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The Influence of Vehicle Characteristics on the Braking Behaviour of Young People as Measured Using Telematics

James Boylan^{1a}, Won Sun Chen², Denny Meyer³

¹ Department of Health Sciences, Swinburne University of Technology, ² Faculty of Health Sciences, Curtin University, ³ Department of Health Sciences and Biostatistics, Swinburne University of Technology

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Abstract

Road traffic crash outcomes for young drivers are worse compared to more experienced drivers, with crashes accounting for 1 in 5 deaths for people aged 15–24 years in Australia. However, the choice of motor vehicle and how they influence driving behaviour and driving outcomes is relatively unknown for young drivers. The aim of this study was to determine the influence of vehicle characteristics on the driving behaviour of young drivers while also considering demographic characteristics. A sample of 35 young drivers used in-vehicle telematics to record their driving behaviour over one month. The numbers of harsh braking events were recorded for each trip and vehicle characteristics were compared across demographic characteristics. Linear mixed models (LMM) were then used to determine whether vehicle characteristics (vehicle weight, engine power, model year and vehicle safety ratings) had significant relationships with braking behaviour, when the demographic characteristics and trip length were controlled for. The LMM indicated that vehicles with higher engine power and vehicles with a higher safety rating were associated with a lower number of harsh braking events. Vehicle characteristics differed significantly across genders. However, the inclusion of demographic variables in the above braking behaviour models failed to improve their fit. Driving behaviour models using in-vehicle telematics data typically include demographic variables. The results of this study highlight the value of including vehicle characteristic variables in understanding the braking performance of young drivers, suggesting that these variables should be considered in future driving behaviour analyses.

Key findings

- Young drivers should be incentivised to drive motor vehicles with higher safety ratings
- No major differences in braking behaviour were found between males and females
- Vehicles with higher engine power and safety ratings had better braking performance
- Vehicle characteristics should be considered in future driving behaviour research

Introduction

Young drivers are among the most overrepresented group in road traffic deaths. Road safety outcomes for these and other drivers have not improved in recent years leading to worldwide concern. Road crashes account for 1 in 5 deaths for people aged between 15 and 24 years in Australia, and

those with probationary licences have more crashes compared to other road users (VicRoads, 2023a). Möller et al. (2021) suggested that novice drivers, especially novice drivers who are young, experience injuries and death in road traffic collisions at a rate of close to double the rest of the population. Inexperience, a higher level of risk acceptance, sensation seeking, and underestimation of risk are among the factors contributing to these statistics (Hassan & Ab-

a Corresponding author: James Boylan, jboylan@swin.edu.au

del-Aty, 2013). While the effects of demographic characteristics on driving behaviour have been investigated, it is also important to understand to what extent motor vehicle characteristics influence young people's driving behaviour to determine how best to address this problem.

The influence of motor vehicle attributes on driving behaviour is relatively unknown as few studies have investigated these relationships. There are wide variations in motor vehicle characteristics including physical dimensions, power to weight ratio and other vehicle characteristics (Maurya & Bokare, 2012). Older vehicles are overrepresented in fatal vehicle crashes (Department for Infrastructure and Transport South Australia, 2018), as the vehicle cabins of older vehicles are less protective of occupants compared to more modern vehicles. Ryb et al. (2009) found that front seat occupants in newer vehicles are more likely to survive a crash compared to front seat occupants in older vehicles. It has also been reported that vehicles with lower power to weight ratio take less time to complete braking manoeuvres (Bokare & Maurya, 2017), suggesting that such vehicles allow safer braking.

The vehicle choices of young drivers and the factors driving these decisions have been well documented. Keall and Newstead (2011) determined that the price of a vehicle and the cost of running the vehicle were key factors in the vehicle choices of groups with low restricted income. Compared to older drivers, young drivers were more likely to use smaller, older and less safe vehicles (Eichelberger et al., 2015). The Victorian government in Australia recently implemented the Unsafe2safe initiative to promote the purchase of newer and safer vehicles by younger drivers but many young drivers are unable to afford these vehicles (VicRoads, 2023b).

With one of the most at-risk driving populations being more likely to drive in older and less safe vehicles, further investigation was warranted to determine whether the increased crash rate in this population is influenced by the attributes of the vehicles they drive. In particular, whether vehicle characteristics (vehicle safety features, power, weight, age) increase the variability of young drivers' behaviours. Investigation of the potential effects required an accurate method for measuring driving behaviour.

In-vehicle telematics and its applications have rapidly improved in the last decade. These devices can be used to infer information about a vehicle and the driver by extracting data from internal vehicle sensors in real-time (Girma et al., 2019). In-vehicle telematics are typically used to measure braking, acceleration, turning and speeding behaviours. The devices remove the need for an observer to record behaviour, increasing the likelihood of natural driving behaviour by study participants in complex real world situations, not available in other driving data collection methods (e.g., driving simulators).

