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Advanced Driver Assistance Systems

February 2026

Executive Summary

Over the past decades, vehicle safety technology has advanced at a pace unmatched in the history of road transport.

In fact, since the early 1990's, in-vehicle safety technology has progressed from primitive forms of anti-lock braking systems (ABS) and traction control to the now highly advanced forms of Advanced Driver Assistance Systems (ADAS).

These systems were once only available on higher priced luxury vehicles. But now are available in various forms on almost every new vehicle.

ADAS support drivers in detecting hazards, maintaining lane position, managing following distance, and responding to imminent collisions. Passive Safety Systems (PSS) have similarly evolved, offering increasingly sophisticated occupant protection when crashes occur.

In theory, this technological transformation should translate into fewer fatalities and serious injuries across all age groups.

However, emerging evidence indicates that young drivers, who remain overrepresented in serious crashes, are often disproportionately excluded from these safety gains.

New teenage drivers are significantly more likely to operate older vehicles and vehicles equipped with fewer driver assistance systems and safety technologies. Both vehicle age and lack of advanced safety features are independently associated with increased risk of death in fatal crashes.

This reveals a structural safety paradox: those at highest behavioural risk are often driving the least forgiving vehicles.

While ADAS technologies offer measurable improvements in crash mitigation and driver performance, they also introduce complex human factors challenges.

Overreliance, distraction, frustration with warnings, and inappropriate responses can undermine intended benefits, particularly among inexperienced drivers. Moreover,

socioeconomic constraints, insurance pricing models, and family vehicle allocation practices reinforce unequal access to safer vehicles.

This report examines the dual nature of modern vehicle safety technologies, explores the relationship between vehicle choice and young driver risk, and outlines the structural and behavioural interventions necessary to bridge the safety gap.

1. Introduction: Technology Advancement and Persistent Youth Risk

Young drivers face elevated crash risk due to a combination of inexperience, developmental factors, and exposure to challenging driving contexts. Graduated licensing systems, improved training, and behavioural campaigns have made some contributions to reducing fatalities.

Yet vehicle safety remains an underexamined dimension of young driver risk. Research suggests that young drivers, aged 16 to 24 years, are 60% more likely to be involved in a serious crash than licensed mature adult drivers and riders, aged 25 to 59 years.

https://share.google/qlruJq1gYXMQFtVxC

The cause of crashes involving young drivers is complex and involves direct and indirect factors. Direct factors include speeding, drink/drug driving, fatigue, distraction and failing to wear a seatbelt.

According to an Australian Institute of Family Studies (AIFS) Longitudinal Study of Australian Children, the most common types of risky driving by 16 to17 year-olds were speeding and driving when very tired. https://aifs.gov.au/media/safe-our-roads-teens-and-risky-driving

The study found that 1 in 5 teens who failed to wear a seatbelt or a helmet did so on every trip, suggesting that these behaviours are already a dangerous habit for some young drivers.

Vehicles are also not passive environments. They shape driver behaviour, influence crash likelihood, and determine injury outcomes.

The integration of ADAS has shifted vehicles from purely mechanical systems to intelligent, semi-autonomous safety platforms.

However, access to these platforms is unevenly distributed. Young drivers, especially those from lower-income households, are more likely to drive vehicles more than fifteen years old, vehicles that predate many modern safety technologies.

A 2022 Insurance Institute for Highway Safety report found that adolescents from lower-income households were more likely to be involved in fatal crashes due to driving older,

less-safe vehicles.
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2833623

This structural inequity creates a mismatch between risk exposure and safety protection. Understanding this mismatch requires examining both the benefits and limitations of ADAS and passive safety systems.

2. The Positive Impacts of ADAS

Advanced Driver Assistance Systems were designed primarily to reduce human error, which remains the dominant contributor to road crashes. Research has demonstrated that these systems can improve several measurable aspects of driving behaviour.

Drivers using ADAS equipped vehicles often exhibit reduced speed variability, improved lane stability, smoother braking patterns, and faster reaction times to hazards. Systems such as Forward Collision Warning and Automatic Emergency Braking have shown particular promise in reducing rear-end collisions, one of the most common crash types.

Lane Departure Warning and Lane Keeping Assist systems help prevent unintended lane departures, often associated with fatigue or distraction. Adaptive Cruise Control reduces tailgating and moderates speed fluctuations in traffic. Blind spot detection systems reduce unsafe lane-change manoeuvres. Vigilance monitoring systems can detect prolonged gaze diversion or signs of fatigue, prompting corrective action.

