often

14.
What is the MAKE and MODEL of the car you drive most often?

Please write the make and model of the car in the space below (e.g. Ford Festiva, Holden Commodore, Toyota Camry, Mazda3, Suzuki Swift). ***If you do not know, please write the letters DNK.***

Toyota Camry

15.
What is the YEAR of manufacture of the car you drive most often?

Please write the year of manufacture (e.g., 2009) in the space below. ***If you do not know, please write the letters DNK.***

2016

16.
Approximately how long have you been driving the car you now drive most often?

Please write the number of years and/or months in the spaces below. ***If you do not know, please write the number 99 in the Years text box.***

Years	99
Months	

17.
Which one of the following statements best describes how you acquired use of the car you now drive most often?

Please select one of the following options

- ○ I bought the car for myself to drive
- ○ I share ownership and use of the car with another driver
- ○ Someone else (e.g., family, friend) bought the car for me to drive
- ◉ Someone else owns the car and I share the use of it with other drivers
- ○ The car was 'handed down', free of cost, to me to drive
- ○ It was provided by my employer for me to drive
- ○ Other (please give details)

18.
Thinking about how you acquired the car you drive most often, how much 'input' or 'say' did you have in selecting the car?

Please select one of the following options

- ○ Unsure/Cannot Recall
- ○ No input or say at all
- ○ Very little input or say
- ◉ Some input or say
- ○ A lot of input or say
- ○ Complete input and say

19.
How important were each of the following factors when it came to selecting the car you now drive most often?

Please rank the factors from 1, which means it was the <u>most important factor</u> relative to others in the list, to 7, which means it was the <u>least important factor</u> relative to others in the list.

Please note that a unique rank must be assigned to each of the seven factors.

5	Financial issues, including the purchase price and all running and maintenance costs
1	The age and/or condition of the car
2	The safety features of the car and its overall safety rating
4	The suitability of the car for my driving needs
3	The performance of the car
7	The ready availability of the car

6 The type of car

20.

To the best of your knowledge, does the car you drive most often have the following features?

Please select one of the response options. Select 'unsure' if you are uncertain whether your car does or does not have the feature.

	Has this feature	Does not have this feature	Unsure
The car will detect a car in front and automatically brake to avoid hitting it if I fail to brake in time	○	○	◉
The car will warn me if I start to wander out of my lane and I have not indicated that I am changing lanes	○	○	◉
The car will detect a loss of steering control and automatically adjust its braking to avoid skidding or running off the road	○	○	◉
The car will warn me when it detects other cars in my car's 'blind spot'	○	○	◉
The car will detect if the wheels begin to spin and lose grip and automatically manage the power and brakes to the wheels to regain control	○	○	◉
The car will detect when I wander out of the centre of the lane, without indicating, and automatically move the car back to the centre	○	○	◉
The car will automatically adjust my speed when in cruise control to maintain a safe distance from the car in front	◉	○	○

21.

Please indicate your level of Agreement/Disagreement with the following statements about the car you drive most often.

Please select the level of Agreement/Disagreement from the drop down list for each statement

Overall, my car has enough safety features to minimise my chances of being killed or seriously injured if I were to have a crash	Agree
I don't see the need to replace my car with another that has additional safety features	Agree
My chances of crashing and being injured have more to do with my skills as a driver than the safety features of my car	Strongly Agree
Overall, I am happy with the level of safety of the car I drive most often	Agree
Other features about my car are more important to me than its overall level of safety	Disagree
Overall, I think my car has insufficient safety features to minimise my passengers' chances of being killed or seriously injured if I were to have a crash	Unsure/Neither Agree or Disagree
My car has enough of the right safety features to reduce my chances of having a crash	Agree
My chances of being killed or seriously injured whilst driving my car have more to do with the type of crash I have than the safety of my car	Disagree
It's very likely that I will replace my current car with a safer one, either new or second hand, in the next two years	Unsure/Neither Agree or Disagree
One of the main reasons I drive my current car is because of its safety features	Unsure/Neither Agree or Disagree

.

SECTION THREE:

In this next section we would like you to respond to questions about your awareness and use of information resources on *Safe Vehicles*

22.

Overall, how would you rate the level of knowledge you have about *Safe Vehicles* in terms of their features and performance to minimise crashes and injury?

Please select one option

- ○ A great deal
- ○ A lot
- ◉ A moderate amount
- ○ A little
- ○ None at all

23.
Which of the following resources for information on *Safe Vehicles* do you know of?

Please provide a response for each of the following

	Know about the resource	
	Yes	No
The Australian New Car Assessment Program (ANCAP)	◉	○
The 'Stars on Cars' program	○	◉
The Used Car Safety Ratings Guide	○	◉
The *howsafeisyourcar.com.au* web site	○	◉
The European New Car Assessment Program	◉	○
"*A consumer guide to Safer Vehicles suitable for remote and regional Western Australia*"	○	◉
The *howsafeisyourfirstcar.com.au* web site	○	◉

24.
For the following *Safe Vehicle* information resources, please indicate which ones you have used when considering a car for yourself or someone else?