At the policy level, the Australian government has taken an interest in in-vehicle telematics with the implementation of the National Telematics Framework (Transport Certification Australia, 2021). Internationally, insurance companies are using in-vehicle telematics to assist in the pricing of insurance premiums for their customers.

Previous research used in-vehicle telematics to measure the effect of various influencing factors on driving behaviour. Stevenson et al. (2021) used in-vehicle telematics to determine whether feedback and incentives improved driving performance. For harsh braking behaviour, no significant differences were found between the control group and either the feedback group or the feedback plus incentives group, though the results trended positively. They did, however, find significantly greater improvements in driving behaviour as measured by a driving score in drivers that received both feedback and incentives compared to drivers that did not. These promising findings are reinforced by the results of the Young Driver Telematics Trial (NSW Insurance Regulatory Authority, 2019), which reported better braking behaviour, acceleration behaviour, and speeding behaviour for drivers who received immediate feedback from an in-vehicle telematics device.

Researchers have often narrowed the scope of their driving behaviour studies to demographic and locational variables, to overcome the challenges with collecting all-encompassing data on diverse populations (McCarty & Kim, 2024). This has meant that other important variables, such as vehicle characteristics, have not been included. There is a limited number of studies that investigated the impact of vehicle characteristics on crashes (Wu et al., 2020). This is surprising given that vehicle insurance pricing models allow for the effects of vehicle characteristic variables, including vehicle age and engine power (Verbelen et al., 2018).

The aim in this paper was to use in-vehicle telematics data to determine the influence of vehicle attributes (e.g., model year, vehicle engine power, weight, safety rating) on braking behaviours in young drivers and, to what extent demographic characteristics improve the accuracy of models that use only vehicle characteristics to predict these driving behaviours.

Methods

This was a mixed method study of young drivers that included three stages: questionnaires; naturalistic driving study using in-vehicle telematics, and an exit interview (optional).

Recruitment

Participants aged between 19 and 28 years who owned their own vehicle were recruited between March and December in 2022. Facebook advertising and convenience sampling were used to recruit the sample. The stated purpose of the study was "To better understand the driving behaviour of young drivers". Posters advertising the study were also placed at Swinburne University (Hawthorn campus). Participants were permitted to keep the in-vehicle telematics device for their personal use at the end of the study as an incentive to join.



Figure 1. GOFAR device and mobile application (GOFAR, 2023)

Questionnaires

Participants completed a questionnaire at the beginning of the study including previous experience in crashes since obtaining their licence. A modified version of the Driving Behaviour Questionnaire (DBQ) was included in the questionnaire (Reason et al., 1990).

Naturalistic driving study using in-vehicle telematics

A GOFAR in-vehicle telematics device was inserted in each of the study participants' motor vehicle and study data was recorded for one month (Figure 1). The study followed a naturalistic observational design as there was no researcher present while participants were driving. Detailed instructions regarding the app usage were provided to the participants when the device was installed. Participants were able to receive feedback after each trip from the mobile application. However it is not possible to determine how often the participants accessed this feedback.

The GOFAR telematics device did introduce a limitation to the motor vehicles that could be included. The device was only compatible with cars manufactured from 2006. Therefore, any potential participants driving an earlier model car were excluded from the study.

Participants drove with the in-vehicle telematics device for a period of one month. Driving data were recorded by the GOFAR company and the summarised trip data were transferred to the researchers at the end of the study period. The data were then cleaned and analysed using IBM SPSS Statistics version 29 (IBM Corp, 2023). A two-sided p -value of <0.05 was considered significant for all tests.

Exit interviews

Participants were also invited to complete an optional interview at the end of the study. In the interview, participants were asked about their perceptions toward the in-vehicle telematics device.

Data analysis

Two datasets were used in the study. The first included all trips observed in the study, with a separate row for each trip for each participant including trip distance and the number of harsh braking events for each trip. Trips shorter than 1km were excluded from the dataset. The second dataset included data for each participant, including both demographic and vehicle data.

The measure of driving behaviour investigated was the number of harsh braking events for each trip. Typically, a deceleration threshold of 0.3 g-force (g) is used to determine a harsh braking event (Meuleners et al., 2023). For this study, harsh braking events were defined as incidents where the participant decelerated at a rate greater than 0.2 g to provide greater sensitivity. Previous research has associated harsh braking events with unsafe driving behaviour and can occur due to driver inattentiveness, driving at high speeds, failure to leave adequate following distances and other unsafe behaviour indicators (Kontaxi et al., 2021).