Collectively, these systems mitigate exposure to risky conditions and compensate for momentary lapses in attention. In Safe System terms, they represent a proactive layer of defence that reduces both crash likelihood and severity.

Associate Professor Milad Haghani Principal Research Fellow, Resilience & Mobility Department of Infrastructure Engineering highlights some research evidence ADAS systems in crash reduction. He stated that a recent international study found:

- Lane-keeping assist delivered the largest crash-rate reduction, especially for some of the most severe crashes (19.1% reduction)
- Automatic emergency braking significantly lowered rear-end and intersection crash rates (10.7% reduction)
- Blind spot monitoring cut lane-change and merging collisions moderately (3.5% reduction)

https://findanexpert.unimelb.edu.au/news/131128-driver-assist-technology-saves-lives.-so-why-do-so-many-people-turn-it-off%3F

For young drivers who are still developing hazard perception skills, ADAS has the potential to serve as a protective scaffold as they learn and develop key higher order skills for safe driving.

By providing warnings and, in some cases, automated intervention, these technologies may partially compensate for inexperience. The promise of ADAS is particularly compelling when viewed as a tool for bridging developmental gaps.

3. The Human Factors Challenges of ADAS

Despite their potential, ADAS systems are not universally beneficial. The interaction between human cognition and automation introduces complexity that can undermine safety outcomes if poorly managed.

One concern is attentional displacement. Drivers may shift focus from primary driving tasks to monitoring system displays or responding to alerts. Frequent warnings can create cognitive overload, particularly in urban environments where alerts may be triggered repeatedly. This phenomenon can result in warning fatigue, where drivers begin to ignore or disable systems altogether.

In some cases, unexpected warnings may provoke inappropriate responses. Sudden auditory or visual alerts can trigger abrupt braking or overcorrection, potentially creating secondary and unintended hazards. Furthermore, partial automation may foster complacency. Drivers may reduce mirror checking, situational scanning, or active engagement, assuming the system will compensate for hazards.

According to the research reporting from Associate Professor Milad Haghani in the previous section, adaptive cruise control appears to be linked to higher crash rates in some studies (8% increase), possibly due to drivers relying on it too much, using it in complex traffic, or paying less attention. Conventional cruise control was associated with an even higher increase (12%) in crash risk.

Young drivers are especially vulnerable to these risks. Neurodevelopmental research indicates that executive function, impulse control, and sustained attention continue developing into early adulthood.

Inexperienced drivers may overestimate system capability or misunderstand operational limitations. Without proper education, ADAS may be treated as a substitute rather than a supplement to skill.

Frustration also plays a role. Some drivers resist systems that override their inputs or intervene unexpectedly. This resistance may be amplified in adolescents, for whom autonomy and control are psychologically salient.

Therefore, ADAS effectiveness depends not only on engineering quality but on behavioural integration and education.

4. Passive Safety Systems: The Final Line of Defence

When crashes occur despite preventive measures, Passive Safety Systems provide occupant protection. Modern vehicles incorporate advanced airbag deployment strategies, reinforced cabin/safety cell structures, crumple zones and seatbelt pretensioners.

These systems significantly reduce fatality and serious injury risk.

However, older vehicles lack many of these advancements. Structural integrity standards have improved substantially over the past two decades. Side-impact protection, roof strength, and occupant compartment integrity are markedly better in newer vehicles. Therefore, vehicle age is directly linked to injury survivability.

Although passive systems are generally reliable, improper design, deployment, or maintenance can introduce injury risk. Nevertheless, the overwhelming evidence supports that newer vehicles provide superior occupant protection.

For young drivers operating older vehicles, the absence of modern passive systems compounds the behavioural risks.

5. Vehicle Age, Technology Access, and Fatality Risk

Recent national analyses confirm that teen drivers are more likely to drive vehicles over fifteen years old and vehicles with fewer driver assistance technologies. Importantly, both vehicle age and the number of ADAS features independently correlate with fatality risk in crashes.

In 2017, ANCAP's (Australian New Car Assessment Program) Analysis of the Australian vehicle fleet showed that while older vehicles (those built 2000 or earlier) account for just 20% of the registered vehicle fleet, they're involved in 33% of fatality crashes, In contrast, newer vehicles (those built 2011-2016) make up 31% of the fleet yet are involved in just 13% of fatality crashes.

https://www.ancap.com.au/media-and-gallery/media-releases/new-analysis-fatality-rate-four-times-higher-in-an-older-vehicle-0e2f9e

This finding reframes young driver risk as not solely behavioural but structural. It challenges the assumption that education alone can close the gap. If two drivers with identical behaviour operate vehicles with significantly different safety performance, their injury outcomes may differ dramatically.

