



MONASH University
Accident Research Centre

**TRENDS IN AGGRESSIVITY OF THE AUSTRALIAN
LIGHT VEHICLE FLEET BY YEAR OF
MANUFACTURE AND MARKET GROUP:
1964 TO 2000**

by

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**Report No. 214
March 2004**

Project Sponsored By



vic roads



Australian Government
Australian Transport Safety Bureau

EXECUTIVE SUMMARY

This report describes the development of aggressivity ratings by year of manufacture for 1964-2000 model vehicles and aggressivity ratings by year of manufacture and market group for 1982-2000 model vehicles. Aggressivity ratings measure the serious injury risk vehicles pose to drivers of other vehicles with which they collide and are estimated from data on real crashes. The analysis is based on crash data from Victoria and New South Wales during 1987-2000 and from Queensland and Western Australia during 1991-2000.

The aggressivity measure used estimates the risk of a driver of a vehicle impacting with the subject vehicle being killed or admitted to hospital when involved in a tow-away crash. It is measured as a combination of injury severity (of injured drivers) and injury risk (of drivers involved in crashes) for the drivers of other vehicles impacted by vehicles of the specified year of manufacture and / or market group.

Aggressivity injury risk by year of manufacture was based on 765,154 drivers involved in crashes between two vehicles in New South Wales and Queensland and Western Australia where at least one vehicle was towed from the scene or someone was injured. Aggressivity injury severity by year of manufacture was based on 187,884 drivers injured in two-car crashes in Victoria, New South Wales, Queensland and Western Australia during. The crashes occurred during 1987-2000 for NSW and Victoria and during 1991-2000 for Western Australia and Queensland. Vehicles manufactured between 1964 and 2000 were considered.

Aggressivity injury risk by year of manufacture and market group was based on 425,324 drivers involved in crashes between two vehicles in New South Wales and Queensland and Western Australia where at least one vehicle was towed from the scene or someone was injured. Aggressivity injury severity by year of manufacture and market group was based on 67,900 drivers injured in two-car crashes in Victoria, New South Wales, Queensland and Western Australia. Vehicles manufactured between 1982 and 2000 were considered in this analysis with years of crash for each state being the same as for the analysis without reference to vehicle market group.

The aggressivity ratings were adjusted for the sex and age of the focus driver, that is the driver of the vehicle impacted by the vehicle of the specific year of manufacture and / or market group. They were also adjusted for the speed limit at the crash location, the year in which the crash occurred and the state in which the crash occurred. These factors were found to be strongly associated with injury risk and injury severity. Adjustments were made with the aim of measuring the effects of vehicle factors alone, uncontaminated by other factors available in the data that affected crash severity and injury susceptibility. The degree of accuracy of the aggressivity ratings is represented by the confidence limits of the rating in each case.

This study has been successful in estimating trends in aggressivity by year of vehicle manufacture of passenger vehicles (cars, station wagons, four wheel drives, vans and taxis) manufactured over the years 1964 to 2000. Trends have been estimated for the vehicle fleet as a whole as well as broken down into 8 specific vehicle market groups. The aggressivity measure estimated the risk of death or serious injury to a driver of a vehicle colliding with a vehicle of a particular year of manufacture and market group where considered.

When considering the vehicle fleet as a whole, no long-term trend to improving or worsening aggressivity by year of manufacture was identified. Only vehicles of a few years of manufacture had estimated aggressivity above or below the long-term average. These included vehicles from 1964 to 1972 that tended to have estimated aggressivity higher than the long term average, although only a few of the years in this range were significantly higher than average. Vehicles manufactured from 1980 to 1985 had estimated aggressivity significantly below the long-term average, although the average for these years was only around 10% less than the long-term average. The lack of overall trend highlights the need for further action to improve vehicle aggressivity.

Analysis of aggressivity by year of vehicle manufacture and market group identified two vehicle market groups that had demonstrated long term trends in aggressivity over the period of study from 1982 to 2000. Estimates of aggressivity of the 4WD market group showed a consistent trend towards improved aggressivity of around 25% over the study period. This reflects a trend in sales away from the traditional large off road 4WD vehicle to the lighter recreational 4WD vehicle over this period. In contrast, the small vehicle market group showed a trend to worsening aggressivity over the study period, with estimated aggressivity increasing by around 30%. The reason for this requires further research but may be related to the need for stiffer structures in small vehicles to improved levels of own occupant protection in this vehicle class. Despite these trends, small vehicles have remained the least aggressive and 4WD vehicles the most aggressive for vehicles of the most recent years of manufacture studied. No consistent trends in aggressivity with year of manufacture were observed in other market groups.

The results and conclusions of this study are based on a number of assumptions and warrant a number of qualifications that should be noted.

ACKNOWLEDGMENTS

A project as large and complex as this could not have been carried out without the help and support of a number of people. The authors particularly wish to acknowledge:

- Mr David Attwood of the Transport Accident Commission (TAC) for the provision of TAC claims data
- Mr Geoff Elston of VicRoads Business Services Division for the provision of data from Victorian Police crash reports
- Mr Geoff Murray and Mr Wesley Soet of the Department of Main Roads Western Australia for the provision of data from Western Australia Police crash reports
- Mr Geoff Meers, Mr Wayne Dale and Mr Scott Boyle of Queensland Transport for the provision of data from Queensland Police crash reports and the Queensland vehicle registration system
- Mr Tony Kursius of Queensland Transport for assistance with facilitating the provision of data from the Queensland vehicle registration system
- Dr Graham Brisbane, Mr David Harkness and Ms Samantha Yee of the New South Wales Roads and Traffic Authority (RTA) for their support of the project and the release of data from NSW Police crash reports
- Mr Jack Haley, Mr Owen Johnstone and Dr Tasha Prabhakar of NRMA for their support for the project and for providing procedures to determine the models of vehicles crashing in NSW, Victoria and Queensland.
- Ms Maria Pappas of NRMA who developed and applied the procedures to determine the models of vehicles recorded on NSW and Victoria Police crash reports
- Mr Michael Adams and Mr Robert Ramsay of the NSW RTA who prepared and provided data files from NSW Police crash reports and gave helpful advice on limitations in the NSW crash data.
- Mr John Goldsworthy of the Australian Transport Safety Bureau for his support of the project as well as valuable assistance in providing detailed comments on the project report.
- Mr Mike Upton of the RACWA for his support for the project and assistance with facilitating the supply of Western Australian crash data
- Dr Gray Scott and Mr Ross McArthur of VicRoads for their support of the project
- Mr Michael Case and Mr Julian Del Beato of the RACV for their support of the project and for advice on substantive changes in designs of specific models over the years

- Professor Caroline Finch, Mr Tri Minh Le, Mr Michael Skalova and Ms Chau My Le, all formerly of MUARC, for the development of the analysis methods in earlier years that formed the basis of the methods used in this report.
- Dr Alan Miller, formerly of the CSIRO Division of Mathematics and Statistics for suggesting analysis methods used in this report to improve the sensitivity of the results and to determine the confidence limits of the estimates.
- Officers of the Victorian, NSW, Western Australian and Queensland Police Forces and of the Transport Accident Commission who diligently recorded the information on crashes and injuries which formed the basis of this report.

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TRENDS IN VEHICLE AGGRESSIVITY BY YEAR OF MANUFACTURE FROM 1964 TO 2000

1. BACKGROUND AND AIMS

1.1 Aggressivity Ratings Background

Aggressivity is a measure of a vehicle's ability to prevent injury to other road users, being either the occupants of other vehicles or unprotected road users such as pedestrians, bicyclists and motorcyclists, with which it collides. This contrasts to crashworthiness ratings that measure a vehicle's ability to protect its own occupants in the event of a crash. In Australia and many other countries, crashworthiness ratings and aggressivity ratings calculated from the analysis of real crash data are published to provide consumer advice on safety by vehicle make and model when choosing to purchase a vehicle.

Crashworthiness ratings for Australian passenger vehicles, calculated from the analysis of real crash data, have been published regularly in Australia since the early 1990s. In contrast, complementary vehicle aggressivity ratings have only been published since relatively recently. Cameron, Newstead and Le (1998) completed an initial study that reviewed methods of rating vehicle aggressivity developed internationally, such as those by Broughton (1994, 1996) and Hollowell and Gabler (1996). Concepts from this review were then taken to develop a methodology for rating the aggressivity of Australian passenger vehicles making appropriate uses of the real crash data available in Australia. The methods developed were then successfully applied to estimate aggressivity ratings for a selection of Australian passenger vehicles that had accumulated sufficient real crash history.

The original study of Cameron et al (1998) investigated the feasibility and methods of providing aggressivity ratings for Australian passenger vehicles in terms of the threat that each subject model represented to:

1. Occupants of other cars colliding with the subject model cars, and
2. Pedestrians, bicyclists and motorcyclists (if possible, separately) impacted by the subject model cars.

Aggressivity ratings of the second type considered by Cameron et al (1998) are problematic. In general, crashes involving pedestrians, bicyclists and motorcyclists are seldom reported to the Police unless someone is killed or injured (usually the unprotected road user). This means that an estimate of the risk of injury cannot be calculated for the unprotected road users for inclusion in the second type of aggressivity rating. Consequently, the measure of aggressivity towards unprotected road users, described by Cameron et al (1998), is a measure of injury severity only (ie the risk of serious injury given some injury was sustained). As such, this aggressivity measure is less able to discriminate between the performances of individual vehicle models as it is based on relatively small quantities of data. These problems made the measure of aggressivity towards unprotected road users of limited practical value and it has not been further considered after the initial work.

This problem described in estimating aggressivity for unprotected road users did not occur for measuring aggressivity towards drivers of other cars. The available data allowed the estimation of aggressivity as a two component measure analogous to the crashworthiness rating measure used in Australia. The aggressivity measure towards drivers of other vehicle was defined as a product of the risk of injury and injury severity (Cameron et al, 1998) and was based on two-car crashes between light vehicles (ie. heavy vehicle collisions were excluded).

The measure of the aggressivity risk of injury (RO) to drivers of other vehicles colliding with the subject model, unadjusted for any other factors, is defined by Cameron et al (1998) as:

$$\text{RO} = \frac{\text{proportion of drivers involved in crashes of tow away or greater severity who were injured}}{\text{injured}}$$

It is estimated from data on two-car crashes reported to Police from Australian states where non-injury as well as injury crashes are reported reliably. In a number of Australian states, non-injury crashes are reported where at least one vehicle was towed or a pre-defined minimum damage level was attained. Consequently, the number of vehicle to vehicle crashes in which neither driver was injured was available, at least so far as tow-away crashes are concerned, allowing the estimation of injury risk.

The measure of aggressivity injury severity (SO) defined by Cameron et al (1998) is:

$$\text{SO} = \text{proportion of injured drivers who were killed or admitted to hospital.}$$

It is estimated from information on injured drivers in two-car crashes reported to Police. The injury severity component can be estimated using crash data from all Australian states regardless of whether tow-away or injury crash reporting criteria are used for reporting.

Based on the definition of RO and SO above, an aggressivity measure for each subject car model was then calculated as:

$$\text{Aggressivity to other car occupants} = \text{AO} = \text{RO} \times \text{SO}.$$

This measures the risk of the driver of other cars being killed or admitted to hospital when involved in collisions with the subject model cars.

When discussing the aggressivity of a vehicle towards drivers of other vehicles, it is useful to define some terms for clarity of understanding. The vehicle of which the aggressivity is being measured, whether represented by its make and model, market group or year of manufacture, is denoted the 'subject' vehicle throughout this report. The driver, whose injury outcome is being measured and is driving the vehicle colliding with the subject vehicle in the two-car crash, is referred to as the 'focus' driver throughout this report.

