

Transport Committee

Oral evidence: [Self-driving vehicles](#), HC 519

Wednesday 16 November 2022

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[Watch the meeting](#)

Members present: Mr Ben Bradshaw (Chair); Jack Brereton; Ruth Cadbury; Chris Loder; Karl McCartney; Grahame Morris; Gavin Newlands; Greg Smith.

Questions 155–187

Witnesses

[II](#): Becky Guy, Road Safety Manager, Royal Society for the Prevention of Accidents; Professor Jack Stilgoe, Professor of Science and Technology Policy, University College London; Ian Wainwright, Chair of Freight and Logistics Policy Group, Chartered Institute of Logistics and Transport.

Written evidence from witnesses:

- [Royal Society for the Prevention of Accidents \(RoSPA\)](#)
- [Professor Jack Stilgoe](#)
- [Chartered Institute of Logistics and Transport \(CILT\)](#)

Examination of witnesses

Witnesses: Becky Guy, Professor Stilgoe and Ian Wainwright.

Q155 **Chair:** Welcome. I don't know whether you were here for the earlier evidence session, but I issue the same appeal: if one of you has already answered the question comprehensively and you do not have anything to add, please do not feel the need to repeat what they said. If you have anything new to add, that is always very welcome to the Committee. Perhaps you could introduce yourselves.

Becky Guy: Good morning, everyone. My name is Becky Guy. I am road safety manager for England at RoSPA, which is the Royal Society for the Prevention of Accidents.

Professor Stilgoe: Good morning. I am Jack Stilgoe, professor of science and technology policy at University College London. I have just stopped running a big social research project called "Driverless Futures?" looking at what experts and members of the public think about this stuff. I was recently one of the authors of a report from the Centre for Data Ethics and Innovation on "Responsible Innovation in Self-Driving Vehicles".

Ian Wainwright: Good morning. I am Ian Wainwright, an independent consultant on urban freight and logistics particularly, but I am here today on behalf of the Institute of Logistics and Transport because I chair its freight and logistics policy group.

Q156 **Chair:** I will ask all of you to start with what you think the advantages or potential disadvantages are of this technology, starting with you, Jack.

Professor Stilgoe: You have already heard some of this from other witnesses, but I can tell you what some of the suggested advantages are. The dominant one is safety. Often, the first justification that researchers and tech developers give would be improvements in road safety. They might say something about the efficiency of mobility. They might say something about congestion. They might say things to do with sustainability, although the connection between this technology and sustainability is not yet fixed. From my perspective, I think none of those things is yet proven. They are all possible. I think the question for policy is what it would take to realise some of those benefits, to realise them in a fair and trustworthy way and to ensure that some of the potential disadvantages are sidestepped.

The disadvantages would be the potential to create new hazards and to worsen some of the problems of mobility that we have at the moment. There is a lot still that is open-ended in this debate. I would not take any of the benefits or the disbenefits for granted at the moment.

Q157 **Chair:** We are going to get into what would it take in a second. Ian, what



is your overall view of the advantages and disadvantages?

Ian Wainwright: It is very similar, in the sense that I think there are some clear potential advantages around safety. We already know that in some commercial circumstances it works in what we would term a closed loop system. Effectively, some of the technology is the equivalent of what is happening in warehouses and the robotics that are being introduced in warehouses, ports and shunting yards, where you can move vehicles around in perhaps an even tighter restricted area through automation. It potentially saves costs.

It has issues in terms of jobs because, clearly, people do not have to be deployed or it changes the nature of the employment. It started from a safety-first principle that if you have automated pallet trucks moving around a warehouse and you still have people moving in there, you have to deal with that. It has to be for the people as well; they have to work together.

I would not say there are necessarily disadvantages, but there are issues we have to tackle. One of those is particularly around the transition. Yes, if everything was fully autonomous, it is a bit of a nirvana—"Can we get there?" But we have the fact of "Will we ever get there?" There are lots of people who have classic cars and vintage cars. How do they evolve to work with an autonomous vehicle? You have to retrofit them.

The biggest issue is probably about human behaviour. At the moment, while everybody needs to be legally insured to drive a car, not everybody is. It relies on enforcement to tackle the people who will not. It is also about how we react. People walking around cities with mobile phones perhaps do not tend to look at the traffic so well. There is also the fact that, if a vehicle is failsafe, currently if somebody steps out in front of it, it should stop. If we all, as humans, get used to that, do we just wander off any pavement to cross the street, knowing the vehicles will stop for us? The potential for congestion could actually get worse. From a commercial vehicle perspective, that is a nightmare because they need journey time reliability. Buses are only going to work if they arrive on a regular basis. Deliveries only happen if they are there on time. There are some issues on those sides of things that need to be proven.

Chair: Becky?

Becky Guy: I totally agree with what has been said so far. In terms of the advantages, there is potential, although it has not yet been proven, that these vehicles could significantly reduce casualties on our roads. At the moment around 85% to 90% of collisions are in some part due to human error. These vehicles, in theory, are not going to be driven while they are tired. They are not going to be texting. They are not going to be driving while impaired, but it is important to caveat that. Although almost 90% of collisions have human error as one of the contributory factors, other things play into that. It is not to say that just because of that



mistake the crash happened. There could be other things that played into it.

One of the key ways in which these vehicles might improve safety is in speed limit compliance. Currently, on 30 mph roads over half of drivers actually exceed the speed limit. A smaller proportion, around 18%, drive at 35 mph or more. In future, driving and speed will be controlled by the system in many instances.

There are mobility benefits for various groups. For young people there are really high costs of learning to drive and high insurance premiums. It is not yet clear, from what the earlier panel said, whether those insurance premiums for younger people will reduce, but it might be that younger people have better access to employment and education opportunities by being able to access these vehicles.

There are also older people as part of that group. As people get older, they may have health issues or issues with their eyesight. Reaction times might not be as good. That could end their driving career. Those people then have to rely on public transport, which can be an issue if they are in a rural area, or on lifts from family and friends. As we are an ageing population, these demands are likely to increase. There is a potential for those vehicles to help with some of that.

