**Written evidence submitted by the Royal Society for the Prevention of Accidents (SDV0021)**

## Introduction

This is the response of The Royal Society for the Prevention of Accidents (RoSPA) to the Transport Select Committee's call for evidence on self-driving vehicles. It has been produced following consultation with RoSPA's National Road Safety Committee. We have no objection to our response being reproduced or attributed.

The Transport Select Committee is scrutinising the development and deployment of self-driving vehicles for use on the roads (also known as connected and autonomous vehicles). The Committee is interested in evidence that addresses:

- likely uses, including private cars, public transport and commercial vehicles;
- progress of research and trials in the UK and abroad;
- potential implications for infrastructure, both physical and digital;
- the regulatory framework, including legal status and approval and authorisation processes;
- safety and perceptions of safety, including the relationship with other road users such as pedestrians, cyclists and conventionally driven vehicles;
- the role of Government and other responsible bodies, such as National Highways and local authorities; and potential effects on patterns of car ownership, vehicle taxation and decarbonisation in the car market.

## Introduction

In the last decade, vehicles have become increasingly autonomous, performing tasks for us such as automatically operating window wipers and lights. Technology has also developed within vehicles to assist us with the driving task, including features such as park assist, reverse cameras, cruise control and lane assist.

The automation of vehicles is set to become more widespread. Many driver support features are currently available to help a human driver by, for example, maintaining a safe distance from vehicles ahead. The Law Commission[1] anticipates that in future, these features will develop to a point where a vehicle will be able to drive itself, without a human paying attention to the road. This is likely to lead to changes in the way that vehicles are owned and used, implications for infrastructure and the regulatory framework and will give rise to new challenges and benefits for road safety.

**Progress of research and trials**

The results of some advanced trials suggest that some automated vehicles are already able to operate reliably in some contexts, but variable performance in other conditions means that these technologies will need to be further developed before autonomous vehicles become a common sight on Britain's roads[2].

**Implications for infrastructure**

Automated vehicles will gradually enter Britain's roadway system. Before our roads are used solely by fully automated vehicles, a long transition period is expected where roads will be shared by fully automated vehicles, partly automated vehicles and manually driven vehicles[3]. Therefore, during this transition period, it will be vital that infrastructure is appropriate for all types of vehicles.

Signing and lining will be particularly important as vehicles transition from being conventional to fully autonomous. This is because increasingly autonomous vehicles are likely to rely heavily on clear and visible lines for lane keeping and signs for speed limit compliance and hazard warnings until a time when GPS signals and other technology offer full support[4].

Some current crash countermeasures may be needed less than they are now in the future. Proving their economic benefits may become more difficult as a result. For example, crash barriers may be required less and the economic benefits of roundabouts over signal-controlled crossroads may be diminished. However, there is a need to keep conventional crash countermeasures during the transition as they will continue to achieve good cost-benefits[5].

**The regulatory framework**

As highly and fully autonomous vehicles are developed, decisions will need to be made as to whether occupants will need a full driving licence as required for conventional vehicles or whether those with a modified driving licence will be able to operate highly autonomous vehicles that are likely to need less input from the 'human driver'. This could work in a similar way to the current system of driving licences required for manual and automatic transmission vehicles.

When a vehicle is driving itself, a human driver can no longer be the principal focus of accountability for road safety. Instead, new systems of safety assurance are needed, both before and after vehicles are allowed to drive themselves on roads and other public places. The Law Commission has therefore recommended a new Automated Vehicle Act, setting out new regulatory regimes and new legal actors[6].

One key change[7] will be that when an automated driving system is engaged, the person in the driving seat will no longer be a driver but will become a "user-in-charge". They will have immunity from a wide range of offences related to the way the vehicle drives, ranging from dangerous or careless driving, to exceeding the speed limit or running a red light. However, the user-in-charge will retain other driver duties, such as arranging insurance and checking loads. They may be also be required to take over driving in response to a "transition demand", if the vehicle encounters a problem it cannot handle.

A very clear regulatory framework will need to be in place before these vehicles become a common sight on Britain's roads.

**Safety and perceptions of safety**

One of the key expected benefits of self-driving vehicles is that the number of road crashes and casualties will significantly reduce. Automation can prevent crashes, limit injury, reduce risky behaviour and provide support to high-risk groups in high-risk situations[8].

