



Overall Findings from Research
with Older People participating
in Connected Autonomous
Vehicle trials

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Contributions to this document

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Preface

This report

This report contains some overall findings from user engagement activity undertaken with potential participants for the Flourish simulator and live-vehicle trials. In particular, it considers how connected autonomous vehicles (CAV) might meet current and future mobility needs of older people.

All of those selected to potentially participate in the trials were invited to attend a pre-trial workshop event (an ‘in-vehicle participant workshop’, or IVPW), to be briefed on the study and to undertake a range of data collection activities. This report summarises the findings from the six workshops held, supplemented with material from seventeen interviews undertaken with some of the same participants after they had taken part in a trial.

The IVPW offered an important opportunity to better understand the views of those already interested in, and aware of CAV, in respect of how they might use such vehicles. The post-trial interviews also provided a further opportunity to speak to people who had experienced how a CAV might function. This allowed participants to again reflect on what role they perceived CAV could play in meeting their current and future mobility needs.

This report provides a reflection on the findings from these two strands of research. A more general description of the IVPW, the data collection, and more detailed results can be found in: *WP3 D3 Findings from Workshops held with Older People considering participating in Connected Autonomous Vehicle trials (April 2019)*

Throughout these research activities the focus was on fully autonomous vehicles, those that would not require human control in order to make a journey, meaning that the occupant of the vehicle would not need to be able to drive. This level of autonomy is commonly referred to as ‘Level 5’ in international standards and in the remainder of this document¹.

¹ SAE International standard J3016: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems.

1. Data collection

Workshops

Six IVPW sessions were held over the course of the Flourish project. These events served two purposes, firstly to brief / prepare those involved in simulator and live-vehicle trials, and secondly to collect data on initial views of CAVs. In total, almost one hundred participants took part, spending around two hours each in the IVPW sessions. Data collection involved responding to a series of questions around potential use of a CAV and how people would like to interact with such vehicles. The latter also provided an opportunity to begin to collect high-level data on how people envisaged the human-machine interface (HMI) in the CAV might be tailored to the needs of an older population.

Table 1 Participant profiles (IVPW - All Bristol)

Workshop No	Date	Participants	Workshop No	Date	Participants
1	20 th Mar 2017	14	2	20 th Mar 2017	5
3	24 th Apr 2017	29	4	15 th Nov 2017	28
5	8 th Oct 2018	7	6	28 th Jan 2019	11
Gender:	Male	Female	Not classified		
	52	38	4		
Age:	Aged 50 - 69	Aged 70 and above	Not classified		
	43	42	9		

Note: Questions used in the workshops can be found in Appendix A.

Interviews

Seventeen semi-structured interviews took place with participants from the workshops. These happened after they had taken completed a simulator or live-trial experiment. The interviews were opportunistic, in that each participant was free to agree or decline to take part. Interviews could also only take place when the researcher was available. Thus, the sample is not necessarily representative of the wider group of participants, or older people in general.

The interviews lasted from 15 minutes to 30 minutes, and asked people to think about the potential uses of a CAV, and what benefits such a means of mobility might bring for them. Questions were posed to encourage people to think about their future mobility (and mobility needs), and to also explore the types of journey that a CAV might be used for. Sample questions used in the interviews can be seen in Appendix B.

The interview participants were relatively unique, in that they had experienced to varying degrees being in a vehicle that was behaving as if it was autonomous. Thus, they had greater insights into the sort of journeys that could be made, and how they themselves might experience that journey.

Overall Findings from participants in trials

Two interviewees undertook both a simulator and live-vehicle trial and gave an interview after both. In this instance they were given an opportunity to reflect on broader issues to do with the trials, the progress of the HMI, and any change in their views on AV following the repeated engagement in the Flourish project. Material from these interviews was incorporated in the wider findings discussed below.

2. Results from the IVPW workshops

Using a fully autonomous CAV

Most IVPW participants were broadly positive about CAVs, and several specifically picked up on the benefits for social inclusion, or for those groups less able to drive.