Finally, there are disabled people. Around 11% of the population have mobility problems. These vehicles could contribute to giving them a chance to access better education and employment opportunities.

As Ian was just saying, we have some safety concerns around the transition demand. We think that could be a real issue, potentially; cyber-security too; also how these vehicles will interact with conventional vehicles and other vulnerable road users.

Chair: Thank you. We are going to come on to some of those areas in a bit more detail in a second, but Karl McCartney wants to come in first.

Q158 **Karl McCartney:** I have two quick questions, first to Professor Stilgoe. From what the three of you have said so far, is safety the main driver or are the cost implications the main driver, would you say, from your research so far, or is it just because we can?

Professor Stilgoe: It depends on who you ask. When companies stand up and give their pitches about why this technology is the next big thing, they are likely to emphasise safety. The arguments about costs are even more speculative at the moment. Where people have done the sums, we are still a long way from developing something that looks like a reasonable business model.

Q159 **Karl McCartney:** I think costs are always the biggest thing in a big organisation though, aren't they?



Professor Stilgoe: Yes. If you talk to a company like Uber, they were developing self-driving vehicles a few years ago. They would have made that argument and would have said that the majority of the cost of any ride is the driver, so if they can replace the driver, it cuts costs. The trouble is that developing the enterprise, the technology, is exceptionally expensive. It is not quite clear how big the hump is and whether, on the other side of that hump, there are substantial cost savings to be made.

Q160 **Karl McCartney:** Ian, I was very interested in what you had to say about where the autonomy is happening or where it is perceived that it is going to happen, in the warehouse and so on. For the general public out there, the supply chain and where lorries go is what they perceive as autonomy. Do you think that is going to happen sooner rather than later, or is it going to be much later? In my mind, I am thinking that with Tesco lorries tipping up at each Tesco store, there are 15 or 30 cages that need to be unloaded from a lorry so that is what the driver does at that point in time, with people in the store. Is the industry expecting autonomy to allow that to happen at each store, with robotics being in place?

Ian Wainwright: If you are going from a warehouse to a warehouse, or somewhere you can do that, then maybe there is a potential benefit because somebody in the store could actually pull the cages out. The issue is when you are delivering to somewhere across a street or it is a home delivery. It is somebody taking it across a pavement. It is the interaction, even if you have pavement drones—droids, robots or whatever we are going to call them. You still have to go and get it and pick it out.

The issue with the pavement robots is quite interesting. The question is whether they will stop for people. I have even seen a picture of one stranded on a pavement—I think it was in Philadelphia or somewhere—where there was some overgrowing vegetation. It did not know what to do because it could not get off the pavement, and it was just stuck there.

I am sure that the technology will solve some of that, but the interaction with the person is the real issue. On the home delivery side, people say, “Oh, this is great,” but you still have to know it is coming, and do you really want to go out there in all weathers? Somebody handing it to you at your door is a lot nicer. You know that you have got the right thing. You can have a conversation with them, and that type of stuff.

The cost saving is minimal, potentially. The DfT were involved in the trial of platooning with TRL. The benefits that people thought they were going to get from the energy saving of putting vehicles together on the motorway were not necessarily as big as people thought they were going to be. There are some issues. There are some potential benefits, but the minute you get into the public domain there is a huge risk. Clearly, as a business, it is the business taking the risk. No business wants to put a driver in a situation where they are going to cause a problem, because they have a duty of care to their employees, apart from anything else. I think there are some real questions in there.



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Karl McCartney: I am conscious, Becky, that I didn't come to you. Is there anything you would like to add?

Becky Guy: No, I don't think so.

Q161 **Chair:** On the economics of this, we already know from the car clubs model, for example, that you can save an awful lot of money as a member of the public by not owning a car that sits outside your house for 96% of the time not doing anything. I am a member in my own city, Exeter, of the local car club, which means that I can have access to an electric vehicle whenever I want at an affordable price. That model is the sort of model that could be replicated, and manyfold more, in an autonomous vehicle system, couldn't it?

Professor Stilgoe: It certainly could be. The question is what the obvious connection is to a driverless system. If you have a system that requires drivers, what transformative change do you add by automating that system? In automating a system, you are adding substantial cost. You are adding staffing costs. Often the staff are behind the scenes in things like remote operation, fleet support and customer support, plus you are adding a lot of hardware costs for the sensors that you are putting on top of a vehicle.

Q162 **Grahame Morris:** Ian, you mentioned some examples of where we might see self-driving vehicles; warehousing and perhaps ports and storage and so on. Looking at the development of self-driving vehicles, what are the opportunities? Can you give some more examples? You mentioned drones going along the pavements. I think we are going to go and see one of them this afternoon. What can we expect as we see the roll-out of this technology and the appropriate legal approvals?

Ian Wainwright: As I say, from a warehousing point of view, for example, we started with things like a pallet truck driven by a human that was guided in the warehouse, which meant that you could narrow the aisles.

There has been the approach that engineers tend to build it because they can, but if there is a benefit to it, people will use it. It has to work with the people. Internally to the warehouse, it depends whether it is like a black-box warehouse where effectively everything is full pallet in and full pallet out, or whether it is something more interactive and is about picking, with people in there. Then you have to deal with that. They tend to be slower speeds.

If you have ever seen it, a yard operating at night when there are vehicles moving around is a very dangerous place and it is dark. The shunters are a breed apart. They are people who know what they are doing, and they know how to work around it. You keep everybody else out of the yard. You could make it even safer by not having humans there. There are people looking at that. Firms like Volvo have developed an automated shunter. It happens in places where there are ports. It is closed-loop things.



There are some limited approaches such as whether you could do it down certain stretches of road that are public access, but the minute you have a pavement, as I say, you start to get this interaction where people have a different view of their safety from what the vehicle or the driver does. We all have different behaviours when we are in a car driving it, as opposed to when we are a pedestrian on the pavement.