Before this aggressivity measure was calculated, consideration was given by Cameron et al (1998) to taking into account likely differences between the crash circumstances of the subject car models,

which may result in a distorted view of its aggressivity only partly related to the characteristics of the subject cars. Factors available in the data to consider such differences included:

- speed limit at the crash location
- subject vehicle driver age (younger drivers may be driving at relatively fast speeds not fully represented by the speed limit)
- subject vehicle driver sex (male drivers may be driving at relatively fast speeds or more aggressively)
- focus driver age (older occupants are more susceptible to injury)
- focus driver sex (female occupants are more susceptible to injury, but males appear to be associated with relatively high injury severities)

Logistic regression techniques were used to adjust RO and SO, separately, for any major differences that emerge between models of the subject cars regarding these factors. The adjusted RO and SO were then multiplied together for each subject car model to provide the final measure of aggressivity towards drivers of other vehicles, AO.

Cameron et al (1998) also considered adjusting the aggressivity ratings for the injury outcome of the drivers of the subject model vehicles, hence providing an indication of the crash severity. This was found to make little difference to the relative aggressivity ratings between vehicle models and has not been further considered here. Consideration was also given to using the injury outcome of the most severely injured occupant of the vehicle colliding with the subject vehicle model in estimating the aggressivity index. Again, little difference was found in the estimated aggressivity ratings when considering all vehicle occupants than when considering drivers only so this method was not further pursued.

The work of Cameron et al (1998) successfully established the methods for rating the aggressivity of Australian passenger vehicles towards drivers of other vehicles. Since then, aggressivity ratings of this type have been estimated as part of regular updates of Australian vehicle crashworthiness ratings. These are published in Newstead et al (2000) and Newstead et al (2003) and, along side the crashworthiness ratings, are published in summary form in a brochure widely distributed by the project sponsors.

1.2 Crashworthiness by Year of Vehicle Manufacture and Market Group

The Monash University Accident Research Centre has studied trends in the crashworthiness of the Australian vehicle fleet by year of vehicle manufacture for a number of years. The original study of Cameron et al (1994) showed that the crashworthiness of passenger vehicles in Australia has improved over the years of manufacture 1964 to 1992 with rapid improvement over the years from about 1970 to 1979. The study concluded that drivers of vehicles manufactured during 1970 to 1979 appeared to have benefited from safer vehicles through the implementation of a number of Australian Design Rules (ADRs) for motor vehicle safety which previous research has shown to be effective in providing increased occupant protection. The most recent update of this analysis is reported in Newstead et al (2003) and covers vehicles manufactured from 1964 to 2003.

Newstead and Cameron (2001) and Newstead et al (2003) have extended the basic analysis to examine trends in vehicle crashworthiness by year of manufacture within specific vehicle market groups. In these studies, only years of manufacture from 1982 to 1998 (Newstead and Cameron 2001) and from 1982 to 2000 (Newstead et al 2003) were examined because of the need to have vehicle model information on the data to be able to classify vehicles appropriately into market groups. Vehicles were grouped into 8 market categories: small cars (<1100kg), medium cars (1100-1400kg), large cars (>1400kg) and 4 wheel drive vehicles (Sports Utility Vehicles). Results of analysis found statistically significant differences in the trends in crashworthiness by year of manufacture between different market groups in both the injury risk and injury severity components of the crashworthiness measure. Results showed that whilst vehicles in the 4wd and large car groups had shown improvement in crashworthiness over time, vehicles in the medium and, particularly, the small car classes had shown deterioration in their crashworthiness performance as a class, especially in recent years. Reasons for the declining average crashworthiness of the small car classes in Australia were discussed and appeared to be explained by a shift in preference of small car buyers towards cheap small vehicles with relatively poor safety performance. These shifts in small vehicle buyer preference have occurred despite the introduction of Australian vehicle design rules and consumer vehicle safety information programs aimed at improving the safety of the Australian fleet, suggesting the urgent need for further action in these two areas.

1.3 Aggressivity by Year of Vehicle Manufacture and Market Group Project Aims

Whilst trends in crashworthiness by year of vehicle manufacture have been studied both for the Australian vehicle fleet as a whole and by market groups, no attempt had been made to examine similar trends in vehicle aggressivity towards other vehicles. The successful development of a measure of aggressivity towards other vehicle drivers by Cameron et al (1998) allows this analysis to be carried out.

The aim of this project was to investigate the relationship between vehicle aggressivity towards drivers of other vehicles and vehicle year of manufacture for the years 1964 to 2000 for the Australian vehicle fleet as a whole. The analysis also aimed to assess trends in the aggressivity measure by year of vehicle manufacture within each vehicle market group for 1982 to 2000 vehicles for which model details could be identified.

2. DATA

Vehicles manufactured over the period 1964-2000 and crashing during the years 1987-2000 were used in the analysis of aggressivity by year of manufacture. A subset of the data from Victoria, NSW, Queensland and Western Australia used to produce the crashworthiness and aggressivity ratings of Newstead et al (2003) covering vehicles manufactured over the period 1982-2000 and crashing during the years 1987-2000 was used to estimate aggressivity by year of manufacture and market group. The methods of selecting appropriate cases from each data source for analysis of trends in vehicle aggressivity will be detailed here.

2.1 Victorian Crashes

Calculation of aggressivity by year of manufacture ratings towards drivers of other vehicles required selecting vehicles involved in two car crashes followed by matching of the vehicle and occupant injury details for the two cars involved in the crash for those vehicles manufactured over the period 1964 to 2000. The data matching process identified 173,950 vehicles that had been involved in a crash with one other vehicle where both vehicles had no restriction on year of manufacture. Of the drivers of these other vehicles, 90,148 were injured and 83,802 were uninjured. It was not possible to use the uninjured records from the Victorian data, as they are incomplete due to the fact that only crashes involving injury are reliably reported in Victoria. Hence only the 90,148 records of other driver injury were used for calculation of the injury severity component of the vehicle aggressivity ratings toward drivers of other vehicles. Of the 90,148 injured drivers, 17,311 were severely injured. In the analysis these numbers were further reduced to 88,794 injured drivers and 17,180 severely injured drivers because of missing values of associated crash factors.

For the study of aggressivity by vehicle year of manufacture and market group the data from Victoria represented 24,483 drivers. After removal of drivers with missing values for any of the associated crash factors, the data from Victoria represented 20,683 drivers of cars, station wagons or taxis manufactured from 1982 to 2000 who were involved in a two vehicle tow-away crash. Again only the injured drivers were utilised because only crashes involving injury are reliably reported in Victoria. Hence of the 20,683 involved drivers only 9,328 injured drivers were used for calculation of the injury severity component of the vehicle aggressivity rating. Of these injured drivers, 2,004 were injured seriously.

2.2 New South Wales Crashes

Vehicles were coded as being involved in crashes with one other traffic unit (ie. the crash involved a total of two traffic units) where the year of manufacture for both vehicles was between 1964 and 2000. In order to compare occupant injury levels in crashes involving two vehicles, it was necessary to match the crash and occupant injury information for each of the two vehicles involved in the crash. Of these matched crashes, there were 549,738 involved drivers, 67,034 of whom were injured. As a result of coding changes a reliable measure of injury severity was not available for the years 1999 and 2000 and thus the NSW data does not include the crash years 1999 and 2000 in the analysis of aggressivity injury severity. Of the injured drivers, 10,568 were identified as seriously injured or killed in crashes from 1987 to 1998 where a valid injury severity level was coded that included the serious injury category. These records were used for calculation of vehicle aggressivity ratings toward drivers of other vehicles by year of manufacture. Because of missing values of associated crash factors these numbers were further reduced to 502,863 involved drivers, 64,599 injured drivers and 10,255 severely injured drivers.

The presence of uninjured drivers in the merged data file meant that it was suitable for measuring the risk of driver injury (in cars sufficiently damaged to require towing). This contrasted with the Victorian data file, which could not be used to measure injury risk directly because not all uninjured drivers were included.

For the study of aggressivity by vehicle year of manufacture and market group there were 227,380 drivers. After removal of records with missing factors, the NSW data represented 190,382 drivers of cars, station wagons or taxis manufactured from 1982 to 2000 who were involved in a two vehicle tow-away crash. Of these drivers, 17,156 were injured, 2,905 seriously. As a result of coding changes a reliable measure of injury severity was not available for the years 1999 and 2000 and thus the NSW data does not include the crash years 1999 and 2000 in the analysis of aggressivity injury severity.

2.3 Queensland Crashes

In order to compare occupant injury levels between two vehicles involved in a crash, it was necessary to match the crash and occupant injury information for each of the two vehicles involved in the crash. Of the vehicles coded as being involved in crashes with one other traffic unit (ie. the crash involved a total of two traffic units) with either vehicle manufactured in the years 1964 to 2000, 80,384 were matched. Of the drivers of the other vehicle, 17,031 were injured and 3756 were severely injured. These numbers were further reduced to 79,006 involved drivers, 17,021 injured drivers and 3,753 severely injured drivers because of missing values of associated crash factors. These records were used for calculation of vehicle aggressivity ratings toward drivers of other vehicles.

As with the data from NSW, the presence of uninjured drivers in the data file meant that it was also suitable for measuring the risk of driver injury (in cars sufficiently damaged to require towing). This contrasted with the Victorian data file, which could not be used to measure injury risk directly because not all uninjured drivers were included.

For the study of aggressivity by vehicle year of manufacture and market group, the Queensland data represented 63,533 drivers of cars, station wagons or taxis manufactured from 1982 to 2000 who were involved in a two vehicle tow-away crash. After removal of records with missing values of associated crash factors the data from Queensland was reduced to 41,540 drivers. Of these drivers, 9,515 were injured, 2,085 seriously.

2.4 Western Australia Crashes

276,482 vehicles involved in crashes with one other traffic unit that could also be identified in the data were matched. Of the drivers of the matching vehicles, 28,911 were injured and 2568 were severely injured. These records were used for calculation of vehicle aggressivity by year of manufacture ratings toward drivers of other vehicles. Because of missing values of associated crash factors these numbers were further reduced to 183,285 involved drivers, 25,209 of whom were injured, 2,420 severely.

For the study of aggressivity by vehicle year of manufacture and market group, the WA data represented 257,784 drivers of cars, station wagons or taxis manufactured from 1982 to 2000 who were involved in a two vehicle tow-away crashes. This was reduced to 131,130 drivers after removal of records with missing crash factors. Of these drivers, 18,399 were injured, 1,903 seriously.

modifications to these methods were required to estimate ratings by year of manufacture and market group. A brief outline of the modified analysis methods follows.

4.1.1 Logistic Models for Each Component

Obtaining the Covariate Models

Rather than simply calculating aggressivity ratings directly from the injury outcome variable, it was necessary to compensate for the effects of possible factors that might have influenced the crash outcomes in terms of driver injury severity, other than those related to the vehicle. Logistic regression analysis was used to adjust for the effects of other factors, apart from vehicle year of manufacture or market group, on measured aggressivity. A stepwise procedure was used to identify which factors of those available in the data had an important influence on injury outcome. This was done without considering the year of manufacture in the model, as the aim was to determine which other factors were most likely to have had an influence across a broad spectrum of crashes. Furthermore, the year of manufacture and market group variables had to be excluded from the logistic modelling process at this stage because of analysis convergence problems when they were competing against the other factors in the stepwise procedure. It was also not considered appropriate to interact vehicle year of manufacture or market group with other factors in the logistic model as this would imply that relative vehicle aggressivity varied between year of manufacture depending on the crash circumstance and occupant characteristics.

Logistic models were obtained separately for aggressivity injury risk and aggressivity injury severity because it was likely that the various factors would have different levels of influence on these two probabilities. The factors considered during this stage of the analysis for both aggressivity injury risk and aggressivity injury severity were as follows.

- **sex:** focus driver sex (male, female)
- **age:** focus driver age (≤ 25 years; 26-59 years; ≥ 60 years)
- **speedzone:** speed limit at the crash location (≤ 75 km/h; ≥ 80 km/h)
- **state:** state of crash (Victoria, NSW, Queensland or Western Australia)
- **year:** year of crash (1987, 1988, ... , 2000)

These variables were chosen for consideration because they were part of the Victorian, Queensland, New South Wales and Western Australia databases. Other variables were only available from one source and their inclusion would have drastically reduced the number of cases that could have been included in the analysis. State and year of crash, along with their interaction, was a necessary inclusion in the logistic model. This was to account for different long-term trends and injury severity profiles between the various states contributing data to the analysis.