Please provide a response for each of the following

	Past use of the resource	
	Yes	No
The Australian New Car Assessment Program	◉	○
The 'Stars on Cars' program	○	◉
The Used Car Safety Ratings Guide	○	◉
The *howsafeisyourcar.com.au* web site	○	◉
The European New Car Assessment Program	◉	○
"*A consumer guide to Safer Vehicles suitable for remote and regional Western Australia*"	○	◉
The *howsafeisyourfirstcar.com.au* web site	○	◉

25.
For the *Safe Vehicle* information resources you have used, please indicate how *useful* it was in identifying an appropriate safe car for your needs or someone else's.

Please select a response from the 'drop down' list for each of the resources you have used

	Usefulness of the resource
The Australian New Car Assessment Program	Moderately useful
The 'Stars on Cars' program	Somewhat useful
The Used Car Safety Ratings Guide	Very useful
The *howsafeisyourcar.com.au* web site	Somewhat useful
The European New Car Assessment Program	Moderately useful
"*A consumer guide to Safer Vehicles suitable for remote and regional Western Australia*"	Somewhat useful
The *howsafeisyourfirstcar.com.au* web site	Somewhat useful

26. Do you know the **ANCAP Star Rating** for the car you drive most often?

- ◉ I do not know the ANCAP Star Rating

○ Yes, I know the ANCAP Star Rating *(please write the number of stars in the box below)*

27. Do you know the most recent **Used Car Safety Rating** for the car you drive most often?

◉ I do not know the Used Car Safety Rating

○ Yes, I know the Used Car Safety Rating *(please write the number of stars in the box below)*

28.

In the future when you might be considering a NEW or USED car for yourself or someone else, how likely are you to consult one of the relevant information resources to determine the car's safety rating and features?

Please select one of the following options

○ Very Unlikely
○ Unlikely
○ Somewhat Unlikely
○ Unsure
◉ Somewhat Likely
○ Likely
○ Very Likely

29.

Thinking now about the ways in which you could obtain information about *Safe Vehicles*, what would be your preferred ways for accessing this information?

Please rate your preference from the 'drop down' list for each option

Commercials on free to air television	Prefer a lot
Advertising features in the State's daily newspapers	Prefer slightly
Display of the relevant safety rating on the windscreen of all second hand cars for sale by car dealers	Do not prefer
Website information mailed with your vehicle registration renewal papers	Prefer slightly
A 'smart-phone' application that enables you to search for vehicle safety ratings	Do not prefer
Roadside billboard advertising	Prefer slightly
Display of the safety rating on the windscreen of all new cars for sale by car dealers	Do not prefer
Safety rating information included in all 'for sale' advertising by car dealers	Do not prefer
Commercials on local radio stations	Prefer slightly
Internet websites	Do not prefer
SMS or email alerts for updated information on the safety rating of selected vehicles	Do not prefer

.

SECTION FOUR:

In this final section of the survey we would like you to respond to a series of general statements about *Safe Vehicles*

30.

Please indicate your level of Agreement/Disagreement with the following general statements about *Safe Vehicles*.

Please select a response from the 'drop down' list for each statement

Governments should offer financial incentives to purchase cars with high safety ratings	Neither Agree or Disagree/Unsure
Even cars with the highest safety ratings will never be able to protect drivers and other occupants from being killed or seriously injured if the crash is bad enough	Neither Agree or Disagree/Unsure
I would find it difficult to trust crash avoidance technologies that take control of the vehicle away from me as the driver	Strongly Agree

I can personally afford to buy a car that has a high safety rating	Neither Agree or Disagree/Unsure
Cars with high safety ratings are typically more expensive and less affordable than cars with lower safety ratings	Agree
One way to promote the use of cars with a high safety rating is to increase the registration costs for cars that have a low safety rating	Neither Agree or Disagree/Unsure
I think the advertised benefits of driving a car with a high safety rating are overstated	Neither Agree or Disagree/Unsure
Vehicle technologies that help avoid crashes will never be an acceptable substitute for good driving skills	Neither Agree or Disagree/Unsure
Government should legislate a minimum safe vehicle rating for the sale of all new vehicles	Neither Agree or Disagree/Unsure
I would be more inclined to buy a car with a high safe vehicle rating if insurance companies offered discounted premiums for these cars	Agree
Government needs to do more to inform the public about the benefits of driving a car that has a high safe vehicle rating	Agree
One of the limitations of safe vehicle information is that it can quickly become 'out of date'	Disagree
Overall, I have no interest in Safe Vehicles and safe vehicle technologies	Neither Agree or Disagree/Unsure

THANK YOU FOR YOUR TIME AND CO-OPERATION IN COMPLETING THIS SURVEY

Embedded Data
consent: 1