- Q163 Grahame Morris:** In terms of productivity, I am thinking of some of the trials, particularly of supermarket delivery vehicles. I think there is going to be one in north London as and when the regulatory approvals are given.

What can we anticipate in productivity gains? I was just reflecting on it. If there is no driver in the vehicle and the vehicle arrives at the destination, and then the individual who has placed the order for their groceries has to come out and collect them, presumably someone or some automated system has had to pack the vehicle. I don't know what the system will be with lockers and combinations, but are the productivity advantages as much as many people are suggesting? Are you sceptical about that?

Ian Wainwright: Personally, I am quite sceptical about it. Clearly, if it is a Tesco or Sainsbury's home delivery vehicle, there are several orders on there; it is not just one person's. Who knows what to pick out, particularly if you have different temperature regimes because you want the product stored properly. Do you start at the motorway end and go for fewer people involved, so therefore it is more vehicle to vehicle, or do you start at the slower urban end, where you deal with speed? There is a big issue on both sides of that.

There will be some opportunities in that, but I think it is about the pace of change. A lot of the conversation at the moment is dictated by companies trying to push the technology or the vehicle. It is interesting that people like Ford and Volkswagen have just come out from the idea of trying to go to autonomy. We have to deal with the people side of it. I think that is important in how we deal with any of this stuff, going forward.

- Q164 Grahame Morris:** Professor Stilgoe, is the thing that is a huge advantage for the driver—I hate to use that word because these are driverless vehicles—not necessarily the increases in productivity arising from having fewer people driving vehicles, but the broader benefits to society such as safer vehicles, safer deliveries and safer roads by removing the opportunity for human error?

Professor Stilgoe: I think it could be if we get it right, but I don't think we should presume those things. I think we should ask what Government need to do in order to create the framework that would get that right.

One thing that I think would be helpful in understanding where benefits might accrue is getting away from the framework that I know you have already discussed about the levels of automation, that there is a sort of ladder, and we are trying to get to the mythical level 5. All of the



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interesting discussion happens at level 4, and the question there is often downplayed because we talk about automation as though it is just a car where you are taking out the driver and putting in a computer, but the important thing is about defining what the engineers call the operational design domain. What are the circumstances in which this thing works?

There is a danger that we get trapped into talking about cars. Actually, some of the most interesting benefits might come with shared transport. They might come with dedicated infrastructures. It might be that some of the most beneficial technologies are the safest and most boring ones. We just need to think about the driverless transport that we already have in London. Defining the operational design domain is key.

Q165 Grahame Morris: You have said several times, and you said in your written evidence, that we should ask the right questions. Are these questions that we should ask of society generally, or directly of the Government?

Professor Stilgoe: They are questions, ultimately, that we need to ask of the technology. Rather than presuming that we know what a self-driving vehicle is, this is still a work in progress and there is a lot still to be defined about what the technology looks like and what its safety assurance systems look like. We have let ourselves be led by the idea that more technology is good. Yes, but in what direction? That is why we said in our evidence that, if self-driving vehicles are the answer, what is the question? We still don't have a good signal on that.

Grahame Morris: I am not sure that I am any clearer but thank you. I will hand over to my colleague, Gavin Newlands.

Q166 Gavin Newlands: Perhaps I could come back to you, Professor Stilgoe. Is it realistic to expect most vehicles to be self-driving in the future? The future is quite a long period of time. Let's keep it to the near future, say the next 25 or 30 years.

Professor Stilgoe: There are a few things that might help. As a social researcher, I do not do predictions. I am not trying to sell things. First, what would it take? What sort of enabling legislation would it take in order for that to happen? Ian mentioned the transition. We should remember that transition to the car is still not complete on our roads. We still allow horses and all sorts on our roads. One question that we might ask is whether in the future we are willing to ban certain sorts of road user from certain sorts of roads. We do that on motorways to guarantee their safety, their speed and all the rest of it.

That is one thing I would ask in predicting whether a self-driving future is going to arrive quickly and neatly. Another thing is just to think about the pace of transition. Ian mentioned classic cars, but equally we could talk about the age of existing cars and how long it takes for those things to get recycled. We have seen relatively quick transitions on things like movements to electric vehicles, but my suspicion is that this is part of a decade's long transition and that it will be an endless transition.



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Q167 **Gavin Newlands:** I would like to frame this question as a yes or no, but I suspect you are going to say that it depends. Is it desirable for most cars to be self-driving in the future?

Professor Stilgoe: I am trying not to say that it depends. For some people, yes, it might be if we can get it right. With the existing problems with our transport system, we could focus on what self-driving vehicles might do to alleviate some of those things, and safety would still be a huge problem, but the transition towards greater automation could have huge benefits there. But if the Government legislate badly, for example, we might have the spectre of a zero-occupancy vehicle arriving in the middle of a city that is already trying to reduce the number of vehicles in its city centre. We might see massive exacerbation of problems of congestion, pollution and all the rest of it, so that is a way of saying it depends.

Q168 **Gavin Newlands:** Heaven forfend that a Government legislate badly. It would be a shock.

Ian, can I turn to you for a logistics point of view? Different parts of the logistics sector have already been touched on. Do you envisage a future where most of the logistics sector is, to some degree, self-driving or autonomous?

Ian Wainwright: Again, I am trying to think of a word that is not "depends".

Gavin Newlands: "Depends" is an answer.

Ian Wainwright: There has to be a degree of nuance. Clearly, at the moment, you can get a very different service. There are experiments, particularly in the States but also in Germany, where there will be deliveries to your fridge. They will actually come in and stock your fridge for you, almost as if it was in a shop. There will always be the interaction of how much you want to pay for a delivery. Logistics is a cost versus a service. Do you want to pay for all the bells and whistles, or do you want it thrown out of the back of the vehicle while it is still moving? Those are the extremes.