All data was analysed using the Logistic Regression procedure (PROC LOGISTIC) of the SAS statistical package (SAS, 1989). Estimates of the coefficients of the logit function, $\hat{\beta}_i, i = 1, \dots, k$, together with their associated standard errors, were obtained by maximum likelihood estimation. In the modelling process, design variables for the various factors were chosen in such a way that the estimated coefficients represented deviations of each of the variable levels from the mean. Each

factor in the model, including year of crash, was treated as categorical to allow maximum flexibility in the relationship between each and the outcome measure.

For both aggressivity injury risk and aggressivity injury severity, a stepwise procedure was used to identify which factors and their interactions made a significant contribution to these probabilities. All possible first and higher order interactions were considered between all factors in the model. A hierarchical structure was imposed so that interaction between two variables was included in the model only when the corresponding main effects were also included. The resultant logistic regression models were referred to as the "covariate" models.

The average value of the aggressivity injury risk or aggressivity injury severity was obtained directly from the outcome variable of interest averaging across all cases in the analysis.

Assessing Year of Manufacture Differences

Aggressivity injury risk and aggressivity injury severity for individual years of vehicle manufacture were estimated after adding a variable representing year of manufacture to the respective logistic "covariate" models and re-estimating all parameters. That is, the year of manufacture variable was included in the logistic model along with those factors and their interactions that were found to be statistically significantly related to the outcome variable in the stepwise modelling procedure and the model re-estimated in a single step process. Coefficients for individual years of manufacture were computed to represent deviations of that year from the average.

Assessing Market Group by Year of Manufacture Differences

Assessing year of manufacture by market group effects was carried out in the same way as for assessing year of manufacture effects alone. Instead of using a variable representing year of manufacture alone, however, a variable representing the interaction between year of manufacture and market group was used. This variable had 152 levels representing the 8 market groups by the 19 years of manufacture from 1982 to 2000 inclusive.

Combinations were excluded with fewer than 20 injured drivers and/or fewer than 100 involved drivers appearing in the crash data. These were based on the number of injured drivers in the vehicles colliding with the subject vehicle model. These selection criteria were used to ensure stability in fitting the logistic regression models along with suitably small confidence limits on the estimated aggressivity ratings.

After exclusion, the regression analyses were performed on 146 market group and year combinations. The variable representing market group and year of manufacture was defined to be categorical with 146 nominal levels.

5. RESULTS

5.1 Aggressivity by Year of Manufacture

Aggressivity injury risk and injury severity by year of vehicle manufacture was estimated from 1,080,554 tow-away crashes involving two matched vehicles. It was a subset of the data on 1,832,186 drivers of cars, station wagons or taxis manufactured from 1964 to 2000 and involved in tow-away crashes in NSW, Western Australia and Queensland during 1987 to 2000. This data set is referred to as the "involved drivers". Because of missing values of some of the factors to be included in the logistic regression, and the exclusion of pre-1964 vehicles and unknown years, injury risk analysis was performed on data relating to 765,154 involved drivers crashing in NSW, Queensland and WA. Similarly, the aggressivity severity analysis was based on 187,884 injured drivers in all 4 states, excluding 1999 and 2000 data from NSW where the injury severity was not coded.

5.1.1 Aggressivity Injury Risk

Aggressivity injury risk was estimated from the data on 765,154 involved drivers of cars, station wagons or taxis manufactured from 1964 to 2000 and involved in tow-away crashes in NSW during 1987 to 2000 and in Western Australia and Queensland during 1991 to 2000, 106,829 of whom were injured. The "covariate" model for injury risk was determined from the variables described in Section 2.1.1. The following covariates and interactions were statistically significantly associated with injury risk and were included in the logistic regression model.

Base effect terms: involved driver sex (sex), involved driver age (age), state of crash (state), speed zone of crash (speedzone), year of crash (year).

First order interaction terms: sex*speedzone, age*state, speedzone*year, age*year, year*state, age*sex.

No other variable or interaction term significantly improved the fit of the logistic model. A term for vehicle year of manufacture was added to the covariate model and the model re-estimated.

The overall (average) aggressivity injury risk for involved drivers in tow-away crashes in NSW, Western Australia and Queensland was 13.96%. In other words, the estimated probability that a driver involved in a two vehicle tow-away crash in NSW, Western Australia and Queensland was injured was 13.96%.

Appendix 2 gives the estimates of aggressivity injury risk derived by logistic regression for the individual years of manufacture. The variability in the aggressivity injury risk estimates relative to the year of manufacture can be seen from the width of the corresponding 95% confidence intervals.

5.1.2 Aggressivity Injury Severity

The data covered 187,884 drivers who were injured in crashes in Victoria during 1987-2000, NSW during 1987-1998 and Queensland or Western Australia during 1991-2000. 33,608 of these injured drivers were severely injured (killed or admitted to hospital).

The "covariate" model for injury severity was determined from the variables described in Section 4.2.1. The analysis identified a number of statistically significant covariate effects. These were:

Base effect terms: focus driver sex (sex), focus driver age (age), state of crash (state), speed zone of crash (speedzone), year of crash (year).

First order interaction terms: sex*age, year*state.

No other variable or interaction term significantly improved the fit of the logistic model. A term for vehicle year of manufacture was added to the covariate model and the model re-estimated.

The overall (average) aggressivity injury severity for injured drivers was 17.89%. In other words, the estimated probability that a driver injured in a crash was severely injured was 17.89%.

Appendix 2 gives the estimates of aggressivity injury severity derived by logistic regression for the individual years of manufacture. The variability in the estimates of aggressivity injury severity relative to year of manufacture can be seen from the width of the corresponding 95% confidence intervals.

5.1.3 Aggressivity by Year of Manufacture

The aggressivity estimates for each year of manufacture were obtained by multiplying the individual aggressivity injury risk and aggressivity injury severity estimates. Because each of the two components has been adjusted for the confounding factors, the resultant aggressivity estimate is also adjusted for the influence of them.

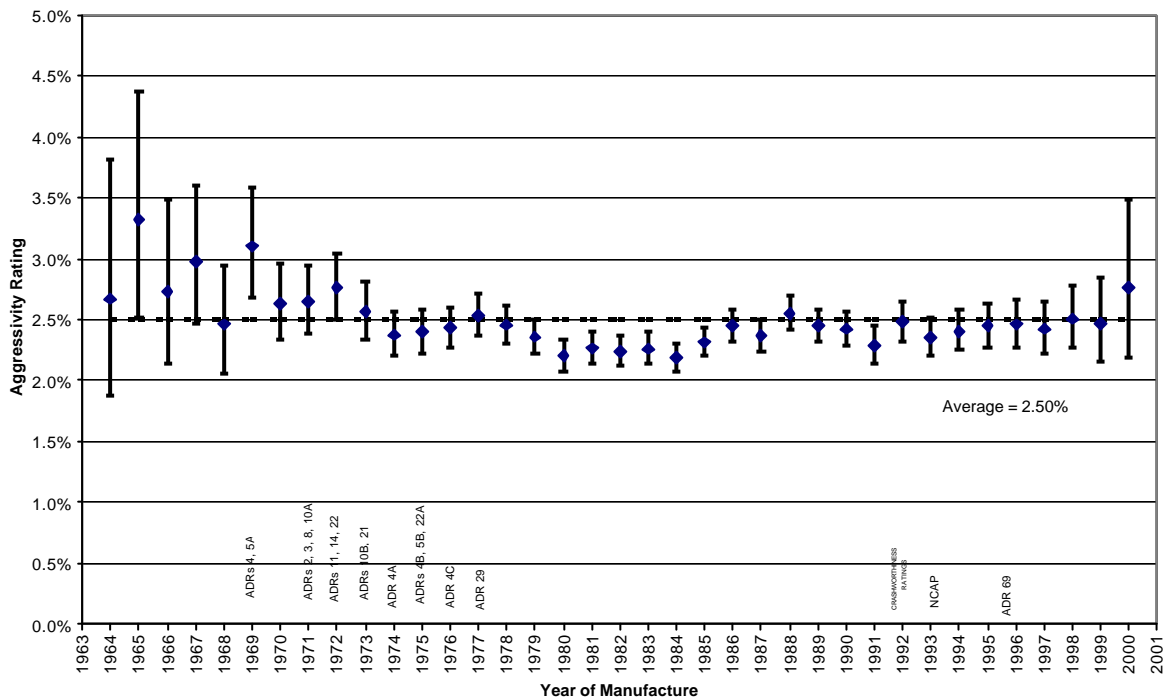
Appendix 2 gives the aggressivity estimates and the associated 95% confidence intervals for each of the 37 years of manufacture included in the analysis. Each estimate is expressed as a percentage, representing the number of drivers killed or admitted to hospital per 100 drivers involved in a tow-away crash where their vehicle collided with one of the indicated year of manufacture. The true risk of a driver being killed or admitted to hospital in a tow-away crash is only estimated by each figure, and as such each estimate has a level of uncertainty about it. This uncertainty is indicated by the confidence limits in Appendix 2. There is 95% probability that the confidence interval will cover the true risk of serious injury (death or hospital admission) to the driver of a vehicle involved in a crash with a vehicle of the given year of manufacture. Confidence limits for the aggressivity are calculated using the procedure detailed in Newstead et al (2003).

Based on the average aggressivity injury risk and severity the overall (average) aggressivity rating for all years of manufacture was 2.50%. In other words, the estimated probability that a focus driver injured in a crash was severely injured was 2.50%.

The aggressivity estimates and their confidence limits are plotted for each year of manufacture in Figure 1. The relatively wide confidence intervals observed on the estimates of aggressivity for years

of manufacture 1964 to 1969 and 2000 are a reflection of the smaller numbers of crashes involving vehicles manufactured in these years appearing in the data. Figure 1 shows no defined long-term trend to improved or worsening aggressivity in the Australian vehicle fleet over the years of manufacture studied. Vehicles manufacture over the years from 1964 to 1972 showed a tendency for higher than average aggressivity with a number of the estimates being significantly higher than the average based on the confidence limits. In contrast, vehicles manufactured from 1980 to 1985 have aggressivity statistically significantly lower than the overall average. The aggressivity estimates of vehicles from the remaining years were generally all around the average.

Figure 1: *Aggressivity by year of manufacture (with 95% confidence limits)*



The injury risk component of the aggressivity estimate, together with its 95% confidence limits, is plotted in Figure 2. In a similar way, the aggressivity injury severity component is plotted in Figure 3. There is slight evidence of improving aggressivity injury risk by year of vehicle manufacture in Figure 2. However, this is counteracted by a slight trend to increasing aggressivity injury severity for vehicles manufactured from 1970 onwards in Figure 3 leading to the relative lack of trend observed in the overall aggressivity measure presented in Figure 1.