The paradox is stark: families often allocate older vehicles to teens to protect newer family cars or reduce financial exposure. Yet this allocation places the highest-risk drivers in the least forgiving vehicles.
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2833623

6. Socioeconomic and Insurance Influences

Financial considerations heavily influence vehicle choice. Newer vehicles with advanced safety systems are more expensive than older models. Lower-income households face constrained access to financing and higher insurance premiums for young drivers. As a result, adolescents from disadvantaged backgrounds are more likely to drive older, less safe vehicles.

To gain a snapshot of the trends, in 2024 Transport for NSW, undertook research to understand consumer behaviour and vehicle safety awareness in New South Wales (NSW).

https://www.transport.nsw.gov.au/system/files/media/documents/2024/crs_consumer_perceptions_vehicle_safety.pdf

The research found that vehicle purchases are influenced by a combination of financial, functional, emotional, and aesthetic factors, with safety often playing a secondary role. Cost is a dominant concern, with 66% of consumers delaying their vehicle purchase due to financial constraints.

Price is also the top consideration for vehicle choice for 38% of consumers, followed by running costs (29%), fuel type and brand (22% each). For 76% of used car buyers, affordability is the main driver, particularly for younger buyers, women, and those on lower incomes. Beyond cost, functional and emotional needs significantly impact vehicle choices. Some consumers view cars purely as transportation, while others are influenced by emotional factors like reliability, comfort, and prestige.

Aesthetics, particularly the "look and feel" of a car play a major role, often more important to consumers than performance or features. In relation to safety, consumers have varied perceptions and knowledge.

Two-thirds (64%) believe newer cars are safer, while 39% associate larger vehicles with better safety. Awareness is generally higher for passive safety features like airbags (95%) and seatbelts (94%) compared to active features such as blind spot monitoring (56%) and speed assist systems (35%). Safety is not a top priority for most buyers, with only 20% ranking it as a primary factor in their decision, behind price, running costs, and aesthetics.

Insurance pricing further complicates the picture. Insurers assess risk based on crash frequency and repair costs.

While ADAS may reduce crash occurrence, these systems often increase repair complexity and cost when damaged.

This creates a tension within pricing models. Premium reductions for safer vehicles may be modest relative to purchase price differences, limiting behavioural influence. Insurance alone cannot resolve inequities in vehicle safety access.

7. Education and ADAS Literacy

Even when young drivers gain access to newer vehicles, lack of understanding can reduce system effectiveness. Many drivers do not fully comprehend system capabilities or limitations. This misinterpretation on the safety systems on board the vehicle can lead to overreliance or disengagement from the driver.

It also appears that there are significant gaps in the levels of awareness and understanding of vehicle safety systems and how they function.

Qualitative research undertaken as part of Transport for NSW Consumers' Perceptions of Vehicle Safety Summary Report in 2024 showed that knowledge and understanding of many active safety features is relatively low.

The research assessed awareness and understanding of 18 specific car safety features.

These safety features were categorised as either active or passive, where active features intervene to prevent a crash, and passive features minimise the impact of a crash.

The study highlighted that airbags and seatbelts have the highest awareness and understanding among consumers, with over 94% aware of these and 90% claiming that they understood what they do to protect road users. However anecdotal evidence would suggest that in the case of airbags, the true levels of understanding could be much less.

Anti-lock braking systems (ABS) showed a high level of awareness (82%), but only 53% claimed to understand what the system actually does.

Electronic stability control (ESC) and speed assist systems appeared to have the lowest levels of awareness and understanding among consumers. Only 38% were aware of ESC with 27% understanding what it does, while speed assist systems fare slightly worse, with 35% aware of this feature and just 26% understanding what it does.

https://www.transport.nsw.gov.au/system/files/media/documents/2024/crs_consumer_perceptions_vehicle_safety.pdf

Structured ADAS education should accompany vehicle purchase, and more work needs to be done to induct drivers on these drive support systems.

Ideally, families should review manuals, practice features in controlled environments, and understand operational boundaries. Car manufacturers clinicians, educators, and

licencing authorities can play a role in reinforcing active engagement rather than passive reliance.

The findings from the NSW's research were also reflected in a broader national study piece that also highlighted the awareness gaps when it comes to ADAS.