Where there is a clear business benefit, businesses will do it. The question there is that they will always err towards some degree of safety because there are more people involved in that decision making. My concern is that it has to be about how the vehicles work with all the other interactions in an area, whether it is other vehicles on a motorway or, when you get into an urban area, pedestrians or somebody pushing a buggy across a pedestrian crossing. There are the cyclists. We have micro-mobility now, which we still need to legislate for. Does everything go on the pavement? Where does all this stuff fit? When you are making the delivery, you are using the kerbside, so every single piece of kerbside has to be digitally enabled.



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With no disrespect to local authorities, a lot of the stuff is not just about the double yellow lines and single yellow lines; for deliveries it is the blips across the kerb. It is an extra piece about how that is timed. It is not digital at the moment. I think Hackney tried to come up with their kerbsides as digital, but we have to put all that legislation into the systems so that the systems know where to park, how to park and everything else. It will get there in the end, but there is a lot of work to do in the meantime, which is a lot of cost as well.

Q169 Gavin Newlands: I accept that. On the safety element, Becky, I will come to you. Everyone knows that I am an optimist, so let's say this is rolled out and it is proven to be a success from a safety point of view and the numbers of accidents and deaths are cut down. Could you envisage a future where a level of automation to level 2 or level 3 is mandated in new cars in that near future of 25 or 30 years? If so, would that be desirable?

Becky Guy: The results of the trials at the moment show that automated vehicles can operate in some contexts, but that their performance in other conditions needs to be further developed before they become a common sight on our roads. I think certainly in the short term probably not. We believe that safe, fully autonomous vehicles are still quite some way off and that probably, in the first instance, they would need to be confined to the simplest types of roads, and only when it is proven that they are safe and can operate reliably can they start to operate on other roads too.

Q170 Gavin Newlands: I put my last question to Jack, if he wants to comment. Does the introduction of autonomous vehicles over the next 25 to 30 years make road pricing or road charging easier to introduce? Will it come in quicker than it might do if it were not for the introduction of these vehicles?

Professor Stilgoe: It depends whether you are talking about road pricing as a technical challenge or as a political one.

Gavin Newlands: A technical challenge.

Professor Stilgoe: In a world of connected vehicles, in principle it would be technically easier to know who is driving where and when, and price the roads accordingly. That does not make the political problem go away.

To Becky's point earlier about speed limit compliance, it is a really interesting question but it is politically controversial, as we know, because it would be technically relatively easy to automatically limit the speed of vehicles. It is pretty much ancient technology in these terms. It is politically very hard to do that.

Q171 Gavin Newlands: But technically more likely.

Professor Stilgoe: Society might be bumped into enabling this sort of thing technically, but I feel that we should have democratic discussion as



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we go along developing the technology. There is a risk of a backlash if it is done without thought.

Gavin Newlands: If nobody else wants to dip their toes in that, I will hand back to the Chair.

Chair: Thank you, Gavin. We have already touched on quite a lot of the safety aspects, but my colleague Ruth is going to drill down into those a bit more.

Q172 **Ruth Cadbury:** Yes. Obviously, the biggest concern that the public have about automated vehicles is the safety aspect. On the one hand, it is said, and it is a fair point, that 90% of crashes and collisions are caused by human error, so if you take that out you are taking out a lot of the danger. But are they safe? Becky, what, in your view, are the biggest potential dangers of automated vehicles?

Becky Guy: One of the key issues for us at the moment is the idea of a partially automated vehicle that issues transition demands. The role of the driver effectively moves from operating the vehicle to becoming a system supervisor. The real challenge is keeping that person engaged and in the loop of the vehicle, especially if drivers begin to believe that the system can operate in lots of contexts and it is very unlikely that they would have to intervene, or that the vehicle would crash. They might tend not to pay as much attention to their driving.

What we came across in this sphere was a study that spoke about ironies of automation. Far from alleviating the driver of the driving task, these systems ask the driver to take control of the vehicle and make quite complex decisions. In terms of task allocation, the moment the things that the average human driver can handle well are handed over to automated systems, it leaves the more challenging tasks to the human driver.

There is also disengagement. By not driving all the time, and perhaps zoning out of situational awareness, drivers are less skilled, and they can be a bit more delayed in reacting to the vehicle when it issues the transition demand. If we think about it in an aviation context, commercial pilots are highly trained. They are given perhaps several minutes to make themselves aware of the situation again and take the appropriate action, but with vehicles it looks as though it could be seconds.

Ruth Cadbury: Or even split seconds.

Becky Guy: Exactly, so how does the driver then make the right decision in that amount of time if they were reading their newspaper, or whatever it might be? Simply supervising the situation is not enough to keep the driver engaged. They start to engage in other things.

There is also the control aspect. Driving needs to be practised regularly to be perfected. As we came out of the covid lockdown, there was lots of coverage in the media about people feeling rusty and not quite as good at



driving as they had been when they were driving regularly. This may be a real issue for new drivers who come into driving as these vehicles are introduced. How are they going to negotiate using the vehicles?

Finally, there is the problem of interacting with vulnerable road users. Pedestrians and cyclists might act unpredictably. That is likely when the system says, "Okay, you need to intervene." How do we get the driver to react in time?

Ruth Cadbury: Jack?

Professor Stilgoe: I think the points about the human/machine interaction in particular are absolutely key. The point we were making in our Centre for Data Ethics and Innovation report about how safe is safe enough is a key political question for regulators. At the moment we simply do not know what the levels of public acceptability of risk would be. Even if we saw dramatic improvements in average safety as a substantial number of vehicles came to be automated, we might see a redistribution in risk and new types of risks—cyber-security risks and systemic risks—and therefore the defenders of these vehicles, whether they are the Secretary of State or the manufacturers, might have to face difficult questions. Even if there were dramatic average improvements in safety, if one of their vehicles was found to have caused a death, how do they defend that?

It is very hard to defend it on the grounds that we see average improvements in safety. You only need to look at other areas of transport like trains and planes to get a feel for the dramatic differences in public acceptability of risk with those systems. Some of the characteristics of public risk perception might turn out to be really important, like a perceived lack of control. People might ask, "Who is benefiting from this technology if it is creating this risk?" even if we see average improvements in risk.