Figure 2: *Aggressivity Injury risk by year of manufacture (with 95% confidence limits)*

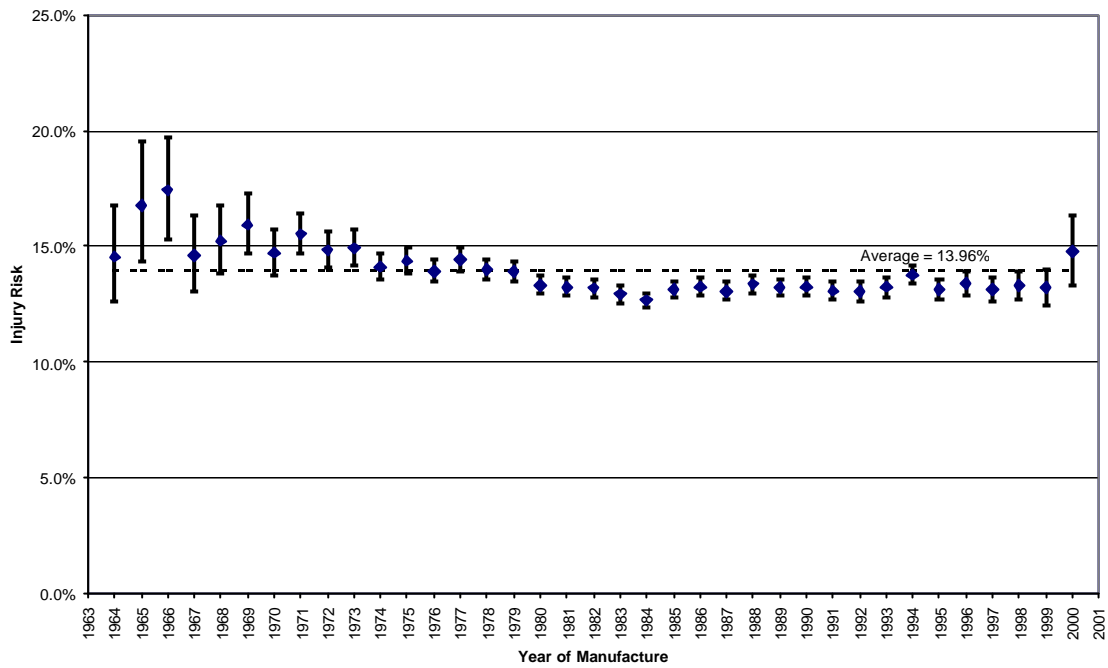
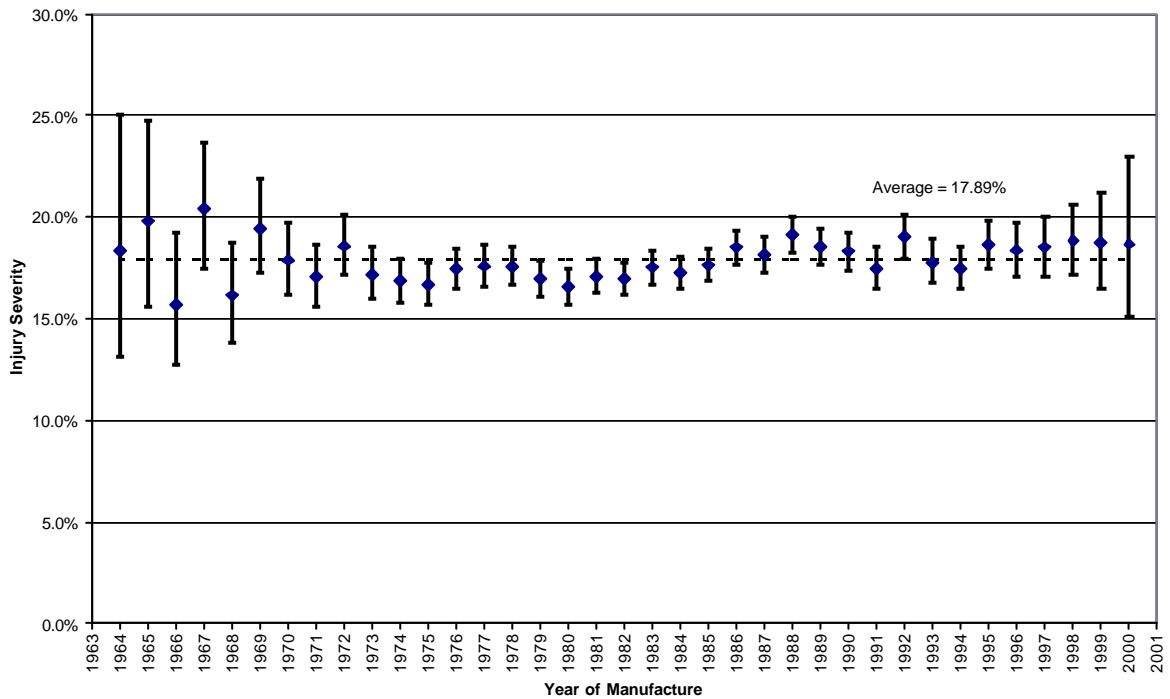


Figure 3: *Aggressivity Injury severity by year of manufacture (with 95% confidence limits)*



5.2 Aggressivity by Year of Manufacture and Market Group

Using the methods described above, trends in vehicle aggressivity by year of manufacture have been estimated separately for each vehicle market group. Analysis has considered each of the 8 market groups into which vehicles are classified in the crashworthiness and aggressivity ratings of Newstead et al (2003). Because vehicle model information was required to assign each a market grouping, analysis of trends by year of manufacture within market group could only be carried out for vehicles manufactured from 1982 to 2000. All vehicle models appearing in the crash data for which a market group could be assigned were included.

5.2.1 Aggressivity Injury Risk

Injury risk was estimated from the data on 425,324 drivers, 61,737 of who were injured, of 1982 to 2000 vehicles with identified model and market group details involved in two-vehicle matched tow-away crashes in NSW, Western Australia and Queensland during 1987 to 2000. The "covariate" model for aggressivity injury risk was determined from the variables described above. The following covariates and interactions were statistically significantly associated with aggressivity injury risk and were included in the logistic regression model.

Base effect terms: involved driver sex (sex), involved driver age (age), speed zone of crash (speedzone), state of crash (state), year of crash (year).

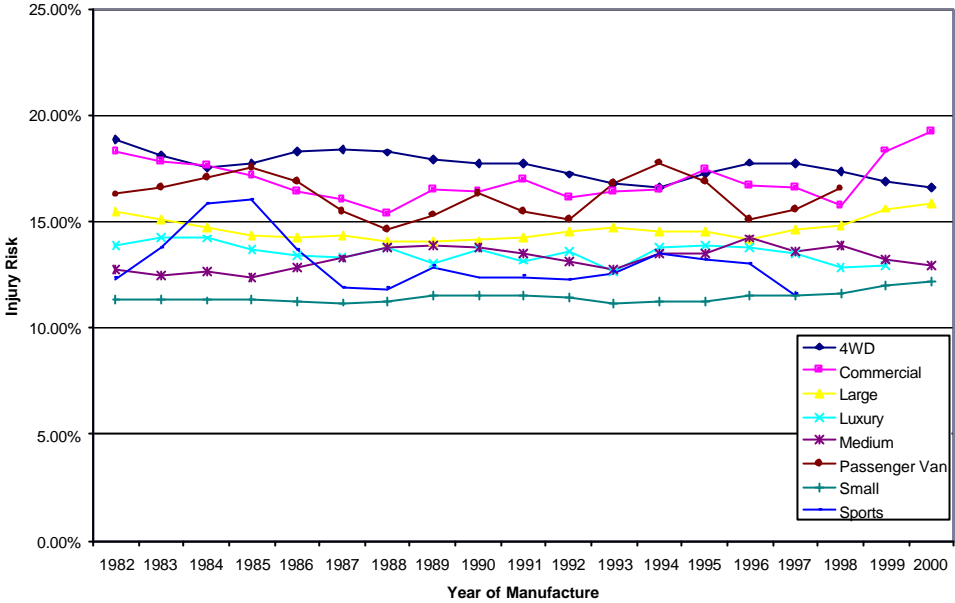
First order interaction terms: sex*speedzone, age*speedzone, sex*state, age*state, age*sex, speedzone*state, speedzone*year, year*state, sex*year, age*year.

Second order interaction terms: sex*state*year.

No other variable or interaction term significantly improved the fit of the logistic covariate model. A term representing vehicle year of manufacture and market group was added to the covariate model and the model re-estimated.

Figure 4 shows the estimates of aggressivity injury risk by year of vehicle manufacture for each of the 8 market groups considered. Estimates have been smoothed using a linear smoothing function over a window of three years (the central year and a year either side). Smoothing of the estimates was carried out to better identify the trends in the data. Smoothing in this way also compensates for known error in the recording of the year of vehicle manufacture, an error typically up to one year from the true date of manufacture.

Figure 4: *Estimated aggressivity injury risk by year of vehicle manufacture and market group*



5.2.2 Aggressivity Injury Severity

The data for computation of aggressivity injury severity covered 67,900 drivers of 1982-2000 model vehicles who were injured in two vehicle matched crashes in Victoria during 1987-2000, NSW during 1987-1998 or Queensland and Western Australia during 1991-2000. 11,260 were seriously injured. The "covariate" model for aggressivity injury severity was determined from the variables described above and identified a number of statistically significant covariate effects. These were:

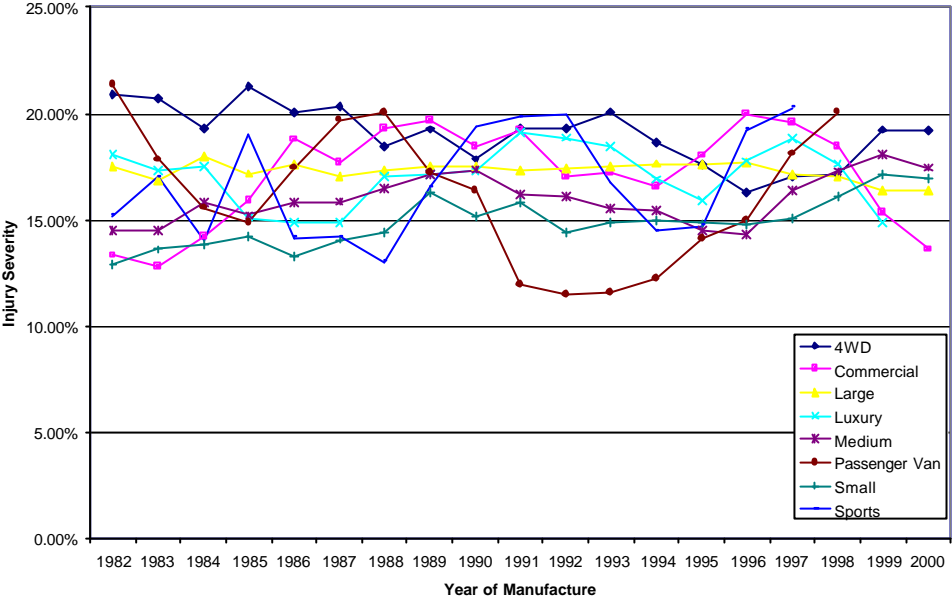
Base effect terms: focus driver age (age), focus driver sex (sex), speed zone of crash (speedzone), year of crash (year), state of crash (state).

First order interaction terms: age*state, speedzone*state, state*year, speedzone*year, age*sex.

Second order interaction terms: speedzone*state*year.

No other variable or interaction term significantly improved the fit of the logistic covariate model. A term for vehicle year of manufacture and market group was added to the covariate model and the model re-estimated. Figure 5 shows the estimates of injury severity by year of vehicle manufacture for each of the 8 market groups considered. Estimates have again been smoothed to better identify the trends in the data.

Figure 5: *Estimated aggressivity injury severity by year of vehicle manufacture and market group.*



5.2.3 Aggressivity by Year of Manufacture and Market Group

The aggressivity estimates for each year of manufacture were obtained by multiplying the individual aggressivity injury risk and aggressivity injury severity estimates. Because each of the two components has been adjusted for the confounding factors, the resultant aggressivity estimate is also adjusted for the influence of them.

Appendix 4 gives the aggressivity estimates and the associated 95% confidence intervals (in brackets) for each of the years of manufacture from 1982 to 2000 by each of the 8 vehicle market groups considered. Each estimate is expressed as a percentage, representing the number of drivers killed or admitted to hospital per 100 drivers involved in a tow-away crash with a vehicle of the given market group and year of manufacture. Confidence limits on each estimate are also given in Appendix 4 with the interpretation of these as before.

The aggressivity estimates are plotted for each year of manufacture and vehicle market group in Figure 6. Again, the values in Figure 6 have been smoothed for reasons given above. Appendix 4 gives the estimates before smoothing. There were differences in trends in each of the components of aggressivity by year of manufacture between the 8 market groups considered reflected in Figure 6.