“Very good idea for elderly people who are isolated” (Ref ME3, Male, 77)

Acceptance of the technology

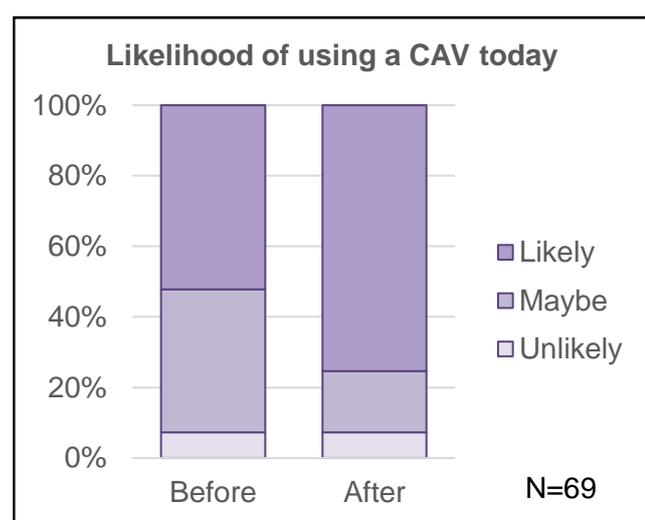


Figure 1 Likelihood of using a CAV if deemed safe. (Before and after IVPWs)²

There seemed to be a general acceptance of CAV technology, around half of all participants professing they were likely to use a CAV at the start of their IVPW, rising to 75% of the sample afterwards. Less than 10% were unlikely to use a CAV if it was already available. This was though a self-selected group of participants who had volunteered to be involved in CAV trials.

Vehicle functionality

Questions about vehicle characteristics and functionality produced a range of responses across the groups. Broadly, these concerned issues of control, capability, vehicle features and accessibility / space in the CAV. There was a strong desire to retain control over what was seen as the most important functionality in the vehicle: the ability to stop the CAV, as well as to determine where they are going and when. Much of the other feedback in respect of functionality actually focused on features and functions of technology that many participants may already be familiar with - such as Sat-Nav for example, or features people desired in existing vehicles. Participants also identified many accessibility features which were not unique to using a CAV in the future and might well be something they were looking for in a conventional vehicle now. There was also some discussion of ‘ownership models’, with some workshop attendees in favour of a more ‘shared ownership’

² Note: The likelihood question was not used in the early IVPW but was added because of its use in data collection activity by other Flourish partners - this then providing a broad measure for comparison of user groups.

approach, akin to a taxi-type service, although this was not for all, others would want to retain their own vehicles.

Journeys and purpose

There were mixed responses when participants were asked to think about the sorts of journeys they might use a CAV for. Suggestions included a mix of location types, some specific destinations, as well as some characteristics of journeys that people would like to make - for example journeys after dark. In terms of journey purpose, the IVPW participants generally suggested a trip to socialise, to see family or to go on holiday. Only around a quarter who gave specific destinations mentioned a trip to shop or to access healthcare.

Leisure trips, including those to cultural activity such as the theatre, cinema or museums also featured. For some older people, mobility for these purposes is seen as problematic, and the ability to undertake such discretionary journeys (as opposed to the necessary travel to the doctors for example) is often foregone as mobility becomes more difficult for older people. This focus on social and family trips by participants may indicate an area of concern in respect of future mobility, with a CAV offering a potential solution for meeting needs in this context.

Categorising the sorts of journeys being described, it is also possible to see three areas where access to a CAV might facilitate additional travel for older people:

- *Replacing journeys seen to be problematic now (possibly self-restricted). For example, travelling at night or on the motorway or at times when the road might be busy.*
- *Enabling journeys that cannot be made on alternate modes of mobility. Particularly for those that don't drive and who then cannot use a bus or other alternative to make a trip*
- *Adding journeys that are not currently made - but could be in the future with CAV. For example trips to the countryside, to cultural destinations.*

Box 1 Types of additional journey potentially made by older people in a CAV

The third category is interesting, in that participants have begun to perhaps think beyond just replacing current mobility needs and patterns and started to explore the opportunities that level 5 automation might mean.