Mark said in the earlier session that he would take issue with the Government's rather low standard for an acceptable safety level for the technology. In our report we did not draw a line on acceptable risk; we said that we simply do not know at the moment and there may be orders of magnitude demands for increased safety with the technology. Just presuming that an AV was as safe as the most careful, competent human driver might not satisfy people.

Ruth Cadbury: Do you have anything to add, Ian?

Ian Wainwright: Just on that last bit. Who is a competent, careful driver? We would all say we are, but somebody is less competent and capable, and nobody admits that. What does that pitch really mean? Whether it is political or not, there is a clear ambition that has come out from a lot of cities. It started in Sweden with vision zero. You try to do everything possible to reduce fatalities on streets to zero. How that works is about how people react to the vehicles, as well as the other way round.



You may never have driven in your life, but currently you sort of know what vehicles are going to do. If the technology ends up doing something different, do you know how to react to that? Currently, we are different animals inside a car from when we are outside a car, and I don't think we have quite worked out how that fits into things.

Q173 Ruth Cadbury: I will move on to that. How will self-driving vehicles interact with other road users? Which interactions are likely to present the biggest problems?

Professor Stilgoe: A crucial part of future rulemaking is that we see the importance of micro-interactions on the road. It is what we might call rules of the road, which include the hard and fast things and the grey area of the highway code and might include some unwritten rules about how people go about interacting on the road. We have seen demonstrations of the technology succeeding in certain areas of certain places, which might themselves have certain rules about where pedestrians are allowed to go and when. We might have seen other road users having to accommodate the arrival of self-driving vehicles.

There will be an important and potentially difficult set of conversations to be had about renegotiating the rules of the road, which are currently designed around human navigation. They are designed around a world that is human readable rather than machine readable. We can think about particular parts of the road network; zebra crossings are a really interesting one, a conversational piece of infrastructure in which there is negotiation between a pedestrian and a driver. That makes it a very hard thing for a self-driving vehicle to navigate, dealing with those moments of uncertainty.

We can also look at shared space. Exhibition Road in London is an example of shared space. We can ask whether self-driving vehicles would be as comfortable there as they are in segregated spaces, where the rules of the road are much more hard and fast and where the expectations on pedestrians are much clearer and you are more likely to have cycle lanes, bus lanes and all the rest of it. As soon as you start to blur the boundaries, things become much harder for an automated system. We might see pressure to "upgrade" the rules of the road or upgrade infrastructure in order to suit automated vehicles. That might be a good thing for overall safety, but it is also likely to be contentious, particularly for vulnerable road users.

Ruth Cadbury: Becky?

Becky Guy: To add to that, technology that can reliably predict the intentions and behaviours of vulnerable road users will be crucial for these vehicles to be successful. We cannot put aside the idea that vulnerable road users might react differently to these vehicles than to other vehicles. There have been studies that have looked at the behaviour of pedestrians and cyclists around these types of vehicles. They found that people are fairly cautious and unsure about the vehicles'



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skills. What they appreciate are messages and signals from the vehicle to let them know that the vehicle has detected them and that they can cross, or whatever it might be. What we do not know is whether, in the future, that will change, and people will believe that the vehicle will stop, no matter what, and step out in front of it.

Informal communication is important in the current road system, but if the vehicle is automated it loses its role. For example, at the moment we might, if we are out as a pedestrian, make eye contact with a driver or smile at them to cross the road. Suddenly you might have a user in charge who is involved in another task, and you cannot get eye contact with them, so how can you have the confidence that the vehicle has detected you?

The majority of proposed solutions at the moment are adding visual cues to the exterior of the vehicle. It could be strips or messages that say, "I am waiting," or, "Safe to cross"—those sorts of things. Although those things might work where there is a single road user, I struggle to understand how they would work at busier and more complex junctions where there are lots of different road users.

The final thing to add is that we have seen that, unfortunately, there is some bias in the design of these vehicles. Current facial recognition shows a bias towards white male faces. When we look at people from different ethnicities and women, for example, the accuracy of those systems goes down. There needs to be a lot of testing and proof that these vehicles can detect different genders and ethnicities. We are looking at whether they are going to be looking at leg movements. Can they detect people who are wearing dresses or skirts rather than trousers? Can the vehicles detect disabled road users if they are in a wheelchair or on a mobility scooter? There is quite a lot that we need to do to look at the interactions with all the different types of road users, such as pets and horses. The list goes on.

Ruth Cadbury: Toddlers.

Becky Guy: Yes, absolutely.

Ian Wainwright: To pick up on that last point, a lot of work has been done on safety around HGVs, particularly for pedestrians and cyclists. DHL does work positively by taking vehicles into primary schools and getting the kids to stand in front of them, to see how much they can and cannot be seen and things like that. I think there is an assumption that the cameras or sensors on the vehicle will cover that. Vehicles are now being designed with safer cabs, which are lower and so on, and that helps, but there is still that last bit. As Becky said, it is about whether you can see the driver and they can see you. I am not certain that we get a lot of kids and adults to really think about that. It is about how people are encouraged to interact with the streets and the pavements.



A lot of the technology for these activities is being driven through the United States and China. Culturally, we are very different in Europe. If you take southern Europe, as opposed to places like the Netherlands, how people behave around things like pedestrian crossings is very different. In Germany and the Netherlands, everybody stands there and waits until the green man comes. In southern Europe, and in Britain as well, we do not do that. We go when we think it is clear.

That is an issue, because the technology is slightly different and is being thought about in different territories. We drive on the left. Are there any issues with that? What does that do? I do not know. I am not saying that there are issues, but clearly there is a different behaviour in turning right or turning left at a junction for a cyclist, and whether other vehicles may cut you up or not. That is true of this technology. Does it pick up all of that? As Becky said, while some of these are great as regards vehicle behaviour, have we actually made sure that the vehicles are accessible to people who have disabilities, who will use hand controls rather than foot controls? If you have to take it over in that semi-automated state, are you able to do so?