Large, luxury and medium class vehicles have shown no real long-term trends in aggressivity over the years of manufacture considered. Both 4WD vehicles and commercial vehicles have shown long term trends in aggressivity. First, 4WD vehicles have shown consistent trend to decreasing aggressivity for later years of manufacture with average aggressivity decreasing by around 25% from

1982 to 2000. In contrast, commercial vehicles have shown a trend to increasing aggressivity over the period 1982 to 1987 although the trend in the last 3 years of manufacture studied is unclear. Smaller vehicles have also shown a trend to increasing aggressivity over the study period rising from around 1.5% in 1983 to 2% in 2000. Trends in the passenger van and sports car segments are difficult to interpret due to the high variability in estimates for this market group (see Appendix 4). Possible reasons for the differential trends between the groups will be discussed below.

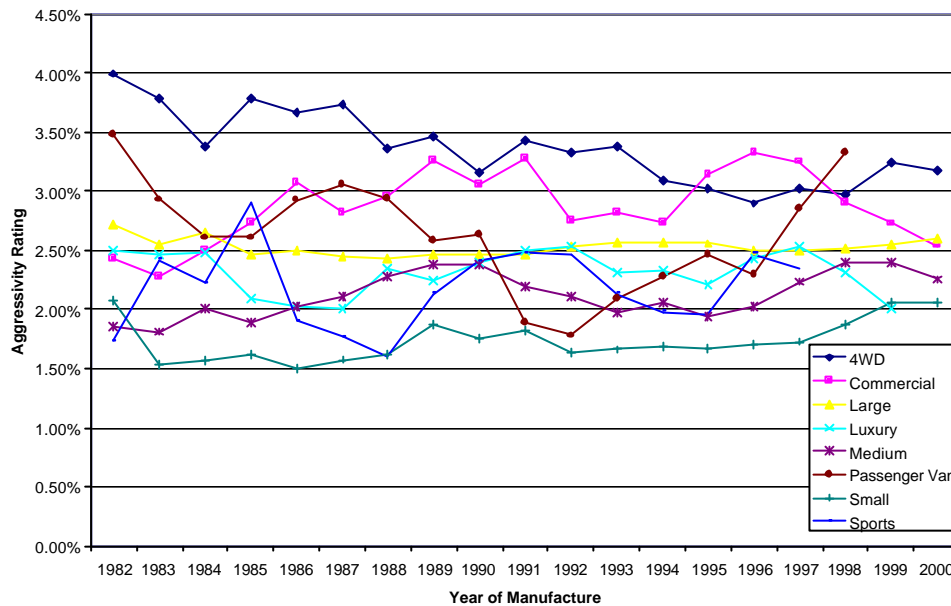


Figure 6: *Estimated aggressivity by year of vehicle manufacture and market group*

6 DISCUSSION

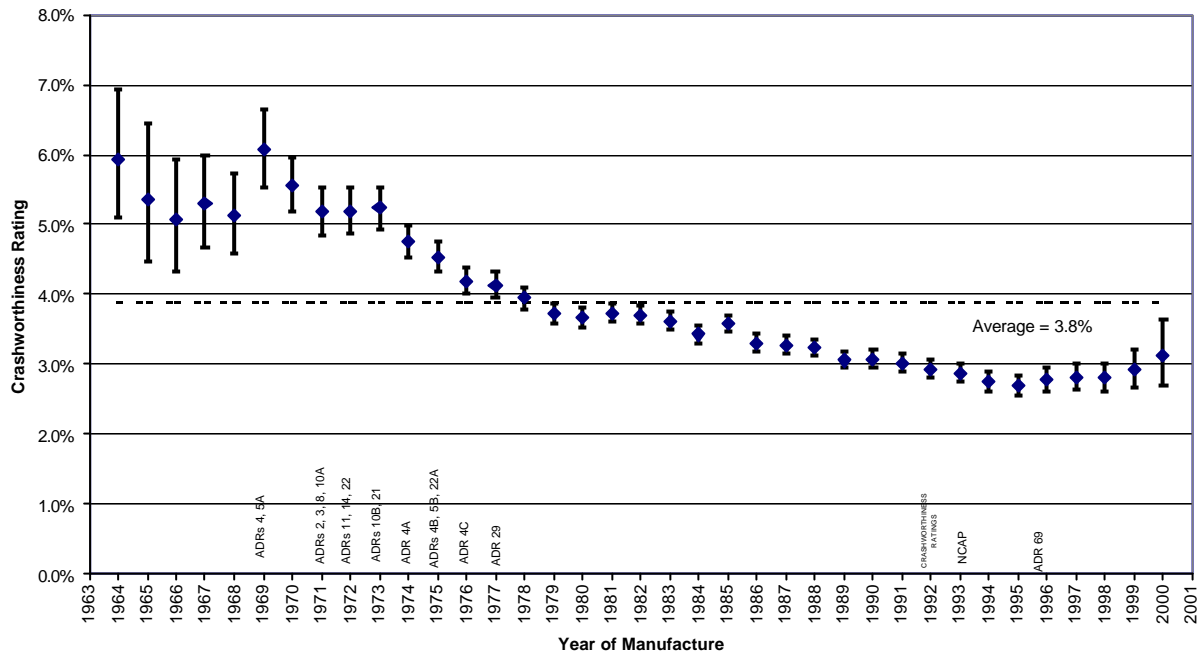
Analysis presented in this report has been able to quantify the long-term trends in the aggressivity of Australian passenger vehicles towards drivers of other vehicles. Trends have been estimated by year of vehicle manufacture for the Australian passenger and light commercial fleet as a whole and broken down by 8 market group classifications.

For the fleet as a whole, there has been no consistent trend to either improving or worsening aggressivity towards drivers of other vehicles by year of vehicle manufacture, as shown in Figure 1. Only vehicles from a few particular ranges of years of manufacture showed evidence of superior or inferior aggressivity. Point estimates of aggressivity for vehicles manufactured from 1964 to 1973 were generally above the long-term average, although only significantly so for a few of the years in that range. In contrast, vehicles manufactured over the years 1980-1985 had estimated aggressivity significantly below the long-term average, although the average for these years was only around 10% less than the long-term average.

Trends in aggressivity by year of vehicle manufacture for the fleet as a whole are in stark contrast to trends in crashworthiness by year of vehicle manufacture. Figure 7 shows estimates of crashworthiness by year of vehicle manufacture most recently estimated by Newstead et al (2003). It

shows consistent improvements in vehicle crashworthiness with increasing year of manufacture, with particularly notable gains occurring throughout the 1970s.

Figure 7: *Crashworthiness by year of manufacture (with 95% confidence limits)*



Measured improvements in crashworthiness by year of vehicle manufacture were related by Newstead et al (2003) to the introduction of a number of Australian Design Rules (ADRs) concerned with occupant protection including the following.

- ADR 4 (seat belts fitted in front seats) from January 1969
- ADR 2 ("anti-burst" door latches and hinges) from January 1971
- ADR 10A ("energy-absorbing" steering columns) also from January 1971
- ADR 22 (head restraints) from January 1972
- ADR 10B (steering columns with limited rearward displacement) from January 1973
- ADR 4B (inertia reel seat belts fitted in front seats) from January 1975
- ADR 22A (minimum-height adjustable head restraints) from January 1975
- ADR 29 (side door strength) from January 1977.
- ADR 5A (seat belt anchorage points for front seats) from January 1969

It is clear that these ADRs have been successful in achieving their objective in improving the ability of a vehicle to protect its own occupants in a crash. However, from their description it is also clear that they have little relevance to improving partner vehicle occupant protection as measured by aggressivity. Plotting the key safety oriented ADRs on Figure 1 further highlights the lack of association between these ADRs and deviations in the aggressivity line. A review of all ADRs for vehicles shows there are no vehicle design regulations aimed specifically at improving vehicle aggressivity towards other vehicle drivers as measured in this study.

In many respects there was no a-priori expectation about how trends in vehicle aggressivity by year of vehicle manufacture may have looked prior to the analysis presented in this report being

undertaken. There has been some suggestion, albeit unproven, that vehicle safety assessment, such as the Australian New Car Assessment Program (ANCAP), may have led to higher aggressivity amongst vehicles of more recent years of manufacture. This premise is based on two aspects of ANCAP. First, apart from the pedestrian assessment, ANCAP is focused only on assessing a vehicle's ability to protect its own occupants in a crash and encourages manufacturers to optimise vehicles in this dimension of performance with no recourse to aggressivity performance. Second, the relatively high impact speed of ANCAP has led to claims that this may lead to vehicles being made unnecessarily stiff to perform well in protecting the vehicle's own occupants in the test but with the stiff structures compromising the vehicle's aggressivity. Figure 1 clearly does not support these claims showing no trend towards increased aggressivity of the vehicle fleet since the introduction of ANCAP in 1993. Furthermore, trend to increasing aggressivity since 1993 has not been seen in specific market groups with high ANCAP test coverage, such as the large car sector which is so popular in Australia. This can be seen in Figure 6.

A possible reason for higher average aggressivity of vehicles manufactured before 1972 may be related to the reason these same vehicles exhibit poorer crashworthiness, as shown in Figure 7. Vehicles of this age were typically built without crumple zones to manage impact energy in a collision. It is now understood that crumple zones are vital for managing energy transfer to the occupants of the vehicle with the crumple zones. For the same reason, crumple zones are also important for managing energy transfer to other vehicles in a collision, hence the poor performance of these older vehicles in the dimensions of both crashworthiness and aggressivity.

To understand potential reasons for vehicles of the early 1980s having estimated aggressivity significantly less than the long-term average, it is useful to review what the points on Figure 1 represent. The estimate of aggressivity for vehicles of a particular year of manufacture represents the average for vehicles of that year of manufacture represented in the crash data. As such, the estimate will reflect to a large degree the mix of vehicle types of that year of manufacture present in the fleet. In the early 1980s, the mix of new vehicle sales changed somewhat due to the oil crisis of the late 1970s. Sales shifted more towards more fuel-efficient medium sized vehicles such as the Toyota Corona, Ford Telstar/Mazda 626 and Nissan Bluebird and away from the larger cars. As can be seen from Figure 6, medium cars of the early 1980s had particularly low aggressivity. It is most likely the predominance of these medium sized cars over the early 1980s that lead to the significantly lower than average aggressivity for those years seen in Figure 1.

The increasing popularity of the 4WD vehicles in Australia throughout the 1990s is well documented. Because of the high aggressivity of 4WDs shown in Newstead et al (2003) it may have been expected that the average aggressivity of the Australian fleet would have worsened through the 1990s. Figure 1, however, does not reflect this with the aggressivity curve remaining relatively flat for these years of manufacture. Figure 6 helps to explain why this is the case. Whilst it confirms that 4WDs are generally the most aggressive vehicle class, the class has shown consistent improvement in aggressivity from 1982 through to 2000. The reason for this is most likely explained by changes in the type of 4WD vehicle typically purchased over this period. During the 1980s and early 1990s, 4WD sales were dominated by the large (>2000kg) serious off road 4WDs like the Toyota Land Cruiser and Nissan Patrol. As well as being particularly heavy compared to the average mass of the passenger vehicle fleet, these vehicles are typically built on very rigid ladder chassis that do not

deform appropriately to absorb energy in collisions. Ratings for individual models of this type of 4WD vehicles given in Newstead et al (2003) show they have particularly high aggressivity.

VFACTS new vehicle sales figures show that during the 1990s buyer preference for 4WDs shifted from the traditional larger off road vehicle to smaller vehicles such as the Honda CRV, Toyota RAV4 and Suzuki Vitara. As well as being considerably lighter, these smaller 4WDs typically have more car-like unitary construction that is likely to lead to improved crash energy management and corresponding aggressivity. Newstead et al (2000) investigated the relative aggressivity of 4WD vehicles above and below 1700kg and found the lighter 4WDs had a measured aggressivity about 40% less than the larger class even though average mass between the two classes only differed by about 25%. The shift in buyer preference to the smaller, more car-like style of 4WD vehicle could certainly explain the 25% reduction in average 4WD aggressivity seen between 1982 and 2000 in Figure 6. Despite these improvements, Figure 6 shows 4WDs are still the most aggressive vehicle class amongst late model vehicles.