Variables describing motor vehicle traits (i.e., engine power, weight) were obtained from the CarsGuide website (CarsGuide, 2023). Vehicle model year was obtained from the participants via data recorded in the GOFAR device. The vehicle safety variable was computed using the Australian New Car Assessment Program ratings (ANCAP, 2023). Previously the ANCAP ratings scored each vehicle out of a total of 37. However, the current rating system uses 4 scales. To ensure consistency with the previous rating system, the participant's vehicle score in each of the 4 scales were combined to a total score, which was converted to a percentage of the maximum score possible and this percentage was then used to calculate the safety rating score out of 37.

Demographic variables which included age, gender, licence type (probationary or full) were also used in the modelling. Gender was reported as male or female as the participants only selected those two options. Socio-economic status was not included as a demographic variable.

An initial descriptive analysis was conducted to investigate the relationships between the demographic and vehicle characteristics using Mann-Whitney tests and correlations. Linear Mixed Models (LMM) were then used to analyse the data due to the correlated structure of the telematics data, with multiple trips for each driver. These models were fitted for the number of braking events with the rate of deceleration exceeding a threshold of 0.2g. Trip distances were controlled for in all models. Gamma Generalised Linear Mixed Models (GLMM) were used to model the number of harsh braking events as the number of harsh braking events had a Gamma distribution.

Initially, vehicle and demographic models were created, consisting of only vehicle variables and then demographic variables respectively. Vehicle variables and demographics

were then included together (combined model). Bayesian Information Criteria (BIC) were used to compare the goodness of fit for the various models. These values are typically used to compare LMM, with lower BIC values indicating a better model fit. An analysis including the trips with no harsh braking events and allowing for a Tweedie distribution produced the same conclusions, but with substantially higher BIC values. Vehicle weight was converted to weight per 100kg for the models so that appropriate parameter estimates could be obtained.

Results

In total, 35 people participated in the study and recorded a total of 2,774 trips over 37,010 kilometres including 42,954 harsh braking events.

The baseline questionnaire results showed that over half of the drivers ($n=19/36$, 54.2%), had been involved in a crash since obtaining their licence. Responses to DBQ violations subscales indicated study participants rarely committed traffic infringements (mean violation score = 14.75 out of a maximum score of 55).

All participants lived in Victoria, Australia. All but one participant lived in postcodes with a Socio-Economic Indexes for Areas (SEIFA) score above the 50th percentile. Additionally, only 4 participants lived in postal codes with centroids more than 20km from the centre of Melbourne. Due to the lack of variation in socio-economic status, the variable was not included in the analysis. The distribution of the SEIFA Advantage and Disadvantages (ABS, 2021) rankings, that is the home postcodes for the participants were: 2.86 percent were lower than the 6th decile; 8.57 percent in the 6th decile; 28.57 percent in the 7th decile; 31.43 percent in the 8th decile, 14.29 percent in the 9th decile, and 11.43 percent in the 10th decile. One participant did not provide their postcode.

The study sample consisted of mostly urban drivers as the majority (88%) resided in postal codes with centroids within 20km from the centre of Melbourne. The other participants (12%) resided within 31km of the centre of Melbourne. Additionally, it was assumed that young people are often still living with their families, and for those people, their postcode reflects their family's socio-economic status rather than their own.

The exit interview was completed by 21 (60%) of participants. Of those participants, 16 reported that the in-vehicle telematics device had a positive effect on their driving behaviour, with safer braking and acceleration behaviours, slower driving, and more cautious driving among the changes mentioned by the participants.

Relationship between demographic and vehicle characteristics

The sample included 17 males and 18 females. The average age of these participants was 23.92 years (range: 19-28 years). There were 9 drivers with probationary licences (female: 55.6%; male: 44.4%) and 26 drivers were fully licensed (female: 50.0%; male: 50.0%). Vehicle model years

ranged from 2006 to 2022. Vehicle weight ranged from 890kg to 2,260kg, engine power ranged from 57 to 270 kilowatts and the ANCAP safety ratings ranged from 22 to 37 out of 37. There was an average of 79.26 (SD 37.88) trips for each participant, an average of 15.48 braking events exceeding the -0.2g threshold in each trip and an average trip distance of 13.34km (SD 18.94). During the study period, participants' average recorded travel distance was 1,057.45km (SD 587.75).

This analysis only included trips with a harsh braking event. Trips without a harsh braking event ($n=276$) were excluded from the dataset prior to analysis. Six participants accounted for 80 percent of the excluded trips. The exclusion allowed for a Gamma distribution to be assumed.