Late in 2025 Insurance Australia Group Limited (IAG) released some preliminary data on its study of consumer attitudes towards ADAS and the boarder use of this technology.

https://www.iag.com.au/newsroom/company/iaglaunchesnationalstudyofdriverassisttechnologytoimprovesafetyoutcomes

IAG surveyed 2000 Australians who are driving ADAS enabled vehicles and discovered the following insights as to their existing attitudes and behaviours:

Key consumer survey findings:

- 60% of drivers admit to actively turning off ADAS in their cars.
- Only 1 in 3 (36%) of drivers on roads have ADAS as the default setting in their vehicles.
- 1 in 3 (38%) drivers find the ADAS features in their vehicle distracting.
- 69% of Australians who did a driving test or lesson recently were not tested or educated on the car's ADAS features.
- 4 in 5 (80%) Australian drivers have adapted to using ADAS in their vehicle through a process of trial-and-error learning only.
- 70% of Australians say they would benefit from more information or instruction on interacting with ADAS systems to ensure better safety outcomes.
- Almost half (49%) of drivers on roads have not taken any proactive steps to educate themselves about how to use ADAS effectively, aside from trial-and-error learning.
- 1 in 5 (21%) drivers learnt about their vehicles ADAS features after purchase, and 16% are still learning.
- More than one third (34%) of drivers think ADAS features can sometimes make driving more difficult or dangerous.
- 2 in 5 (43%) Australians have experienced a situation in which they felt an ADAS feature negatively impacted their driving.
- More than 1 in 3 (37%) Australians feel that ADAS has not helped prevent a collision or crash while driving.

These results show that whilst ADAS can provide safety benefits, there is clearly more work to do around public education on these systems to increase public awareness and over acceptance.

8. Future Directions: Intelligent Coaching Systems

Next-generation systems may extend beyond warnings to real-time coaching. Artificial intelligence driven monitoring could provide feedback on speed management, braking smoothness, hazard perception, and distraction. Such systems may transform vehicles into training platforms.

Work is being done to explore the opportunity to use cloud-based road safety technology and a potential coaching tool.

https://www.researchgate.net/publication/383919964_Cloud-Based_Road_Safety_for_Real-Time_Vehicle_Rash_Driving_Alerts_with_Random_Forest_Algorithm

The technology examined in this research enhances real-time monitoring of vehicle behaviour and provides alerts for unsafe or aggressive driving. It leverages cloud computing to collect and process data from onboard vehicle sensors and external traffic monitoring systems. Advanced machine learning techniques, specifically the Random Forest (RF) algorithm are applied to analyse this data intelligently.

The RF model is trained using a diverse range of driving behaviour indicators to identify patterns associated with reckless or high-risk driving.

By utilising scalable cloud infrastructure, the system can efficiently process continuous real-time data streams, enabling timely detection and rapid response to unsafe driving behaviours.

However, system design must consider adolescent cognitive capacity and striking the right balance of interactions could prove to be challenging. Alerts and coaching interventions must enhance rather than overload the driver and their performance. Design that fails to account for developmental limitations risks diminishing returns.

9. Bridging the Safety Gap

Closing the safety gap requires a multi-layered approach. Accelerating the penetration of proven safety technologies across the fleet through regulatory standards offers the most equitable long-term solution.

Encouraging families to allocate the safest available vehicle to the least experienced driver addresses household-level decisions. Leveraging insurance claims data to inform consumer guidance may improve transparency.

Crucially, ADAS literacy must become part of driver education frameworks. Technology without understanding may fail to deliver intended benefits. As it stands currently, many drivers and are not fully aware of the range of safety systems on their vehicle and have little real understanding on how those systems work.

Conclusion

Advanced Driver Assistance Systems and Passive Safety Systems represent transformative advancements in road safety. It is well understood that safer vehicles save lives and it is essential that these safety technologies continue to be developed by car manufactures.

Yet access to these technologies remains uneven and there are significant gaps in the levels of comprehension about these systems.

Overall, the knowledge and understanding about many active safety features is relatively low across the driving community. Young drivers especially, who face the highest crash risk, are often the least likely to be able to access modern vehicle safety innovations due to cost. Cost of living and other economic or social issues will also add further complexity.

Addressing this inequity requires recognising vehicle choice as a structural risk factor in improving road safety outcomes. Drivers should be encouraged to buy the safest vehicle they can afford.

On top of the costs, there are also attitudes and social norms that need to be addressed. These attitudes also go well beyond the issue of safety systems.

Therefore, behavioural interventions such as training and education also remain essential, and they must be complemented by policies that improve equitable access to safer vehicles and ensure effective integration of technology into the driving task.

Ensuring that young drivers can access these newer vehicles and understand how the safety on board the vehicle works, is both a public health imperative and a matter of safety equity.

Greater collaboration across government, private, and non-profit sectors is needed to improve community awareness of how these vehicle safety systems operate.

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February 2026

References

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