Interacting with a fully autonomous CAV

Participants in the user workshops were asked to think about the ways in which they might interact or communicate with a CAV through its human-machine interface (HMI). In all instances the participants were encouraged to think about their responses in relation to a scenario of Level 5 autonomy - that is vehicles that can complete journeys without intervention from a human driver. More specifically, they were asked to consider four different factors relating to the HMI: Usability, Accessibility, Functionality and Adaptability. Short descriptions of each were provided to participants (see table 1 below).

Table 2 HMI Theme descriptions

HMI Theme	Description to workshop participants
Usability	<i>How should the interface to the vehicle behave and what features should it have that would help you to understand what it is doing and to do what you want it to</i>
Accessibility	<i>Are there things that might increase your ability to interact with and use a CAV in-vehicle interface, or that might hinder your ability to interact with and use a CAV in-vehicle interface?</i>
Functionality	<i>Are there particular functions and features you would like to see in the interface to the vehicle?</i>
Adaptability	<i>How should the interface to the vehicle work, and be set up so those who might be less able can use it equally well, or just make it easier for all of us to use?</i>

In reality, these are subjective (for participants and researchers), and the boundaries between them are somewhat fluid. This meant that responses might sometimes cross them. Where this has occurred, some limited reorganisation has taken place in the analysis to align answers more clearly under the four headings.

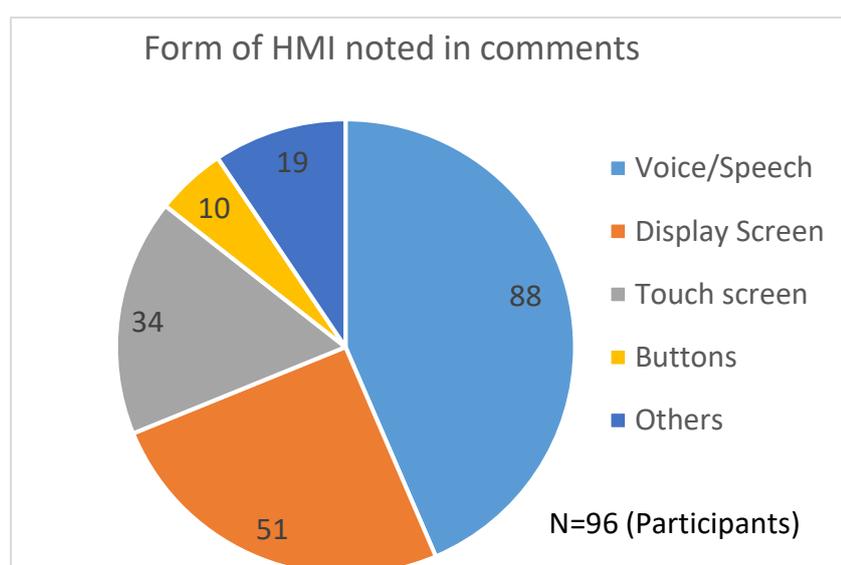


Figure 2 Form of HMI interface mentioned by participants

The most frequently suggested form of HMI was the use of some form of speech / voice control interaction. The second most popular form of interface was the use of display screens (explicitly or

implicitly talking about what might be on them), touch screens and then ‘buttons’ to control functionality. Others mentioned included eye tracking and joysticks. Almost 30% of the sample mentioned voice/speech and touch screen in one comment. There was no particular age or gender bias in the results. A more detailed discussion of the comments (by theme) follows below.

Usability

- The expectation of voice interaction with the HMI, or voice and other channels (e.g. touch-screen).
- The desire for a simple, uncomplicated interface.
- That the vehicle (and HMI) would need to inform the passenger(s) as to where they were, when they would reach their destination, and the vehicle state (e.g. fuel reserves).
- That the vehicle would need to ‘confirm’ what it was doing and what it had been asked (or told) to do.