[Tables 1](#) shows to what extent gender and licensing were related to vehicle characteristics. Comparisons by gender showed that compared to females, male drivers owned heavier vehicles with higher engine power. No significant differences were found in the characteristics of the vehicles owned by licence type (probationary licence compared to full licence). Spearman's rank correlations were computed to assess the relationships between the vehicle characteristic variables. There was a moderate positive correlation between vehicle weight and vehicle engine power ($r=0.607$, $p<.001$) and between safety rating and model year ($r=0.634$, $p<.001$). But there was no significant correlation between safety rating and vehicle weight ($r=-0.160$, $p=0.687$). There were no significant correlations between any of the vehicle characteristic variables and driver age.

Based on the sample of 2,774 trips from 35 participants (average of 79 trips per participant) and an intra-cluster correlation (ICC) of 0.163, the effective sample size was adjusted to 200 trips. Power analysis using G*Power indicated that with 80 percent power and a two-tailed alpha level of 0.05, the minimum detectable effect size is a point biserial correlation of 0.195.

GLMM models

A GLMM using only gender as a predictor showed that there was no significant difference ($F(1, 2.772) = 1.847$, $p=.174$) in the number of harsh braking events per 100km between males (Mean 189.79, SD= 177.52) and females (Mean = 210.61, SD = 174.55). There was also no significant difference in braking events per 100km ($F(1, 2.772)=.049$, $p=.825$) between fully licensed drivers (Mean= 200.87, SD= 181.44) and probationary licensed drivers (Mean =194.87, SD=154.63) in a GLMM using only licence type as a predictor. Finally, a GLMM was conducted using gender as the only predictor variable to determine whether there were significant differences in driving distance between males (Mean=15.49, SD=19.27) and females (Mean=10.97, SD =18.29), with males having longer trips on average ($F(1, 2.772) = 5.819$, $p=.016$).

[Table 2](#) shows the harsh braking events models and none of the demographic variables are statistically significant. Vehicle engine power was significant in both the vehicle characteristic model and the combined model. Vehicles with higher engine power had a lower number of harsh braking events on average. Engine power had a slightly re-

Table 1. Participant gender and licensing relationships with vehicle characteristics

Participant characteristics		Vehicle characteristics											
		Model/Year			Weight (kg)			Engine power (kw)			Safety		
		Mean	Std. Deviation	Mann-Whitney Z statistic	Mean	Std. Deviation	Mann-Whitney Z statistic	Mean	Std. Deviation	Mann-Whitney Z statistic	Mean	Std. Deviation	Mann-Whitney Z statistic
Gender	Male, n=17	2012.94	5.12	0.199	1519.76	312.11	-2.988**	127.47	32.94	-2.907**	33.21	4.07	0.925
	Female, n=18	2013.55	4.84		1248.22	160.01		96.77	21.23		33.25	3.29	
	Total, n=35	2013.25	4.91		1380.11	278.57		111.68	31.28		32.74	3.67	
Licence type	Probationary, n=9	2012.44	4.82	0.625	1258.33	195.89	1.567	99.77	28.41	1.341	33.21	2.35	0.434
	Full, n=26	2013.53	5.01		1422.26	293.38		115.80	31.68		32.58	4.06	

*** indicates a p-value of <.001, ** a p-value < .01 and * a p-value < .05

Table 2. Generalised Linear Mixed Model for harsh braking events with deceleration of more than 0.2g

Participant characteristics		Demographic model		Vehicle model		Combined model	
		Exp(B)	95% confidence intervals	Exp(B)	95% confidence intervals	Exp(B)	95% confidence intervals
Licence type	Probationary	1.101	0.738-1.642			1.111	0.731-1.690
	Full						
Gender	Male	1.033	0.821-1.299			1.135	0.876-1.470
	Female						
Motor vehicle characteristics							
Age		0.967	0.821-1.299			0.975	0.899-1.058
Model year				1.008	0.981-1.034	1.013	0.986-1.040
Weight				1.030	0.982-1.080	1.020	0.962-1.082
Engine power				0.993**	0.989-0.998	0.994**	0.989-0.998
Safety Rating				0.962*	0.929-0.997	0.958*	0.925-0.993
Distance		1.029***	1.027-1.031	1.029***	1.028-1.030	1.029***	1.028-1.030
BIC		5,115.26		5,123.10		5,131.05	

*** indicates a p-value of <.001, ** a p-value < .01 and * a p-value < .05

duced effect in the combined model, perhaps due to the relationship between gender and engine power. Vehicle safety rating was significant in both the vehicle model and the combined model. Vehicles that had a higher safety rating had a lower number of harsh braking events on average. In all the models trip distance was significant with a longer trip distance associated with a larger number of harsh braking events. This was expected as there is more time in longer trips for the experience of harsh braking events.

The BIC value of the combined model was higher compared to the vehicle model and the demographic model, suggesting a worse model fit in the combined model although the differences were small.