The other notable trend in aggressivity by vehicle market groups shown in Figure 6 is the trend to increasing aggressivity in the small car class. From 1982 to 2000 the aggressivity of small cars was estimated to have increased around 30%. In contrast to the general argument made about ANCAP not being associated with increased aggressivity, it may be the case that the need for greater own occupant protection in small cars has led to increased structural stiffness and consequently aggressivity. This need is dictated by the shorter crash structures available in small cars to manage impact energy. One problem with this argument is that Newstead and Cameron (2001) found a trend to decreasing crashworthiness of the small vehicle fleet. This seems to be inconsistent with the concept of increasing small car stiffness to improve safety. However, it has been argued above that over stiff structures may have been the cause of both poor crashworthiness and aggressivity in cars from the 1960s. Clearly, there is a need for further investigation as to the reasons for the trend to worsening aggressivity of the small vehicle fleet, along with the relatively poor crashworthiness performance of these vehicles.

A key outcome of the analysis presented in this report is the general lack of progress in improving the aggressivity of the Australian fleet even though it is likely that significant gains in reducing road trauma could result from doing so. Further research into the factors determining vehicle aggressivity, apart from the general factors of mass, geometry and stiffness, needs to be undertaken and applied to vehicle design to make progress in this key area. Continued analysis such as that presented in this report is also vital to monitor progress in this area.

7. CONCLUSIONS

This study has been successful in estimating trends in aggressivity by year of vehicle manufacture of passenger vehicles (cars, station wagons, four wheel drives, vans and taxis) manufactured over the years 1964 to 2000. Trends have been estimated for the vehicle fleet as a whole as well as broken down into 8 specific vehicle market groups. The aggressivity measure estimated the risk of death or serious injury to a driver of a vehicle colliding with a vehicle of a particular year of manufacture and market group where considered.

When considering the vehicle fleet as a whole, no long-term trend to improving or worsening aggressivity by year of manufacture was identified. Only vehicles of a few years of manufacture had estimated aggressivity above or below the long-term average. These included vehicles from 1964 to 1972 that tended to have estimated aggressivity higher than the long term average, although only a few of the years in this range were significantly higher than average. Vehicles manufactured from 1980 to 1985 had estimated aggressivity significantly below the long-term average, although the average for these years was only around 10% less than the long-term average. The lack of overall trend highlights the need for further action to improve vehicle aggressivity.

Analysis of aggressivity by year of vehicle manufacture and market group identified two vehicle market groups that had demonstrated long term trends in aggressivity over the period of study from 1982 to 2000. Estimates of aggressivity of the 4WD market group showed a consistent trend towards improved aggressivity with increasing year of around 25% over the study period. This reflects a trend in sales away from the traditional large off road 4WD vehicle to the lighter recreational 4WD vehicle over this period. In contrast, the small vehicle market group showed a trend to worsening aggressivity over the study period, with estimated aggressivity increasing by around 30%. The reason for this requires further research but may be related to the need for stiffer structures in small vehicles to improve levels of own occupant protection in this vehicle class. Despite these trends, small vehicles have remained the least aggressive and 4WD vehicles the most aggressive for vehicles of the most recent years of manufacture studied. No consistent trends in aggressivity with year of manufacture were observed in other market groups.

7. ASSUMPTIONS AND QUALIFICATIONS

The results and conclusions presented in this report are based on a number of assumptions and warrant a number of qualifications that the reader should note. These are listed in the following sections.

7.1 Assumptions

It has been assumed that:

- TAC claims records and, Victorian, NSW, Western Australian and Queensland Police crash reports accurately recorded driver injury, hospitalisation and death.
- There was no bias in the merging of TAC claims and Victorian Police crash reports related to the model of car and factors affecting the severity of the crash.
- Crashed vehicle registration numbers were recorded accurately on Police crash reports and that they correctly identified the crashed vehicles in the Victorian, NSW and Queensland vehicle registers.
- The adjustments for driver sex, age, speed zone, the number of vehicles involved and the state and year in which the crash occurred removed the influences of the other main factors available in the data that affected crash severity and injury susceptibility.

- The form of the logistic models used to relate injury risk and injury severity with the available factors influencing these outcomes (including the car models) was correct.
- Information contained in the Police crash records allowed accurate matching of both vehicles involved in crashes between two passenger cars for the purpose of calculating aggressivity ratings.

7.2 Qualifications

The results and conclusions warrant at least the following qualifications:

- Only driver crash involvements and injuries have been considered. Passengers occupying the same model cars may have had different injury outcomes.
- Other factors not collected in the data (eg. crash speed) may differ between the models and may affect the results. However, earlier analysis has suggested that the different rating scores are predominantly due to vehicle factors alone (Cameron et al 1992).

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**AGGRESSIVITY DATA FREQUENCY FOR EACH YEAR OF VEHICLE
MANUFACTURE INVOLVED IN VICTORIAN AND NSW CRASHES DURING
1987-2000 AND WESTERN AUSTRALIA AND QUEENSLAND CRASHES
DURING 1991-2000**

**DRIVER INJURY OUTCOME BY COLLIDING VEHICLE YEAR OF MANUFACTURE:
ALL CRASH TYPES
(NSW/VIC/QLD/WA)**

Aggressivity Year of Manufacture	No. of uninjured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of involved drivers in NSW (87-2000) and QLD,WA (91-2000)	No. of injured (but not severely) drivers in NSW and Victoria (87-2000) and QLD,WA (91-2000)	No. of severely injured drivers in NSW and Victoria (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW, Victoria (87-2000) and QLD, WA (91-2000)
1964	887	159	1046	135	29	164
1965	643	135	778	225	59	284
1966	904	196	1100	376	77	453
1967	1492	254	1746	487	130	617
1968	1969	355	2324	687	137	824
1969	2521	467	2988	881	227	1108
1970	4392	762	5154	1474	344	1818
1971	5657	1024	6681	1951	416	2367
1972	6594	1125	7719	2090	513	2603
1973	7669	1323	8992	2657	593	3250
1974	13084	2111	15195	3792	812	4604
1975	13389	2209	15598	4142	868	5010
1976	17231	2766	19997	4857	1060	5917
1977	16194	2720	18914	4835	1060	5895
1978	22051	3570	25621	5880	1276	7156
1979	26104	4198	30302	6874	1436	8310
1980	27269	4200	31469	6794	1379	8173
1981	29026	4467	33493	7097	1479	8576
1982	33756	5216	38972	7963	1645	9608
1983	29490	4501	33991	6969	1501	8470
1984	37406	5588	42994	8412	1794	10206
1985	40816	6351	47167	9226	1999	11225
1986	32795	5103	37898	7504	1732	9236
1987	28990	4494	33484	6582	1477	8059
1988	32089	5202	37291	6969	1626	8595
1989	35206	5690	40896	7544	1682	9226
1990	31680	5187	36867	6541	1462	8003
1991	25098	4100	29198	4991	1044	6035
1992	24373	4053	28426	4714	1080	5794
1993	23164	3924	27088	4539	952	5491
1994	22958	4103	27061	4740	979	5719
1995	19862	3363	23225	3785	845	4630
1996	15124	2604	17728	2997	664	3661
1997	12544	2174	14718	2417	544	2961
1998	9497	1784	11281	1832	406	2238
1999	5012	1021	6033	979	209	1188
2000	1389	330	1719	338	72	410
Total	658325	106829	765154	154276	33608	187884

Note :

* NSW injury severity data for 1999 and 2000 was not included in the analysis because of changes in injury severity coding that resulted in inaccurate injury severity reporting.

**Uninjured records for Victoria are incomplete as only crashes involving injury are reliably reported and hence Victorian data is not included in the injury risk analysis

**AGGRESSIVITY, INJURY RISK AND INJURY SEVERITY ESTIMATES BY VEHICLE
YEAR OF MANUFACTURE**

AGGRESSIVITY INJURY RISK BY YEAR OF MANUFACTURE

Year of Manufacture	Logistic Regression Coefficient of Year of Manufacture	Standard Error of Coefficient	Pr(Risk) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE YEAR	-1.8185		13.96			
1964	0.0486	0.0855	14.56	12.59	16.77	4.17
1965	0.2163	0.0939	16.77	14.35	19.50	5.14
1966	0.2622	0.0783	17.42	15.32	19.74	4.42
1967	0.0528	0.0674	14.61	13.04	16.33	3.30
1968	0.1020	0.0574	15.23	13.84	16.74	2.91
1969	0.1557	0.0503	15.94	14.66	17.30	2.64
1970	0.0622	0.0394	14.73	13.78	15.72	1.94
1971	0.1236	0.0343	15.51	14.65	16.42	1.76
1972	0.0708	0.0326	14.83	14.04	15.66	1.61
1973	0.0777	0.0302	14.92	14.19	15.69	1.50
1974	0.0118	0.0241	14.10	13.54	14.69	1.14
1975	0.0337	0.0237	14.37	13.81	14.95	1.14
1976	-0.0029	0.0213	13.93	13.43	14.44	1.00
1977	0.0374	0.0215	14.42	13.90	14.94	1.04
1978	0.0035	0.0190	14.00	13.56	14.46	0.90
1979	-0.0043	0.0177	13.91	13.50	14.33	0.83
1980	-0.0551	0.0176	13.31	12.92	13.72	0.80
1981	-0.0621	0.0171	13.23	12.85	13.62	0.77
1982	-0.0671	0.0160	13.18	12.82	13.54	0.72
1983	-0.0901	0.0170	12.91	12.54	13.29	0.75
1984	-0.1130	0.0155	12.66	12.33	13.00	0.67
1985	-0.0710	0.0147	13.13	12.81	13.46	0.66
1986	-0.0608	0.0161	13.25	12.89	13.61	0.73
1987	-0.0772	0.0170	13.06	12.69	13.44	0.76
1988	-0.0521	0.0161	13.35	12.99	13.72	0.73
1989	-0.0619	0.0155	13.23	12.89	13.59	0.70
1990	-0.0610	0.0162	13.24	12.88	13.61	0.73
1991	-0.0762	0.0180	13.07	12.68	13.48	0.80
1992	-0.0790	0.0181	13.04	12.64	13.45	0.80
1993	-0.0613	0.0184	13.24	12.83	13.66	0.83
1994	-0.0151	0.0182	13.78	13.36	14.21	0.85
1995	-0.0704	0.0199	13.14	12.70	13.59	0.89
1996	-0.0493	0.0224	13.38	12.88	13.90	1.02
1997	-0.0726	0.0245	13.11	12.57	13.67	1.09
1998	-0.0568	0.0272	13.29	12.69	13.92	1.23
1999	-0.0645	0.0357	13.20	12.42	14.03	1.60
2000	0.0654	0.0623	14.77	13.29	16.37	3.08

AGGRESSIVITY INJURY SEVERITY BY YEAR OF VEHICLE MANUFACTURE

Year of Manufacture	Logistic Regression Coefficient of Year of Manufacture	Standard Error of Coefficient	Pr(Severity) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	-1.524		17.89			
YEAR						
1964	0.0313	0.2031	18.35	13.12	25.08	18.35
1965	0.1236	0.1459	19.78	15.63	24.70	19.78
1966	-0.1578	0.1246	15.69	12.72	19.19	15.69
1967	0.1614	0.0988	20.38	17.42	23.70	20.38
1968	-0.1241	0.0933	16.14	13.81	18.77	16.14
1969	0.1032	0.0749	19.45	17.26	21.86	19.45
1970	0.0010	0.0606	17.90	16.22	19.71	17.90
1971	-0.0580	0.0548	17.05	15.59	18.62	17.05
1972	0.0467	0.0504	18.58	17.14	20.13	18.58
1973	-0.0475	0.0467	17.20	15.94	18.54	17.20
1974	-0.0727	0.0402	16.84	15.77	17.98	16.84
1975	-0.0835	0.0389	16.69	15.66	17.78	16.69
1976	-0.0306	0.0357	17.44	16.46	18.47	17.44
1977	-0.0201	0.0356	17.59	16.61	18.63	17.59
1978	-0.0235	0.0328	17.55	16.63	18.49	17.55
1979	-0.0653	0.0310	16.95	16.11	17.82	16.95
1980	-0.0943	0.0315	16.54	15.71	17.41	16.54
1981	-0.0547	0.0306	17.10	16.26	17.97	17.10
1982	-0.0643	0.0292	16.96	16.17	17.78	16.96
1983	-0.0263	0.0305	17.50	16.66	18.38	17.50
1984	-0.0446	0.0282	17.24	16.47	18.04	17.24
1985	-0.0190	0.0270	17.61	16.86	18.39	17.61
1986	0.0406	0.0288	18.49	17.66	19.36	18.49
1987	0.0161	0.0308	18.13	17.25	19.04	18.13
1988	0.0830	0.0297	19.14	18.25	20.06	19.14
1989	0.0421	0.0293	18.51	17.66	19.40	18.51
1990	0.0278	0.0312	18.30	17.40	19.23	18.30
1991	-0.0272	0.0360	17.49	16.50	18.53	17.49
1992	0.0761	0.0359	19.03	17.97	20.14	19.03
1993	-0.0070	0.0377	17.78	16.73	18.89	17.78
1994	-0.0293	0.0373	17.46	16.43	18.54	17.46
1995	0.0505	0.0403	18.64	17.47	19.87	18.64
1996	0.0336	0.0451	18.39	17.10	19.75	18.39
1997	0.0408	0.0498	18.49	17.07	20.01	18.49
1998	0.0639	0.0574	18.85	17.18	20.63	18.85
1999	0.0546	0.0792	18.70	16.46	21.18	18.70
2000	0.0535	0.1318	18.69	15.07	22.93	18.69