Professor Stilgoe: Can I add a final point? It is about how to ensure that the technology becomes safer over time. Again, there is a danger that we ask, "Is the technology safe?" There are some important policy questions about how to ensure that the developers of the technology and the regulators learn from mistakes, because there will be mistakes.

In air travel, we saw dramatic improvements in safety over the course of the 20th century. That is down to a few things. It is down to learning from accidents and prioritising learning over blame. It is also down to a regime of data sharing, which is absolutely key for self-driving vehicles. Governments do not allow airlines and aircraft manufacturers to say, "No, that's our proprietary data. We're not handing it over." Government claims on data when it comes to something like a self-driving vehicle crash, or even a near miss, will be a key part of this going forward.

Ian Wainwright: Can I add something on that? Clearly, at the moment we struggle to get commercial data from commercial vehicles, whether they be passenger vehicles or logistics vehicles, into the public domain because there is commercial sensitivity to it. There are costs, service levels and things like that in the logistics stuff. We have to work out how to deal with some of that. Is it publicly accessible data, and what does that mean? Clearly, the road incident investigation branch will have to understand some of that data. How far back do they go? They may examine the crash, but are they examining what is there in terms of the driver's previous behaviour and stuff like that? There is a whole series of issues about the data and access to it, which may be more than just the incident itself.

Q174 **Ruth Cadbury:** You have answered my question about vulnerable road users, but there are all the other road users, such as those driving



conventional vehicles, as against those driving automated vehicles. The same issues about anticipation and thinking for others apply. How and where should the needs and priorities of self-driving vehicles be balanced against those of other road users?

Professor Stilgoe: It is important to ask, “Whose needs and whose priorities?” A lot of this would be geographical. We might well find that there are some geographies in which self-driving vehicles are a really important and beneficial part of the transport system, which is not the same thing as saying that there should be a blanket transition from conventionally driven vehicles to self-driving vehicles across the whole country. We might identify real needs in, say, a transport desert, where a bus route is no longer economically sustainable, but a self-driving model might help in some way. Then we might ask, “Is that technically possible, or are we limited to deploying self-driving vehicles in places that look like Milton Keynes and were built around the car in the first place?”

I do not think that it is just a question of balancing gross benefits against gross needs. There may need to be a more sophisticated set of transport conversations about how and where this fits in. To Ian’s point, is it a last-mile thing that allows you to complement your existing public transport system? There is a danger that the arrival of a new mobility mode somewhere like London substitutes for public transport, which could increase congestion and so on. It is going to be a difficult and differently textured conversation.

Q175 **Ruth Cadbury:** Ian, I guess you have thought about this. You talked about working in closed systems being much easier than working in open systems, where there is a multitude of different road users.

Ian Wainwright: Yes. One of the things that came through across the institute was the interaction, particularly for passenger commercial vehicles—taxis and buses—that access the kerbside a lot. There is already the fact of how the drivers behave around cyclists, pedestrians, people with buggies and everything else, and where you do that. Increasingly, there are issues with what street furniture is there, whether it be an old-fashioned telephone box or a micro-mobility stand for e-scooters or whatever.

There is a range of things, and where and how you do that is critical. How do you determine even just the fact of pulling in and out from the kerbside on a regular basis, as a bus does? How does it react to that, and to the fact that people will often dive out from either side of it? Is there the data to make that safe, so that you have data for all the incidents that have occurred? That is where I have a concern, because there is a quantity and a quality issue around those incidents. To be honest, we want fewer of them in the first place, which means that there is less data on which to base your decision for the autonomous vehicle in the future. If you have a closed system, it is a lot easier. Basically, you can fill your boots on it and speed up what the vehicles are doing, but it is the



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balance. We have to make sure that the balance is in terms of the humans, rather than the machines.

Ruth Cadbury: That is all from me. Thank you.

Chair: Greg Smith is going to focus on the final couple of areas—whether the Government's approach is right and whether we have the infrastructure that we need.

Q176 **Greg Smith:** Good morning, witnesses. We have spoken a lot about the theory, the practice and so on, but ultimately it will come down to a regulatory framework in this country and in other countries where self-driving vehicles operate. The Government have said quite a lot on this so far, not so much in detail but in terms of approach. This is quite a broad opening question, but we will dig down into it a bit afterwards. Are the UK Government on the right track when it comes to the approach they are taking to self-driving vehicles? Ian, do you want to start?

Ian Wainwright: Yes. The ambition is great. We are aiming at the right point. The issue for me is how we enable some of that more quickly.

I say that because I am involved in a project that is trying to use drones for medical logistics across to the Isle of Wight. One of the issues is how you deal with the area you can fly in, which is called a temporary danger area. It is very difficult to get one. It takes months. We have the product, but we have to drop it to prove that the containers are safe. We have paperwork coming out of our ears to try to make sure that we can get through that activity. I understand the reasons why—we have to make sure that we prove that what we are doing is safe—but it becomes very difficult. There are applications for drones that could do micro-spraying on crops. Again, those are impossible because of the paperwork needed to achieve them. How do we enable some of that in areas where it is safer to do it?

I think that that is true on the roads for self-driving vehicles. Where is the right place to trial them? Pavement droids have been trialled in Milton Keynes, where there is an awful lot of pavement and people tend to drive. It is similar to what is being done in places such as Phoenix. It has masses of sidewalks, but nobody is on them, because it is too hot.

As Jack said, some of this stuff is about where geographically you can deal with some of this and, potentially, allow a slightly looser regime that enables the trial, because we must have the trials. We must have trials of the interactions, maybe on student campuses, where all the students are aware of them. It is how people deal with that and what they are expecting. Expecting everybody in the country to understand that one of these things is in their area is impossible. It is about getting the balance right. Yes, aim for the stars, but how we actually get there needs a bit more thought.

Q177 **Greg Smith:** You are saying that there will have to be geographic



consideration in the Government's approach to regulating. I take your point about Milton Keynes. Milton Keynes is adjacent to my constituency. Within 10 minutes of being in the city of Milton Keynes, you are in the town of Buckingham, with very narrow roads and tight pavements—pavements that someone of my girth would be lucky to get along. You are saying that there will have to be different geographic regulations.