Discussion

This study has identified that the most important motor vehicle characteristics for predicting braking behaviour among young drivers are engine power and vehicle safety rating. On average, fewer harsh braking events were recorded for those vehicles with higher engine power as well as vehicles with higher safety ratings. No demographic variables were significant in any of the models. However, there are differences in vehicle preference between different driver groups (Keall & Newstead, 2011), and this study has found significant gender differences with young males driving heavier and more powerful vehicles.

The relationship between demographics and driving outcomes is so strong that, before the introduction of usage-based insurance, insurers would only use demographics and driving experience to set insurance premiums for their customers (Ben-Shahar, 2023). While there have been few studies regarding the effects of vehicle characteristics on driving behaviour, there has been investigation into demographic differences in vehicle usage and driving performance. Cubells et al. (2020) found that females drive

for shorter durations and on fewer occasions. This is reflected in our data as the males tended to have longer trip distances compared to females. Demographic variables such as gender and age have previously been found to influence driving behaviours. Males are consistently found to have worse driving outcomes compared to females and novice drivers are more frequently involved in traffic collisions compared to other age groups (Cordellieri et al., 2016). However, Ayuso et al. (2016) investigated differences in crash risk between male and female drivers using data collected from in-vehicle telematics and found that while gender was a significant predictor for explaining time to first crash, this effect was no longer significant when average distance driven per day was included in the model. Similarly, in our data, there were no significant differences in harsh braking events between males and females.

The vehicles with higher safety ratings in our sample also tended to be vehicles with a more recent model year and this may explain why vehicle model year was not significant in the braking models. Osthöver et al. (2024) noted that the time taken to complete a braking manoeuvre is trending downwards as newer vehicles are released. A vehicle's technology assisted braking capability to avoid collisions is also considered in the ANCAP vehicle safety ratings (ANCAP, 2024), so improved braking performance in vehicles with higher safety ratings should be expected.

ANCAP safety ratings were also used by Oviedo-Trespalacios and Scott-Parker (2018) to determine whether vehicle safety influenced the driving behaviour of young people. They found no differences in the driving behaviours of drivers of vehicles with a low/medium safety rating compared to drivers of vehicles with a high safety rating. They did, however, find better driving behaviour for drivers of low/medium safety rated cars compared to drivers of vehicles with no safety rating. These authors also found that older vehicles were associated with increased risky driving

behaviour, though no such results were found in the present study.

Vehicles with a higher engine power having fewer harsh braking events was an unexpected result given the restrictions on engine power imposed on young drivers by lawmakers in various countries. In Victoria, Australia, drivers with probationary licences are not permitted to drive vehicles exceeding a power to weight ratio of 130 kilowatts per tonne (VicRoads, 2024), well above the maximum power to weight ratio seen in the current study. All of the study participants, both probational and fully licensed, owned vehicles within the power to weight ratio restriction for Victorian probationary drivers. Ayazi et al. (2020) found that vehicles with higher engine power were safer to drive, with increases in engine power relating to decreases in crash severity. However, there is currently no consensus on the influence of engine power on driving behaviour. McCart and Hu (2017) found that drivers of vehicles with greater engine power were more likely to exceed road speed limits. Keall and Newstead (2013) suggested that the value of these restrictions may be limited due to the rarity of vehicles exceeding the restrictions in the vehicle fleet, and this study confirms their finding.

In our sample, more powerful vehicles tended to be heavier vehicles, and this may explain why vehicle weight was not significant in any model. Typically, larger vehicles have wider tyres that reduce a vehicle's braking distance and increase a vehicle's stability (J.D. Power, 2022). This is caused by an increase in traction due to the larger surface area of wider tyres (Jones & Childers, 2001). Further, the width of the tyres assists the braking performance of larger vehicles that have room for larger disk brakes on all wheels in the vehicle whereas smaller cars often contain a combination of disk brakes and drum brakes (Cars24, 2024). Increasing the radius of brake discs can improve braking performance (CarThrottle, 2015), and along with the wider tyres fitted in larger vehicles, may improve the overall braking performance of these vehicles.

While vehicle weight was not a significant predictor of the number of harsh braking events, other studies found that drivers behaved differently in vehicles of varying sizes. A driving simulator study conducted by Claus and Warlop (2022) found that when their participants believed they were driving a larger vehicle, they exhibited more intense and risky driving behaviour, with acceleration behaviour having a significantly higher intensity in the larger car compared to the smaller car. Braking behaviour also trended in this direction, though it was not statistically significant. The researchers proposed the "car cushion" hypothesis, which suggested that bigger cars provide a greater sense of security and control which leads to more risk taking while driving. Wenzel and Ross (2005) found that drivers of smaller vehicles were more likely to suffer a fatality in road traffic collisions and noted that risk appeared to increase as the mass of the vehicles decreases. Similarly, Høye (2019) found that a 100kg increase in mass decreases risk of death to the driver of a vehicle involved in a crash by 4.9 percent on average.