AGGRESSIVITY BY YEAR OF VEHICLE MANUFACTURE

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved	Overall rank order	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE YEAR	13.96	17.89	2.50				
1964	14.56	18.35	2.67	31	1.87	3.81	1.94
1965	16.77	19.78	3.32	37	2.52	4.37	1.85
1966	17.42	15.69	2.73	33	2.15	3.48	1.33
1967	14.61	20.38	2.98	35	2.46	3.60	1.14
1968	15.23	16.14	2.46	20	2.05	2.94	0.89
1969	15.94	19.45	3.10	36	2.68	3.58	0.90
1970	14.73	17.90	2.64	29	2.34	2.97	0.62
1971	15.51	17.05	2.65	30	2.38	2.94	0.56
1972	14.83	18.58	2.76	34	2.50	3.04	0.54
1973	14.92	17.20	2.57	28	2.34	2.81	0.47
1974	14.10	16.84	2.38	11	2.20	2.57	0.37
1975	14.37	16.69	2.40	12	2.23	2.59	0.36
1976	13.93	17.44	2.43	15	2.27	2.60	0.33
1977	14.42	17.59	2.54	25	2.37	2.71	0.34
1978	14.00	17.55	2.46	19	2.31	2.61	0.30
1979	13.91	16.95	2.36	9	2.22	2.50	0.28
1980	13.31	16.54	2.20	2	2.08	2.34	0.26
1981	13.23	17.10	2.26	4	2.14	2.40	0.26
1982	13.18	16.96	2.23	3	2.12	2.36	0.24
1983	12.91	17.50	2.26	5	2.13	2.39	0.26
1984	12.66	17.24	2.18	1	2.07	2.30	0.23
1985	13.13	17.61	2.31	7	2.20	2.43	0.23
1986	13.25	18.49	2.45	18	2.32	2.58	0.26
1987	13.06	18.13	2.37	10	2.24	2.51	0.27
1988	13.35	19.14	2.55	27	2.42	2.70	0.28
1989	13.23	18.51	2.45	21	2.32	2.59	0.26
1990	13.24	18.30	2.42	14	2.29	2.57	0.28
1991	13.07	17.49	2.29	6	2.14	2.44	0.30
1992	13.04	19.03	2.48	23	2.33	2.65	0.32
1993	13.24	17.78	2.35	8	2.20	2.52	0.32
1994	13.78	17.46	2.41	17	2.25	2.58	0.33
1995	13.14	18.64	2.45	13	2.28	2.63	0.36
1996	13.38	18.39	2.46	24	2.27	2.67	0.40
1997	13.11	18.49	2.43	16	2.22	2.65	0.44
1998	13.29	18.85	2.51	22	2.26	2.78	0.51
1999	13.20	18.70	2.47	26	2.15	2.84	0.69
2000	14.77	18.69	2.76	32	2.18	3.49	1.31

**AGGRESSIVITY DATA FREQUENCY FOR EACH YEAR OF MANUFACTURE
AND MARKET GROUP INVOLVED IN VICTORIAN AND NSW CRASHES
DURING 1987-2000 AND WESTERN AUSTRALIA AND QUEENSLAND
CRASHES DURING 1991-2000**

**FREQUENCY FOR EACH AGGRESSIVITY YEAR OF MANUFACTURE
BY MARKET GROUP FOR ALL TYPES OF CRASHES
(NSW/VIC/QLD/WA)**

Year of Manufacture and Market Group	No. of uninjured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of involved drivers in NSW (87-2000) and QLD,WA (91-2000)	No. of injured (but not severely) drivers in NSW and Victoria (87-2000) and QLD,WA (91-2000)	No. of severely injured drivers in NSW and Victoria (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW, Victoria (87-2000) and QLD, WA (91-2000)	Analysis Inclusion Criteria INV=100 INJ=20
Four Wheel Drives							
1982	567	142	709	109	31	140	1
1983	664	157	821	129	25	154	1
1984	1039	221	1260	170	42	212	1
1985	1428	338	1766	276	66	342	1
1986	888	207	1095	171	42	213	1
1987	622	148	770	126	21	147	1
1988	1216	296	1512	241	58	299	1
1989	1591	386	1977	344	68	412	1
1990	1522	357	1879	313	76	389	1
1991	1160	283	1443	254	49	303	1
1992	1469	365	1834	302	78	380	1
1993	1407	306	1713	281	62	343	1
1994	1375	301	1676	279	66	345	1
1995	978	239	1217	227	45	272	1
1996	879	228	1107	223	45	268	1
1997	800	203	1003	218	43	261	1
1998	703	183	886	203	48	251	1
1999	405	105	510	137	27	164	1
2000	102	25	127	33	9	42	1
Commercials							
1982	776	173	949	140	28	168	1
1983	615	139	754	126	14	140	1
1984	1009	204	1213	172	24	196	1
1985	1080	232	1312	168	42	210	1
1986	1094	225	1319	185	30	215	1
1987	980	172	1152	138	33	171	1
1988	1205	252	1457	206	40	246	1
1989	1314	256	1570	219	52	271	1
1990	1045	252	1297	195	51	246	1
1991	954	207	1161	181	29	210	1
1992	852	198	1050	159	49	208	1
1993	895	188	1083	159	32	191	1
1994	1043	241	1284	204	35	239	1
1995	943	215	1158	166	41	207	1
1996	854	214	1068	171	43	214	1
1997	745	151	896	132	35	167	1
1998	572	138	710	125	30	155	1
1999	325	82	407	71	15	86	1

Year of Manufacture and Market Group	No. of uninjured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of involved drivers in NSW (87-2000) and QLD,WA (91-2000)	No. of injured (but not severely) drivers in NSW and Victoria (87-2000) and QLD,WA (91-2000)	No. of severely injured drivers in NSW and Victoria (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW, Victoria (87-2000) and QLD, WA (91-2000)	Analysis Inclusion Criteria INV=100 INJ=20
2000	100	37	137	39	5	44	1
Large							
1982	4324	779	5103	699	118	817	1
1983	3426	622	4048	528	125	653	1
1984	5164	874	6038	786	142	928	1
1985	7031	1162	8193	981	214	1195	1
1986	7443	1257	8700	1063	206	1269	1
1987	7806	1273	9079	1081	206	1287	1
1988	8202	1437	9639	1188	239	1427	1
1989	9265	1597	10862	1456	325	1781	1
1990	7512	1313	8825	1197	255	1452	1
1991	5879	1100	6979	976	210	1186	1
1992	6226	1150	7376	1056	223	1279	1
1993	7567	1417	8984	1278	270	1548	1
1994	7897	1538	9435	1381	299	1680	1
1995	6728	1199	7927	1036	228	1264	1
1996	5353	1022	6375	938	197	1135	1
1997	4003	745	4748	676	154	830	1
1998	3188	692	3880	637	126	763	1
1999	1653	393	2046	352	75	427	1
2000	444	117	561	115	22	137	1
Luxury							
1982	1172	186	1358	146	33	179	1
1983	884	140	1024	115	25	140	1
1984	1014	177	1191	144	30	174	1
1985	1271	201	1472	163	38	201	1
1986	821	112	933	101	14	115	1
1987	681	112	793	95	18	113	1
1988	963	154	1117	126	28	154	1
1989	1291	208	1499	203	45	248	1
1990	1210	175	1385	174	34	208	1
1991	665	130	795	116	28	144	1
1992	849	121	970	117	37	154	1
1993	754	123	877	115	20	135	1
1994	921	148	1069	151	32	183	1
1995	811	151	962	141	32	173	1
1996	667	115	782	111	15	126	1
1997	607	97	704	74	24	98	1
1998	360	71	431	67	20	87	1
1999	228	39	267	36	3	39	1
2000	68	21	89	20	2	22	0
Medium							
1982	5050	678	5728	633	85	718	1
1983	4508	662	5170	577	117	694	1
1984	5253	695	5948	586	95	681	1
1985	4450	648	5098	541	100	641	1
1986	2624	366	2990	308	54	362	1

Year of Manufacture and Market Group	No. of uninjured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of involved drivers in NSW (87-2000) and QLD,WA (91-2000)	No. of injured (but not severely) drivers in NSW and Victoria (87-2000) and QLD,WA (91-2000)	No. of severely injured drivers in NSW and Victoria (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW, Victoria (87-2000) and QLD, WA (91-2000)	Analysis Inclusion Criteria INV=100 INJ=20
1987	2099	316	2415	273	54	327	1
1988	3200	528	3728	451	85	536	1
1989	3708	623	4331	548	104	652	1
1990	3252	524	3776	472	107	579	1
1991	2572	418	2990	364	70	434	1
1992	2179	346	2525	310	46	356	1
1993	846	140	986	115	27	142	1
1994	891	150	1041	118	24	142	1
1995	741	163	904	125	21	146	1
1996	579	100	679	93	19	112	1
1997	544	116	660	99	19	118	1
1998	529	100	629	99	23	122	1
1999	295	58	353	56	13	69	1
2000	95	20	115	29	7	36	1
Passenger Vans							
1982	189	37	226	26	7	33	1
1983	534	95	629	68	17	85	1
1984	566	116	682	86	10	96	1
1985	461	96	557	73	11	84	1
1986	238	49	287	40	9	49	1
1987	163	29	192	26	5	31	1
1988	276	45	321	32	8	40	1
1989	378	68	446	56	15	71	1
1990	217	50	267	44	5	49	1
1991	245	53	298	44	9	53	1
1992	291	45	336	39	4	43	1
1993	227	48	275	40	4	44	1
1994	229	71	300	52	11	63	1
1995	149	29	178	23	3	26	1
1996	136	24	160	21	4	25	1
1997	161	38	199	31	8	39	1
1998	109	26	135	20	6	26	1
1999	65	18	83	13	2	15	0
2000	16	6	22	2	0	2	0
Small							
1982	5186	660	5846	594	88	682	1
1983	5269	650	5919	573	77	650	1
1984	6315	807	7122	698	118	816	1
1985	5582	736	6318	604	94	698	1
1986	5925	757	6682	664	95	759	1
1987	4154	512	4666	447	58	505	1
1988	6271	829	7100	668	113	781	1
1989	5973	825	6798	728	118	846	1
1990	5891	825	6716	702	140	842	1
1991	6213	869	7082	774	113	887	1
1992	6539	919	7458	784	137	921	1
1993	6347	870	7217	755	112	867	1