In 2020, 1,460 people were killed, 22,069 were seriously injured and 92,055 were slightly injured as a result of a reported collision on Great Britain's roads[9]. Human error is considered a contributory factor in around 90% of all fatal road crashes[10]. As automated vehicles are not subject to being driven impaired, driven while texting or subject to other forms of distraction such as being fatigued, it is likely that there will be a reduction in collisions. However, it must not be believed that human error has been correctly identified as a contributory factor in collisions or that all crashes could have been otherwise avoided by addressing that error. Many crashes that involve human error also involve other factors that may have still contributed to the crash even if the human had not made a mistake. Errors linked to poor roadway design or faulty vehicle design are often attributed as human factors, when they are in fact design errors[11].

One way in which automated vehicles could reduce the number of road casualties is through speed limit compliance. Currently on 30mph roads, over half of car drivers tend to travel above the speed limit and 11 per cent travel at 35mph or more[12]. However, in future, driving speeds will be controlled by the system. Sensors that are expected to be installed in automated vehicles are likely to be much faster and more reliable at detecting and avoiding vulnerable road users than most drivers today. This could provide large reductions in road casualties for vulnerable groups such as children, the elderly and cyclists[13].

There is an expectation that driverless cars and autonomous systems will deliver a 'near zero' harm solution for everyone, including vehicle occupants and those termed 'vulnerable road users' such as pedestrians and cyclists. However, 'near zero' does not mean absolutely zero, as there could be times where the driverless vehicle will be forced to choose between options where there is no outcome that avoids harm to all road users.

Therefore, a full application of the Safe System approach is still recommended, taking into account the possibility of technology failures of autonomous vehicles, acting as a fall-back solution. The system should be built to tolerate human and machine errors, preventing death and serious injury in the event of a collision[14]. The Australasian College of Road Safety describe Safe System countermeasures as aiming to either prevent a crash from occurring or to reduce the severity of that crash while minimising the possible role of human error in precipitating the crash[15]. Safe System measures include central and nearside barriers that prevent vehicles striking one another head-on and dedicated facilities for vulnerable road users that provide separation such as cycle lanes[16].

Despite the benefits of autonomous vehicles, there are also a number of risks faced, particularly during the transition period where conventional, semi-autonomous, highly autonomous and fully autonomous vehicles will share the road.

As automation in the vehicle increases, the role of the driver will move from one of a vehicle operator to a system supervisor[17]. The difficulty stems from ensuring safe driving performance when vehicles are semi or highly autonomous. The challenge of this is keeping the driver, who may need to take control of the vehicle at any time if the system requires them to be kept ‘in the loop’. Drivers may not pay much attention to their ‘driving’ if they believe that the technology will prevent them from crashing no matter what. This is related to a number of ‘ironies of automation’ because far from alleviating the driving task, partially automated systems which require the human driver to take control of the vehicle may lead to complex decision making environments and risks of unintended consequences. These ironies are:

- Task allocation: poorly adapted task allocation occurs when easy tasks, which the average human driver can handle well are allocated to automated driving systems leaving only the most challenging tasks to the human driver, leaving potential for error or unsafe outcomes. Automation should target the tasks that are difficult or in some cases impossible for human drivers[18].
- Disengagement: a lack of practice or imperfect situational awareness leads to reduced skill and delays in humans carrying out driving functions when they are required to do so by the system[19]. It could even be dangerous to assume that drivers can safely take over control from an autonomous vehicle in time to avoid accidents and injury. Highly trained commercial aviation pilots sometimes take minutes to detect the need to takeover and determine an appropriate response. In the vehicle, drivers are often relatively untrained and highly distractible, yet time for corrective action is seconds rather than minutes[20].
- Cognition: lack of engagement in the driving tasks leads to lower levels of situational awareness and longer reaction times when the automated driving function disengages and asks the human to take control. Simply supervising the situation does not offer enough engagement to keep the driver vigilant. Drivers may also easily become bored and begin to engage in distracting activities that can limit the speed and effectiveness of system handovers[21].
- Control: driving is a skill that needs to be practiced regularly to be perfected. The less time spent driving and less recall of the physical ‘feel’ of the vehicles can lead to an unsafe driving response in the form of poor steering, acceleration and deceleration[1]. This could be particularly problematic for young drivers who begin their driving career in these vehicles. They may not have the ability to anticipate situations in which they will need to control and drive the vehicle.

The issue of transition of control and being ‘out of the loop’ potentially becomes a serious problem in interactions with vulnerable road users such as cyclists and pedestrians. If it takes too much time for the driver to take over when needed, they may not be able to avoid a crossing pedestrian or cyclist in time. The occasionally rather unpredictable behaviour of pedestrians and cyclists could well be the reason that the automated system malfunctions and the human driver is asked to take over[22].