Strengths, limitations, and future research

The study's strength lies in its collection of driving data using in-vehicle telematics. Without a researcher present, more naturalistic behaviours were captured. Further, the *in situ* device recorded real world behaviour that are difficult to replicate in driving simulators.

This study had some limitations that could be addressed in future research. Firstly, the present study focused on only one aspect of driving behaviour. While braking behaviour is an important measure of driving performance, other aspects that can be measured by in-vehicle telematics should be considered in future studies, such as speeding which is a significant contributor to crash risk for young drivers (Ivers et al., 2009). The small sample size is also a limitation and the results of the study should be confirmed by future research with a larger sample size. In particular, no regional drivers were included in the sample and the high traffic density in Melbourne may have influenced the generalisability of the results. While participants were required to own their own vehicles, there was no way to determine if other people (e.g., friends, family) drove the participant's vehicle during data collection. It was also not possible to determine how much influence the mobile application linked to the in-vehicle telematics device had on the braking behaviours of the participants as they were able to access driving feedback. We were also unable to account for the influence of the purpose of each trip and the location of each trip. These variables may have influenced the results as the participant's motivation to drive may have influenced their choice of vehicle. Additionally, the geographical location of each trip may have influenced the braking behaviour exhibited during the trip.

Future research should consider the geographic nature of each trip. It is possible that areas with steep inclines or declines could contribute to adverse braking behaviours that are not due to driver error. Further research is also required to obtain a deeper understanding of the way in which other demographic factors, such as whether the driver lives in an urban or rural area, relate to vehicle characteristics when investigating braking behaviour. In addition, our results regarding the positive impacts of higher vehicle engine power on braking behaviour need to be validated in further studies.

Conclusion

The key finding of this study is young drivers of vehicles with a higher engine power had better braking performance, having fewer harsh braking events on average. Driving behaviour models using in-vehicle telematics data typically include demographic variables. However, this study highlights the value of considering vehicle characteristics to understand the braking performance of young drivers. Findings suggest that the characteristics of vehicles with higher engine power, perhaps relating to tyre width and type of braking system, may have a beneficial impact on braking behaviour. Vehicles with a higher ANCAP safety rating also had fewer harsh braking events on average, sug-

gesting that the vehicle characteristics associated with higher ANCAP safety ratings may also be associated with better performance braking.

The results of this paper suggest that young people should be encouraged or even incentivised to purchase safer vehicles. Recognising that young driver are often unable to afford recent model cars, some governments are trialling incentivised programs, for example, Unsafe2Safe in Victoria (VicRoads, 2023b). This follows international initiatives that have promoted turnover of vehicle fleets, with incentives for owners to replace older vehicles (Scully et al., 2012). With safety features continuing to improve, there are road safety advantages to be gained in supporting young drivers to purchase newer vehicles, specifically vehicles with wider tyres and better braking systems, which allow improved vehicle stability and decreases in braking distance.

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Author contributions

James Boylan: Conceptualisation, Data collection, Formal analysis, Methodology, Writing – original draft, Writing – review and editing. Denny Meyer: Conceptualisation, Pro-

ject administration, Resources, Methodology, Supervision, Writing – review and editing. Won Sun Chen: Conceptualisation, Funding acquisition, Project administration, Supervision, Writing – review and editing.

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Human Research Ethics Review

The study protocols were reviewed and approved by the Swinburne University Human Research Ethics Committee on 22 April 2022 (SUHREC 22/6551).