Year of Manufacture and Market Group	No. of uninjured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW (87-2000) and QLD, WA (91-2000)	No. of involved drivers in NSW (87-2000) and QLD,WA (91-2000)	No. of injured (but not severely) drivers in NSW and Victoria (87-2000) and QLD,WA (91-2000)	No. of severely injured drivers in NSW and Victoria (87-2000) and QLD, WA (91-2000)	No. of injured drivers in NSW, Victoria (87-2000) and QLD, WA (91-2000)	Analysis Inclusion Criteria INV=100 INJ=20
1994	5630	737	6367	649	102	751	1
1995	6165	889	7054	754	143	897	1
1996	4719	668	5387	579	87	666	1
1997	4709	705	5414	649	104	753	1
1998	3739	598	4337	501	104	605	1
1999	1634	289	1923	259	54	313	1
2000	501	96	597	88	20	108	1
Sports							
1982	520	69	589	58	9	67	1
1983	447	62	509	53	7	60	1
1984	398	78	476	52	13	65	1
1985	387	82	469	70	6	76	1
1986	449	66	515	51	19	70	1
1987	335	35	370	33	3	36	1
1988	490	71	561	56	5	61	1
1989	518	75	593	70	21	91	1
1990	665	97	762	84	19	103	1
1991	430	57	487	64	13	77	1
1992	504	79	583	67	21	88	1
1993	360	51	411	46	10	56	1
1994	292	44	336	49	4	53	1
1995	184	35	219	29	6	35	1
1996	222	30	252	26	6	32	1
1997	203	29	232	26	7	33	1
1998	122	17	139	15	2	17	0
1999	55	10	65	9	1	10	0
2000	18	6	24	7	1	8	0
Reference Group	52941	9753	62694	11207	2369	13576	
Total (Included/criteria=1)	363931 (363587)	61815 (61737)	425746 (425324)	56706 (56640)	11268 (11260)	67974 (67900)	146

Note :

1. Shaded market groups and years not included in the analysis due to insufficient data
2. NSW injury severity data for 1999 and 2000 was not included in the analysis because of changes in injury severity coding that resulted in inaccurate injury severity reporting
3. Uninjured driver records for Victoria are incomplete as only crashes involving injury are reliably reported and hence Victorian data is not included in the injury risk analysis.

**AGGRESSIVITY, INJURY RISK AND INJURY SEVERITY ESTIMATES BY YEAR
OF VEHICLE MANUFACTURE AND MARKET GROUP**

AGGRESSIVITY BY YEAR OF VEHICLE MANUFACTURE BY MARKET GROUP

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
Four Wheel Drives						
1982	20.00	25.14	5.03	3.57	7.08	3.51
1983	17.74	16.68	2.96	1.99	4.40	2.41
1984	16.63	20.18	3.36	2.47	4.56	2.08
1985	18.12	21.06	3.81	3.00	4.86	1.86
1986	18.55	22.52	4.18	3.10	5.62	2.52
1987	18.27	16.47	3.01	1.97	4.59	2.61
1988	18.36	21.90	4.02	3.12	5.19	2.07
1989	18.12	16.91	3.06	2.40	3.91	1.50
1990	17.38	18.95	3.29	2.61	4.16	1.55
1991	17.59	17.64	3.10	2.34	4.11	1.77
1992	18.15	21.39	3.88	3.10	4.87	1.77
1993	15.90	18.90	3.01	2.33	3.87	1.54
1994	16.21	19.98	3.24	2.53	4.15	1.62
1995	17.59	17.08	3.00	2.23	4.05	1.82
1996	18.06	15.70	2.84	2.09	3.85	1.76
1997	17.64	16.13	2.84	2.08	3.89	1.82
1998	17.44	19.31	3.37	2.50	4.54	2.04
1999	16.99	15.98	2.72	1.82	4.06	2.24
2000	16.21	22.40	3.63	1.82	7.25	5.43
Commercial						
1982	18.17	16.90	3.07	2.12	4.45	2.33
1983	18.38	9.75	1.79	1.06	3.03	1.97
1984	16.87	11.73	1.98	1.32	2.96	1.64
1985	17.59	21.17	3.72	2.76	5.02	2.26
1986	16.93	14.74	2.50	1.75	3.57	1.82
1987	14.73	20.41	3.01	2.14	4.23	2.09
1988	16.42	17.85	2.93	2.15	3.99	1.83
1989	15.04	19.60	2.95	2.24	3.89	1.65
1990	18.07	21.49	3.88	2.95	5.12	2.17
1991	16.24	14.33	2.33	1.61	3.36	1.75
1992	16.59	21.89	3.63	2.71	4.86	2.15
1993	15.59	14.77	2.30	1.61	3.30	1.69
1994	17.06	14.88	2.54	1.82	3.54	1.72
1995	16.77	19.99	3.35	2.47	4.56	2.09
1996	18.40	19.22	3.54	2.61	4.79	2.18
1997	14.91	20.80	3.10	2.21	4.35	2.15
1998	16.58	18.74	3.11	2.15	4.49	2.34
1999	15.76	15.81	2.49	1.48	4.18	2.70
2000	22.65	11.39	2.58	1.07	6.25	5.18
Large						
1982	15.26	15.33	2.34	1.94	2.81	0.87
1983	15.68	19.71	3.09	2.58	3.70	1.12
1984	14.36	15.36	2.21	1.86	2.62	0.76
1985	14.16	18.87	2.67	2.33	3.07	0.74

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
1986	14.58	17.24	2.51	2.18	2.90	0.71
1987	13.94	16.62	2.32	2.01	2.67	0.66
1988	14.47	17.21	2.49	2.18	2.84	0.66
1989	13.82	18.09	2.50	2.23	2.81	0.58
1990	13.86	17.28	2.40	2.10	2.73	0.63
1991	14.63	17.06	2.50	2.16	2.88	0.72
1992	14.26	17.59	2.51	2.19	2.88	0.69
1993	14.77	17.52	2.59	2.28	2.94	0.66
1994	15.04	17.40	2.62	2.32	2.95	0.63
1995	13.85	18.01	2.49	2.18	2.86	0.68
1996	14.73	17.35	2.56	2.21	2.96	0.75
1997	13.87	17.69	2.45	2.08	2.90	0.82
1998	15.15	16.29	2.47	2.06	2.96	0.90
1999	15.39	17.12	2.63	2.08	3.33	1.25
2000	16.29	15.68	2.56	1.66	3.93	2.26
Luxury						
1982	14.07	17.81	2.51	1.77	3.54	1.77
1983	13.69	18.28	2.50	1.69	3.71	2.02
1984	15.05	15.84	2.38	1.65	3.44	1.80
1985	13.90	18.40	2.56	1.85	3.53	1.68
1986	12.01	11.05	1.33	0.78	2.27	1.49
1987	14.33	15.14	2.17	1.35	3.48	2.13
1988	13.64	18.35	2.50	1.72	3.64	1.92
1989	13.42	17.55	2.35	1.74	3.19	1.45
1990	12.03	15.41	1.85	1.31	2.63	1.32
1991	15.72	18.84	2.96	2.03	4.32	2.29
1992	11.70	23.02	2.69	1.92	3.77	1.85
1993	13.29	14.71	1.96	1.25	3.06	1.81
1994	13.05	17.53	2.29	1.60	3.26	1.66
1995	14.86	18.42	2.74	1.92	3.89	1.97
1996	13.80	11.70	1.62	0.97	2.70	1.73
1997	12.63	23.14	2.92	1.94	4.41	2.47
1998	14.09	21.54	3.03	1.92	4.79	2.86
1999	11.79	8.25	0.97	0.32	3.00	2.68
Medium						
1982	12.33	12.08	1.49	1.20	1.85	0.66
1983	13.20	16.87	2.23	1.85	2.69	0.84
1984	11.87	14.44	1.71	1.40	2.11	0.71
1985	12.88	16.13	2.08	1.70	2.54	0.84
1986	12.42	14.99	1.86	1.42	2.44	1.03
1987	13.23	16.20	2.14	1.63	2.82	1.19
1988	14.13	16.36	2.31	1.86	2.87	1.01
1989	14.02	16.86	2.36	1.94	2.88	0.93
1990	13.46	18.22	2.45	2.01	2.99	0.97
1991	13.73	16.98	2.33	1.84	2.96	1.12
1992	13.25	13.38	1.77	1.32	2.38	1.05
1993	12.40	17.87	2.22	1.51	3.25	1.74
1994	12.58	15.23	1.92	1.27	2.88	1.61
1995	15.53	13.15	2.04	1.32	3.15	1.83
1996	12.35	15.14	1.87	1.17	2.98	1.81

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
1997	14.74	14.68	2.16	1.37	3.42	2.06
1998	13.77	19.37	2.67	1.75	4.07	2.32
1999	13.22	17.75	2.35	1.33	4.13	2.80
2000	12.61	17.13	2.16	0.96	4.87	3.92
Passenger Vans						
1982	16.77	19.72	3.31	1.57	6.98	5.41
1983	15.78	23.04	3.64	2.30	5.74	3.44
1984	17.21	10.73	1.85	1.00	3.42	2.42
1985	18.10	12.91	2.34	1.30	4.20	2.90
1986	17.42	20.88	3.64	1.93	6.85	4.92
1987	15.13	18.57	2.81	1.20	6.60	5.40
1988	13.88	19.70	2.73	1.38	5.43	4.06
1989	14.93	21.95	3.28	1.98	5.43	3.45
1990	17.16	10.05	1.73	0.72	4.13	3.41
1991	16.88	17.04	2.88	1.50	5.53	4.03
1992	12.36	8.71	1.08	0.40	2.91	2.51
1993	16.03	8.60	1.38	0.51	3.70	3.19
1994	22.03	17.40	3.83	2.13	6.90	4.77
1995	15.21	10.73	1.63	0.53	5.05	4.52
1996	13.49	14.15	1.91	0.70	5.20	4.50
1997	16.62	20.08	3.34	1.66	6.70	5.04
1998	16.48	20.11	3.31	1.44	7.63	6.19
Small						
1982	11.53	13.40	1.55	1.25	1.91	0.67
1983	11.11	12.35	1.37	1.09	1.73	0.64
1984	11.27	15.03	1.69	1.41	2.04	0.63
1985	11.49	14.08	1.62	1.32	1.99	0.67
1986	11.35	13.52	1.53	1.25	1.88	0.63
1987	10.87	12.26	1.33	1.03	1.73	0.70
1988	11.32	16.40	1.86	1.54	2.24	0.69
1989	11.47	14.51	1.66	1.38	2.00	0.62
1990	11.67	17.99	2.10	1.77	2.48	0.71
1991	11.48	13.01	1.49	1.24	1.81	0.57
1992	11.47	16.41	1.88	1.59	2.23	0.64
1993	11.23	13.66	1.53	1.27	1.85	0.59
1994	10.78	14.45	1.56	1.28	1.90	0.62
1995	11.66	16.69	1.95	1.65	2.30	0.66
1996	11.33	13.32	1.51	1.22	1.87	0.65
1997	11.55	14.17	1.64	1.34	1.99	0.65
1998	11.57	17.56	2.03	1.67	2.48	0.81
1999	11.62	16.61	1.93	1.46	2.54	1.08
2000	12.72	17.24	2.19	1.39	3.45	2.06
Sports						
1982	12.08	17.08	2.06	1.10	3.87	2.77
1983	12.52	11.17	1.40	0.66	2.95	2.29
1984	16.68	22.78	3.80	2.26	6.40	4.14
1985	18.21	8.06	1.47	0.66	3.27	2.61
1986	13.15	26.20	3.45	2.17	5.46	3.29
1987	9.64	8.18	0.79	0.25	2.49	2.24
1988	12.81	8.17	1.05	0.44	2.50	2.07

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
1989	13.05	22.71	2.96	1.90	4.62	2.71
1990	12.73	18.76	2.39	1.51	3.77	2.26
1991	11.28	16.64	1.88	1.07	3.29	2.22
1992	13.17	24.05	3.17	2.05	4.89	2.84
1993	12.26	19.13	2.35	1.26	4.36	3.09
1994	12.30	7.09	0.87	0.32	2.35	2.03
1995	15.83	17.18	2.72	1.23	6.03	4.80
1996	11.41	19.83	2.26	1.02	5.01	3.99
1997	11.71	20.70	2.42	1.14	5.15	4.01