The issue of reduced cognition and engagement with the driving task is illustrated by 2021 Swedish research[23] into the effects of automated driving on driver sleepiness, conducted by Ahlström et al. It was hypothesised that partial (level 2) automation of the driving task would lead to increased sleepiness in drivers as a result of lack of interaction, due to the fact that level 2 automation only requires the driver to monitor the environment, as the vehicle takes over the steering wheel and pedals. The research involved 89 drivers carrying out long drives on a Swedish motorway, once during the day and once during the night. The drivers carried out these two long drives twice, on separate days, once using normal manual driving and once using the same car but with partial automation enabled. As the participants were driving across all of the conditions, various parameters were measured, such as heart activity, eye movement and blinking, sleepiness, speed and acceleration. When comparing the different conditions, the following was found:

- As would be expected, the night drive resulted in increased sleepiness, and sleepiness increased faster during the night than during the day
- The partially automated driving conditions led to small (but statistically significant) increases in sleepiness parameters, and this effect was much stronger during the night drives
- Participants reported being less sleepy during the day when driving with automation turned on compared to manual driving, and more sleepy during the night.

The researchers conclude that partially automated driving results in increased driver sleepiness during night driving, with a minimal effect on day driving when the driver is naturally more alert and less requiring of sleep, and this should be considered as part of driving regulations.

As there will be a transitional period in which conventional vehicles, semi-autonomous, highly autonomous and fully autonomous vehicles will share the road, drivers will need to have an understanding of the various types of vehicles. The public will also need to be aware of the performance abilities and limitations of these vehicles.

So far, it can be concluded that automated vehicle technology has mainly focussed on the detection and recognition of pedestrians and cyclists by the vehicle and although good progress has been made, many difficulties are yet to be overcome. Technology to reliably predict intentions and behaviour of cyclists and pedestrians, so that the automated vehicle can adjust its behaviour is crucial for safe interaction between these vehicles and pedestrians and cyclists. However, this is not straightforward as it can be very difficult for an automated system to predict behavioural intentions of pedestrians and cyclists[24]. The idea that pedestrians and cyclists will respond differently to partly automated vehicles also cannot be ignored. The few studies that have examined the behaviour of pedestrians and cyclists in interaction with automated vehicles found that they were fairly cautious and not per definition confident of its 'skills'. Pedestrians and cyclist were found to appreciate messages and or signals from indicating whether the vehicle had detected them and what it intends to do[25].

RoSPA also notes that there is a lack of information and evidence on how self-driving vehicles will recognise and react to horses and riders. It is not yet clear whether consideration has been given to the way horses may react or behave on a road. The horse and rider are the vulnerable road user together and should be considered as such. A self-driving vehicle will need specific programming to enable it to recognise horse behaviour and ensure the recently updated Highway Code advice is adhered to.

In current interactions between pedestrians and cyclists and conventional vehicles, informal rules and non-verbal communication are important aspects of communication. However, with the increasing level of automation, this type of communication will lose its function from the perspective of the vehicle and the pedestrian or cyclist. It will be very difficult for the vehicle to predict the behaviour of pedestrians and cyclists if they do not use the formal non-verbal communication cues such as using an arm to indicate a change of direction. Informal cues are generally subtle and therefore difficult to read. For pedestrians and cyclists, interaction with automated vehicles implies that they cannot rely on informal communication cues anymore. The effect of making eye contact with or smiling to a 'car driver' is not the same if the driver is not the person who is controlling the car and may be involved in completely other tasks, such as reading the newspaper or typing a text message[26].

As vehicles become increasingly autonomous, it is essential that drivers understand the technology in their vehicles, what it does, how to use it safely and the potential risks of misuse. Drivers should receive vehicle familiarisation training when they receive new vehicles, including the safe use of technology, particularly if their previous vehicle did not have it. Drivers need to be alert and ready to take control of their vehicle at any time and therefore must not engage in other tasks such as making phone calls or writing texts or emails during driving time, as they are still in charge of the vehicle.

If used properly autonomous vehicles have enormous potential to reduce crashes and casualties, but if they are not used properly, they can also increase risk, especially if drivers over-rely on the technology.

RoSPA has no further comments to make on the call for evidence process, other than to thank Transport Select Committee for the opportunity to comment. We have no objection to our response being reproduced or attributed.

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**Endnotes**

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