Data availability statement

The researchers do not have consent to share the data used for the analyses. The consent form provided to the participants prohibited the researchers from sharing the data. The consent form can be provided to support this.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- ANCAP. (2023). *Car Safety Ratings*. ANCAP Vehicle Safety Testing. <https://www.ancap.com.au/>
- ANCAP. (2024). *Car safety testing*. <https://www.ancap.com.au/how-are-cars-tested-for-safety>
- Australian Bureau of Statistics (ABS). (2021). *Socio-Economic Indexes for Areas (SEIFA), Australia*. ABS. <https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release>
- Ayazi, E., Khorsand, R., & Sheikholeslami, A. (2020). Investigating the effectiveness of geometric and human factors on the severity of urban crashes. In *IOP Conference Series: Materials Science and Engineering* (Vol. 671, Issue 1, p. 012102). IOP Publishing.
- Ayuso, M., Guillen, M., & Pérez-Marín, A. M. (2016). Telematics and gender discrimination: Some usage-based evidence on whether men's risk of accidents differs from women's. *Risks*, 4(2), 10. <https://doi.org/10.3390/risks4020010>
- Ben-Shahar, O. (2023). Privacy Protection, At What Cost? Exploring the Regulatory Resistance to Data Technology in Auto Insurance. *Journal of Legal Analysis*, 15(1), 129–157. <https://doi.org/10.1093/jla/laad008>
- Bokare, P. S., & Maurya, A. K. (2017). Acceleration-deceleration behaviour of various vehicle types. *Transportation Research Procedia*, 25, 4733–4749. <https://doi.org/10.1016/j.trpro.2017.05.486>
- Cars24. (2024). *Brake system in automobile - types of brake system explained*. <https://www.cars24.com/blog/brake-system-in-cars/>
- CarsGuide. (2023). *CarsGuide: Car reviews, car news, and advice*. <https://www.carsguide.com.au/>
- CarThrottle. (2015). *Engineering explained: Brake Systems and how to improve stopping performance*. <https://www.carthrottle.com/news/engineering-explained-brake-systems-and-how-improve-stopping-performance>
- Claus, B., & Warlop, L. (2022). The car cushion hypothesis: Bigger cars lead to more risk taking-evidence from behavioural data. *Journal of Consumer Policy*, 45(2), 331–342. <https://doi.org/10.1007/s10603-022-09511-w>
- Cordellieri, P., Baralla, F., Ferlazzo, F., Sgalla, R., Piccardi, L., & Giannini, A. M. (2016). Gender effects in young road users on road safety attitudes, behaviors and risk perception. *Frontiers in Psychology*, 7, 213861. <https://doi.org/10.3389/fpsyg.2016.01412>
- Cubells, J., Marquet, O., & Miralles-Guasch, C. (2020). Gender and age differences in metropolitan car use. Recent gender gap trends in private transport. *Sustainability*, 12(18), 7286.
- Department for Infrastructure and Transport South Australia. (2018). *Safer vehicle choices save lives*. <https://www.dit.sa.gov.au/news/feed?a=474141>
- Eichelberger, A. H., Teoh, E. R., & McCartt, A. T. (2015). Vehicle choices for teenage drivers: A national survey of U.S. parents. *Journal of Safety Research*, 55, 1–5. <https://doi.org/10.1016/j.jsr.2015.07.006>
- Girma, A., Yan, X., & Homaifar, A. (2019). Driver identification based on vehicle telematics data using LSTM-recurrent neural network. *2019 IEEE 31st International Conference on Tools with Artificial Intelligence (ICTAI)*. <https://doi.org/10.1109/ictai.2019.00127>
- GOFAR in-vehicle telematics device. (2023). [Image]. GOFAR. <https://www.gofar.co/features/>
- Hassan, H. M., & Abdel-Aty, M. A. (2013). Exploring the safety implications of young drivers' behavior, attitudes and perceptions. *Accident Analysis & Prevention*, 50, 361–370. <https://doi.org/10.1016/j.aap.2012.05.003>
- Høye, A. (2019). Vehicle registration year, age, and weight–Untangling the effects on crash risk. *Accident Analysis & Prevention*, 123, 1–11. <https://doi.org/10.1016/j.aap.2018.11.002>
- IBM Corp. (2023). *IBM SPSS Statistics for Windows, Version 29.0.2.0*. IBM Corp.
- Ivers, R., Senserrick, T., Boufous, S., Stevenson, M., Chen, H. Y., Woodward, M., & Norton, R. (2009). Novice drivers' risky driving behavior, risk perception, and crash risk: findings from the DRIVE study. *American Journal of Public Health*, 99(9), 1638–1644. <https://doi.org/10.2105/AJPH.2008.150367>
- J.D. Power. (2022). *What difference does the wheel size make?* <https://www.jdpower.com/cars/shopping-guides/what-difference-does-the-wheel-size-make>