Ian Wainwright: I think there will. A lot of urban areas are moving to 20 mph speed limits. In somewhere like Barcelona or New York, where you have a fairly grid-like pattern, it is a lot easier to control the traffic. Barcelona has done masses of stuff to get traffic off the streets and to make some of the streets more available for people. We are doing that in a lot of urban areas, to make them nicer environments and to improve air quality. How do you deal with that if you are trying to say, "Actually, you can treat that in the same way as you treat something like a suburban dual carriageway"? We have to treat things differently. That subtlety becomes very difficult, because where is the line? Where is the boundary line between Milton Keynes and Buckingham? Yes, everybody will have a different view, to an extent, of what should be allowable. That is where the human issues come in. It is about how the humans behave around the rules, not just what the rules are.

Q178 **Greg Smith:** That is very interesting. Jack or Becky, do you have a view on the Government approach?

Professor Stilgoe: Yes. I am broadly supportive of what the Government have done in the last six or seven years. I think that the setting up of CCAV, the Centre for Connected and Autonomous Vehicles, was a very good early move. The Law Commission's work has been world leading, in working out what some of the difficult questions are and trying to get ahead of them. Britain can continue to be a leader in the debate where I think all these difficult conversations are going to happen, around standard setting, rules and safety assurance, a lot of which is quite wonkish.

There has been some discussion about delays to primary legislation. Some of this is about primary legislation, but a lot of it will be about the redesign of institutions and the design of regulatory functions—a sort of secondary legislative process. Even though I am supportive of the Government's direction up to now, there is a huge amount of work still to be done. It is probably going to be done in conversation with a lot of real-world experimentation. I will be interested to see how that process plays out and how Britain can continue leading that conversation.

Q179 **Greg Smith:** It is almost as if you have seen the questions that are written down in front of me. I was going to come on to the Law Commission and, indeed, the UK's role as a global trendsetter on this; whether we should be seen as the leaders on this or whether, as sometimes in the case of technology, there is an argument that it is better to wait for other people to learn the lessons and then follow. Where do you think we sit on that scale? Should we be the ones out



front, putting our flag in the sand, or should we let the American market or others lead?

Professor Stilgoe: I would definitely be in favour of a proactive approach. A wait-and-see approach to the technology means that we may end up with some technologies that are a very poor fit to the needs of our cities and our country. It might also be technology that is not as safe and not as beneficial as we would like it to be. The more we can create expectations in advance and put in place the frameworks that deliver on those, the better. I would be firmly proactive, rather than reactive.

Q180 **Greg Smith:** That is really interesting. Before I bring Becky in, and when you come back in later, Ian, you may want to comment on this as well, what is the single biggest thing that the Government, as distinct from anyone else, need to do next to move this along?

Professor Stilgoe: I don't know. I have already set out my stall and said that it is lots of difficult little things. There are some big things. For example, the Law Commission's study focused on the question of liability, which seems to be one of those questions that need to be answered, especially before you start to see level 2 and level 3 systems on highways. That is a thing that it needs to do soon, but there are some longer-term discussions that will be more complicated. There are some urgent issues and some important issues.

Q181 **Greg Smith:** Becky, on this point about Government approach, is the Law Commission right? We have just heard evidence that suggests that it is world leading. Do you agree with that? Where should the UK be on the sliding scale from first to market, if you like, from a regulatory perspective, to waiting for others to learn the lessons?

Becky Guy: We welcome the work that the Government have done so far. We responded to the Law Commission's three consultations and agreed with a lot of its proposals. We agreed slightly less with some of the things about remote driving in its recent proposals. It goes back to some of the things that I said earlier about keeping someone who is sitting in the vehicle in the loop. How do you keep someone who is not sitting in the vehicle in the loop?

The main thing we are concerned about is that, as we trial these vehicles, we are putting people who are exposed to them at some level of risk. We therefore need to ensure that there are publicly accessible risk assessments. Trials should be communicated to the public so that they can understand the potential benefits, the nature of the trial and some of the mitigating measures that have been put in place. The public may need to be convinced in some areas. As Thatcham Research recently showed, some people are not sure about these technologies. We need to consider how the vehicles interact with other people. There will be a huge driver education piece on that in future. We need education for people who are not using these vehicles, too.



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On the question of where we should stand, there are arguments to be proactive and set out the requirements, but there is part of me that thinks, "Should we watch and wait to see what issues other countries come across before we jump in?" It is not clearcut.

Greg Smith: Ian, you did not get some of those latter questions when I first asked them.

Ian Wainwright: Should we be first? We would love to be first, but the issue is that places like China and the States are where the tech companies are. Therefore, they are going to deliver a lot of it up front.

What we could be first in is some of the subtlety. There is a role for Government, potentially, in bringing the range of people together. I watched two of your previous sessions online and saw the difference between what the automotive people, or the people who are developing the technology, have on this and what people from Guide Dogs for the Blind have—people who are almost completely at the other end of the spectrum of acceptability of this technology. There is a whole different series of things. It is partly about how we bring those people together so that there is agreement about what is going on.

I do not know whether that was picked up through the research that Jack did. It is about how this stuff fits together and, as he said, the subtlety of identifying where the dividing line is for where things should be trialled. Do we go for high speed, with few people around—in other words, a motorway—or the other end, with the low-speed stuff? I do not know where we start. What is the right end of the pipeline to look at? It is probably not a pipeline, so that is probably a wrong analogy, but how do we interact, and can we help to lead on bringing these things together? That is a role that Government can bring, because you start to bring people into the conversation.

Q182 **Greg Smith:** My last point on this is slightly different from the question of whether we should lead. Are we actually influential as a country on the self-driving or autonomous—call it what you will—vehicle market in the way it is developing, in terms of both industry and regulation, or is it all about the Americans and China? Do they say, "The UK is interesting but..."?

