Time to change?

How hi-tech motoring could rip up the rule book on the way ADIs teach driving

Sit back and relax: Google's 'driverless' car. While the technology exists to put such a vehicle on the roads, US highways authorities believe the road network itself is incapable of supporting such technology for decades

Motoring has seen a number of major technological developments in recent years, and increasingly they are impacting on the world of driver training. In this article **Dr Charles Johnson** offers his view on how developments in road safety, particularly in cars, could impact on the way ADIs teach learners in the future

UN Decade of Action Pillars	EU Road Safety Programme Objectives
Road safety management	Improve education and training of road users
Safer roads and mobility	Increase enforcement of road rules
Safer vehicles	Safer infrastructure
Safer road users	Safer vehicles
Post-crash response	Promote the use of modern technology
	Improve emergency and post-injury care
	Protecting vulnerable road users with a focus on motorcyclists

BOTH the EU and the United Nations General Assembly have published action plans in recent years aimed at reducing the number of injuries and fatalities related to road transport. Versions of these plans have been adopted by many countries and introduced into national road safety policies. There seems to be general agreement in them about what the key areas for improvement are.

The table below left shows the five 'pillars' taken from the UN's Decade of Action for Road Safety and the seven main objectives from the European Commission's Road Safety Programme (2011 – 2020).

Many, but not all, of these pillars and objectives are associated with technological advances and some, but not all, of these have important implications for driver training. Improvements in road safety management are largely aimed at policy makers and national agencies concerned with road safety strategy and the implementation of safety initiatives. As such they are unlikely to have a direct impact on driver training and, therefore, are not considered further in this article although it is recognised that they could have indirect implications. A number of improvements to road infrastructure have been identified. These include:

- Removing or redesigning bends
- Traffic calming measures
- Removing or redesigning junctions
- Separation of road users
- Signage, road furniture and visibility
- Removal of roadside distractions

Improvements in these areas are likely to change the content of training. Driving instructors will need to be aware of these improvements and their implications for learner driver knowledge and understanding but the improvements will not fundamentally change the way in which drivers are trained.

The same can be said about improvements to and enforcement of legislation and regulation, for example involving:

- European licences
- The use of personal protective equipment such as seat belts
- Drink driving
- Driver rehabilitation
- Graduated licences
- and to improvements in post-crash response, where training may be needed to help learner drivers understand how these improvements will affect them.

In both cases, however, this will result in changes to the learner driver curriculum but not to the process of driver training.

Advances in the other pillars and objectives, however, could have significant impact on the way in which driving instructors provide driver training and these are considered in turn below.

Driving in line: While driverless cars may be a long way off, the development of automatic 'road trains', as in the above example of a test on the technology by Volvo, could transform the way we drive, particularly on long-distance journeys

Safer vehicles

There are a number of improvements that have been made to vehicle design over the last several decades which have had a significant impact on road safety. These can be roughly divided into improvements in roadworthiness (eg, better braking, more effective steering, improvements in maintenance requirements, etc) and improvements in crashworthiness (eg, airbags, seat restraints, crumple zones, etc). Many of these improvements have implications for changes to the driver training curriculum and, indeed, for the content of driving tests, but for the purposes of this article the more interesting implication is the effect these improvements in vehicle design may have on driver attitudes.

The concern has often been expressed that having safer cars may lead to drivers being more careless or even more reckless. As far as I can see, however, there is no particular evidence suggesting an increase in either carelessness or recklessness, though there have been some indications in recent years which could be interpreted that way.

For example, for most of the time while fatalities and serious injuries have been decreasing on the roads in Europe and the USA, insurance claims for damage or personal injury have also been decreasing.

However, in the past six or seven years in the UK and since 2010 in the USA there is evidence that although the number of claims for damage have continued to decrease, claims for personal injury have been increasing by about the same amount. This shift in the types of claim is probably a result of the introduction into the market of claims management companies but the important issue is that while fatality and serious injury rates have continued to decrease, insurance claims appear to have plateaued.

The importance of this for driving instructors is the role they may be expected to play in the process of attitude change and management, increasing social awareness and responsibility, and other facets of driver behaviour which can be found in the higher levels of the GDE matrix.