- Jones, E. R., & Childers, R. L. (2001). *Contemporary College Physics*. McGraw Hill.
- Keall, M. D., & Newstead, S. (2011). Passenger Vehicle Safety in Australasia for different driver groups. *Accident Analysis & Prevention*, 43(3), 684–689. <https://doi.org/10.1016/j.aap.2010.10.012>
- Keall, M. D., & Newstead, S. (2013). The potential effectiveness of young driver high-performance vehicle restrictions as used in Australia. *Accident Analysis & Prevention*, 52, 154–161. <https://doi.org/10.1016/j.aap.2012.12.005>
- Kontaxi, A., Ziakopoulos, A., & Yannis, G. (2021). Trip characteristics impact on the frequency of harsh events recorded via smartphone sensors. *IATSS Research*, 45(4), 574–583. <https://doi.org/10.1016/j.iatssr.2021.07.004>
- Maurya, A. K., & Bokare, P. S. (2012). Study of Deceleration Behaviour of Different Vehicle Types. *International Journal for Traffic & Transport Engineering*, 2(3). [https://doi.org/10.7708/ijtte.2012.2\(3\).07](https://doi.org/10.7708/ijtte.2012.2(3).07)
- McCartt, A. T., & Hu, W. (2017). Effects of vehicle power on passenger vehicle speeds. *Traffic Injury Prevention*, 18(5), 500–507. <https://doi.org/10.1080/15389588.2016.1241994>
- McCarty, D., & Kim, H. W. (2024). Risky behaviors and road safety: An exploration of age and gender influences on road accident rates. *PLoS One*, 19(1), e0296663. <https://doi.org/10.1371/journal.pone.0296663>
- Meuleners, L., Fraser, M., Stevenson, M., & Roberts, P. (2023). Personalized driving safety: Using telematics to reduce risky driving behaviour among young drivers. *Journal of Safety Research*, 86, 164–173. <https://doi.org/10.1016/j.jsr.2023.05.007>
- Möller, H., Ivers, R., Cullen, P., Rogers, K., Boufous, S., Patton, G., & Senserrick, T. (2021). Risky youth to risky adults: Sustained increased risk of crash in the DRIVE study 13 years on. *Preventive Medicine*, 153, 106786. <https://doi.org/10.1016/j.ypmed.2021.106786>
- NSW Insurance Regulatory Authority. (2019). *NSW Young Drivers Telematics Trial*. https://www.sira.nsw.gov.au/_data/assets/pdf_file/0010/556264/NSW-Young-Drivers-Telematics-Trial.pdf
- Osthöver, M., Dralle, J., Pfeffer, P. E., & Albig, J. (2024). Development of Power-to-weight Ratio and Braking Distance of Passenger Cars during the last 30 Years. *ATZ Worldwide*, 126(4), 60–63. <https://doi.org/10.1007/s38311-024-1903-x>
- Oviedo-Trespalacios, O., & Scott-Parker, B. (2018). Young drivers and their cars: Safe and sound or the perfect storm? *Accident Analysis & Prevention*, 110, 18–28. <https://doi.org/10.1016/j.aap.2017.09.008>
- Reason, J., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations on the roads: a real distinction? *Ergonomics*, 33(10–11), 1315–1332. <https://doi.org/10.1080/00140139008925335>
- Ryb, G. E., Dischinger, P. C., & Ho, S. (2009). Vehicle model year and crash outcomes: A ciren study. *Traffic Injury Prevention*, 10(6), 560–566. <https://doi.org/10.1080/15389580903271401>
- Scully, M., Newstead, S., Oxley, J., French, A., & Burke, P. (2012). *Advice and Guidance on Increasing the Purchases and Usage of Safer*.
- Stevenson, M., Harris, A., Wijnands, J. S., & Mortimer, D. (2021). The effect of telematic based feedback and financial incentives on driving behaviour: a randomised trial. *Accident Analysis & Prevention*, 159, 106278. <https://doi.org/10.1016/j.aap.2021.106278>
- Transport Certification Australia. (2021). *National Telematics Framework*. <https://tca.gov.au/national-telematics-framework/>
- Verbelen, R., Antonio, K., & Claeskens, G. (2018). Unravelling the predictive power of telematics data in car insurance pricing. *Journal of the Royal Statistical Society Series C: Applied Statistics*, 67(5), 1275–1304. <https://doi.org/10.1111/rssc.12283>
- VicRoads. (2023a). *Reducing P driver crash risk*. <https://www.vicroads.vic.gov.au/safety-and-road-rules/driver-safety/young-and-new-drivers/reducing-p-driver-crash-risk>
- VicRoads. (2023b). *Unsafe2safe*. <https://www.vicroads.vic.gov.au/safety-and-road-rules/vehicle-safety/buying-a-safe-car/unsafe2safe>
- VicRoads. (2024). *Prohibited vehicles for P-plate drivers*. <https://www.vicroads.vic.gov.au/licences/your-ps/prohibited-vehicles-for-p-plate-drivers>
- Wenzel, T. P., & Ross, M. (2005). The effects of vehicle model and driver behavior on risk. *Accident Analysis & Prevention*, 37(3), 479–494. <https://doi.org/10.1016/j.aap.2004.08.002>
- Wu, W. J., Li, C. S., & Peng, S. C. (2020). The relationships between vehicle characteristics and automobile accidents. *Risk Management and Insurance Review*, 23(4), 331–377. <https://doi.org/10.1111/rmir.12163>