Ian Wainwright: There is a lot of cost in the trials. If you go for adding a bit to the current autopilot that you can put on a car, it costs you hundreds of pounds. If you are trying to do full autonomy, it is thousands or millions. Any trial we get involved in would be costly for anybody, and it is a question of who has the money to do it. It tends to be some of the automotive companies, but also the technology companies.

Do the Government want to be putting their money into it? I think we want to be putting our money in to make sure that what we get is suitable for what we have. We have medieval streets. Clearly, there is a difference.



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Q183 Greg Smith: Can we move on to that infrastructure point for a few minutes? Ian, in answer to earlier questions, you spoke about some of the issues around the kerbside—the digital kerb. I do not fully pretend to know what that means. Clearly, there is a huge difference between an inner-city environment and the predominant environment in my constituency, which has 300 square miles of country lanes, rural environment, overgrown hedges, low bridges and lots of horses on the road. Is it actually possible to make all of Britain, urban and rural, technologically ready to take self-driving vehicles?

Ian Wainwright: I understand the comments that were made earlier about the wi-fi enabled bit. Clearly, there needs to be enough connectivity to make the thing and the system work. There has to be an understanding of exactly where you are. Currently, I struggle to get a signal in several places, but, even where I do, sometimes whatever app you use on your phone will tell you that you are in the middle of the street rather than on the pavement. That is quite important when you get to the precise granularity of what we are trying to do with this stuff.

It is probably technically possible. I am not entirely certain what the cost is. The issue is still whether that is what we need everywhere. If you are in some of the more rural parts—not necessarily your constituency, but the highlands and islands—do we really need all of this? It feels like it is completely over the top. However, we all have mobile phones that have every app in the world, so sometimes we do all of this stuff because we can. I still think that that is a debate.

Q184 Greg Smith: Is the infrastructure ready?

Professor Stilgoe: No, obviously. It is really important to think about infrastructure. There is a danger that we buy into the story that says that a computer can drive like a human, and then better, and that therefore anywhere a human can go, a computer will go. The more you explore with the people developing the technology, the more you realise how conditional that technology is. It is conditional not just on infrastructure but on the accommodations that other road users might make.

The technology and the intelligence of the systems will keep improving, but there will be places where the technology looks too expensive or impossible to deploy. You see a set of difficult trade-offs. Do you want to upgrade infrastructure to suit a particular new technology? Is that worth the cost? Who is going to pay for it? Will it benefit everybody, or will it just benefit the users of the new technology? That is a key point about inequality. There might be things that you would do to roads, like improving signs and lines, that would benefit all the users of those roads, which is a rather different thing from 5G-enabling all roads or adding other forms of digital connectivity that might just benefit AV systems.

It is important to pay attention to the conditions. It would be the wrong presumption that this was a universal technology. Like most mobility



technologies, it will have places where it works well and places where it may never work.

- Q185 **Greg Smith:** Is that an argument that suggests that the whole thing will never work? If someone lives in London, Birmingham or another major city, they might not use a car that often. Certainly, when I lived in London in my 20s, I probably got the tube and bus more often than I used my own car, but I went back to see my folks in the countryside. I visited friends, went to places and had weekends away. If people are buying into this technology, they are going to buy or rent a self-driving car. They will not want to do so just in a single environment. If we are saying that they will only work properly in a city—in inner Birmingham or Manchester—and you cannot have that weekend away in the countryside because the car ain't going to work there, is that not an argument that the whole thing is going to fall over?

Professor Stilgoe: No, not at all. If you look at the mobility needs in London, as you have just described, you can imagine a world in which an automated vehicle is doing an important job for you, in just the same way as a ride-hailing system like Uber does within city limits. The current systems that are being tested and deployed, almost, in San Francisco and Phoenix are what the tech people call geofenced. They say, "Only within this area. We have calculated that not only is that doable technically, but it provides enough of a market to sustain the system. There are enough people who want to get around within that system." You can separate mobility needs, once you get away from the idea that people are going to buy or rent their own self-driving vehicle and instead it becomes something that people just use.

- Q186 **Greg Smith:** Becky, what is your take on the infrastructure readiness of the UK?

Becky Guy: I don't have an awful lot to add to what has already been said. If these vehicles can work only in particular geographies, that has big implications for ownership. People are not going to own them if they cannot use them wherever they wish. I imagine that they will be very expensive.

- Q187 **Greg Smith:** This is my last question. Who should be responsible for infrastructure upgrades to our roads and kerbs? Do you foresee its being a role for local government, which owns roads, the national Government or devolved Governments, or should it be the technology companies that are trying to sell these things?

Ian Wainwright: We are all looking at each other. If there is a requirement to change physical infrastructure that is purely down to self-driving vehicles, to my mind it has to come from the technology companies. One of the issues is infrastructure being upgraded quickly enough, which is a longer issue, but some of this is about how mobility generally works. We have tended to go away from big gaps with the kerbside. There are more shared surfaces—Jack mentioned Exhibition



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Road—and things like that. It is more about trying to make urban areas, in particular, more liveable.

Does that match with having more vehicles? No. Most cities are trying to get vehicles out, to reduce the amount of vehicle occupancy. I have a slight issue about whether there is an unintended consequence. Uber's introduction in London actually increased the number of private hire vehicles. That may have been Uber's intention, but it certainly did not help the traffic and the congestion. There are issues to do with what the impacts of this are. We do not know, so we need to trial some of it to see what happens and how much infrastructure needs to be upgraded.

Professor Stilgoe: I have one additional caution. At the moment, while we are largely still in this experimental phase, it would be reasonable to expect the people trialling the technology to be responsible for the infrastructure that might be needed to support their technology in the short term. My concern for the future would be that if the technology is shown to work in a particular context, there will be pressure on local authorities to upgrade infrastructure, following a story that says, "Look, here are the benefits we're delivering. You need to pay in order to scale up this technology." That could be a very expensive endeavour, the beneficiaries of which could be rather narrow.

Chair: Thank you all for coming along. It has been a fascinating session.