Use of modern technology

The uses of modern technology can be divided into two main groups:

- **Autonomous vehicles** – essentially driverless cars
- **Driver assistance** – essentially technological aids to drivers.

Autonomous vehicles

There has been considerable interest in the media in recent years about the possibility of the widespread introduction of driverless cars. Opinion on the likelihood of it happening in the foreseeable future varies considerably. The unveiling of the Google driverless car in 2005 and, more particularly, successful trials with the vehicle starting in 2012 have led to claims that a fully functioning driverless car could be mass manufactured within the next 20 years. Indeed, Nissan has committed to bringing a number of affordable autonomous models to market, based on its LEAF prototype, by 2020 and Tesla Motors has said it could have a driverless car available in the next three years. Almost all the other major motor manufacturers (such as Audi, BMW, Ford, General Motors, Honda, Mercedes Benz and Volkswagen) have autonomous vehicles in development. A number of legislative authorities in the USA have been sufficiently impressed by the claims that, as of December 2013, four States (Nevada, Florida, California and Michigan) have passed laws permitting the use of autonomous cars and a fifth (Texas) may do so soon.

Not everyone believes that the introduction of autonomous vehicles will happen on this timescale, if at all. For example, the US National Highway Traffic Safety Administration has cautioned that it may be 75 years before road infrastructure is sufficiently well-developed for autonomous vehicles to drive on all routes.

The major concern with fully autonomous vehicles is the issue of what happens if the controlling computer in the vehicle crashes, hangs or otherwise fails. As one cynic has recently noted, how often has this happened to your own laptop in the past year? As in other cases where automation has been introduced, eg, automatic pilots in aeroplanes, the driver will have to be fully competent to take over the driving of the vehicle when necessary. Numerous human factors issues are known to be consequences of full or increasing automation including increasing reliance on the automated systems, trust in the systems, maintenance of situational awareness and, indeed, maintenance of competence. The task of driver training will be radically different in this scenario.

A different issue for training concerns the fact that for many years the competence requirements of drivers will go through a transition period where the precise demands on drivers will gradually change over time.

For example, at the moment there are no prototype vehicles which are fully autonomous. All systems recognise a variety of situations where control has to be passed back to a human driver. This handover point is likely to change as the systems become more sophisticated. There may also be a migration through different types of automation over time.

For example, one type of autonomous driving being considered at the moment is remote control convoys employing co-operative adaptive cruise control[1].

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[1] See, for example, Stephen Jones (2013) Cooperative adaptive cruise control: Human factors analysis. U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA-HRT-13-045, Mclean, VA.

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With this technology, the vehicle can drive autonomously while in convoy and communicating with other vehicles in the convoy but has to return to human control when leaving the convoy and be in human control when joining. This might be an intermediate stage in the introduction of fully autonomous vehicles and would carry with it yet another set of different competence requirements and implications for driver training and driving instructor competence.

This may mean that different levels of vehicular automation may be introduced before reaching the level of full autonomy. In the USA, the National Highway Traffic Safety Administration (NHTSA) has established an official classification system:

- **Level 0:** The driver completely controls the vehicle at all times.
- **Level 1:** Individual vehicle controls are automated, such as electronic stability control or automatic braking.
- **Level 2:** At least two controls can be automated in unison, such as adaptive cruise control in combination with lane keeping.
- **Level 3:** The driver can fully cede control of all safety-critical functions in certain conditions. The car senses when conditions require the driver to retake control and provides a "sufficiently comfortable transition time" for the driver to do so.
- **Level 4:** The vehicle performs all safety-critical functions for the entire trip, with the driver not expected to control the vehicle at any time. This can include unoccupied cars.

In fact, many aspects of levels 1 and 2 already exist. For example, there are already systems which can be fitted to vehicles which can control the brakes, the accelerator and the steering on the basis of sensor, GPS or roadside information.

The main issue for driver competence where such systems are fitted is how drivers cope with the systems being switched off or failing or if they have to drive a vehicle which does not have the system fitted. The challenge for driving instructors will be to create situations in which these competences can be trained and assessed.

> 'The issues for training... include helping the learner driver how to react to and make best use of the information being made available to them... the second concerns how to help learners cope with vehicles where the systems they are used to using are no longer operative or available...'

Driver assistance

Most technological systems introduced to vehicles currently, however, do not take over full control of the vehicle. Largely they either provide information to the driver or make adjustments to the primary or secondary controls. Examples of the former are:

- Telematics
- Proximity sensors e.g. in-car radar
- Motion sensors – either internal (e.g. passenger movement) or external

Examples of the latter are:

- Intelligent speed adaptation
- Cruise control
- Assisted steering and braking

The distinction between these is not clear cut. For example, both telematics and proximity sensors could trigger assisted braking rather than simply alerting the driver as part of a collision avoidance system. Eye movement tracking devices monitoring the onset of fatigue could either produce warnings or adjust vehicle speed. Inter-vehicle communications and other sorts of intelligent transport communications can feed into either driver information or driver assistance systems. Alcolocks are an example of a system which takes control away from the driver but does not take autonomous control of driving.

There are two issues here for training. The first is helping the learner driver how to react to and make best use of the information being made available to them. The second concerns the same issue as for autonomous vehicles, namely how to help learners cope with vehicles where the systems they are used to using are no longer operative or available.

Safer Road Users

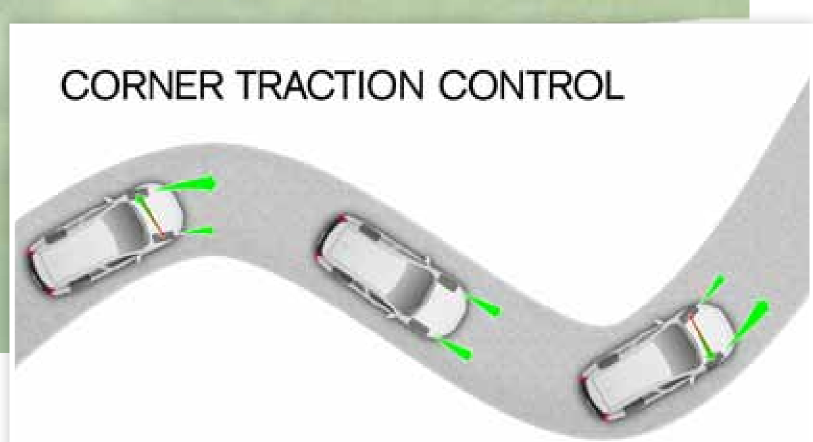
There are four main types of technology which have been promoted by people in the driver training industry in the last few decades and which have implications for driver training:

- Driver information systems such as telematics
- E-learning systems
- Computer-based driving practice, eg, simulators
- Computer-based cognitive and perceptual skills enhancement. The issue for driving instructors is how to integrate these systems into their training approach. All four types require the driving instructor to be familiar with the use of the technology, the content of the specific tools, the nature of the information (including any assessments) that the tools provide and how to give feedback to learners on the basis of the tools. They will also need to know when best to introduce and how best to apply such tools.

In the case of skills enhancement, this may mean being able to assess the cognitive maturity of the learner. This might be based on an assessment using the same skills enhancement tools but implies an awareness of psychological testing and the underlying psychometric theory.

Helping hand: Advancements in car technology such as electronic steering programmes (ESP) and traction control have transformed the way cars handle. Today's cars have more invasive systems that take control away from the driver. It is vital, says Dr Johnson, that learner drivers are taught how about these systems, how to respond to them and how they impact on the car and driver

ESP: The main diagram shows a critical manoeuvre in a car fitted with an electronic stability programme and one without. A car coming around a sharp bend encounters a vehicle stationary in the road. The driver performs a violent swerve to avoid the car, and the ESP allows him to maintain control and avoid the other vehicle. Without ESP, his car is thrown into a spin – with possible disastrous consequences



Corner traction control: how it works

Braking the inner driven wheel and redistributing torque to the outer wheel help to maintain the desired line when turning into a corner

Corner traction control significantly improves traction and performance on winding roads

Torque distribution from inner to outer wheels reduces understeer when accelerating out of the corner