Box 2 Key responses in respect of usability in a CAV HMI

Accessibility

- Voice interaction - perhaps supported by touch-screen
- Ensuring effective physical design, ergonomics, possibly using plug-in devices
- Avoidance of jargon

Box 3 Key responses in respect of accessibility in a CAV HMI

Functionality

- Building on existing experience - e.g. with Sat-Nav
- Access to entertainment and information
- Simple journey programming
- Being able to personalise
- The ability for the vehicle to automatically call for help
- Being able to communicate with friends or family about your whereabouts and expected time of arrival at a destination

Box 4 Key responses in respect of functionality in a CAV HMI

Adaptability

- Large screens, large fonts, variable contrast and specific screen colours to help those with vision problems
- Eye tracking, or even monitoring of brain waves to interact with the HMI
- Ideas about where any interface might be located in the vehicle (to support wheelchair users for example), and if ‘remote’ devices might be a useful approach to take for some
- Ability to select an interface to suit your own personal abilities perhaps, or let the HMI determine its own complexity based on the responses of a user

Box 5 Key responses in respect of adaptability of a CAV HMI

An important point raised in the adaptability feedback was that people’s condition might change from day to day, and thus personalisation might not be straightforward. Advance training would

also help people to use a CAV and its HMI. This might be some form of online support, or even workshops and training sessions.

Barriers to CAVs meeting mobility needs

Barriers to CAV and HMI use were also identified. For example, CAV would need to meet safety standards and the technology would need to have been proven to be reliable. This would be especially important if the CAV were to share the roads with non-driverless vehicles. For some participants, sharing the road with non-driverless vehicles was a 'red line' they would be unwilling to cross in terms of their acceptability.

There was also widespread concern about the cost of such vehicles, and whether older people would be able to afford to either buy or use them - particularly when they were initially launched. It was thought that hire schemes and government subsidies might help to make the vehicles affordable, and there was interest in whether concessionary passes might operate on public-transport CAVs.

Another potential barrier to use was the availability of training and support to use CAV. It was often suggested that people in the oldest age groups, who were not confident technology users, would need a greater level of reassurance, training and support before they could appreciate the benefits of CAV, and be able to use them.

Other issues included CAV making it too easy to avoid walking with implications for health, or that the surge in demand created by those currently unable to drive would lead to increased congestion. This might then imply some degree of rationing, again perhaps by price to manage such situations. This might curtail access, and thus the ability to meet mobility needs.

Overall Findings from participants in trials

3. Results from the post-trial interviews

Participant information

Those who undertook the simulator and live-vehicle trials were offered the opportunity to have a short (20-30 minute) interview after their trial experience. Nineteen such interviews took place across the trials, with seventeen separate participants. See Table 3 below for participant details.

Table 3 Interview participants

	Participants		Participants
2017	7	Female	8
2018	7	Male	9
2019	3		
		Car user	14
Simulator	12	Cycle user	2
Live-vehicle	5	Bus user	1

Most interviewees identified as car drivers, several in two-car households, with a couple more having access to a car in the household if needed. A few cited cycle or bus as their primary means of mobility. However, practically all the participants made at least some use of buses, most frequently for access to Bristol city centre - expressly to avoid parking problems.

A small number of participants had already made a location choice to ensure access to facilities and transport networks. Some were actively thinking about making such a choice in the future, but others said they would not be addressing this issue in their next move.

In the main, the interviewees did not express any issues with their mobility, or the potential to make journeys. There were some indications for some people that they were avoiding travel at busy times of day, at night, or in making longer journeys. The latter tended to be because such a journey would be tiring, or more often 'boring'. The consequence for one or two interviewees was that they were now seeing less of relatives who lived further afield.

Results from interviews

Would you use a level 5 CAV?

All of the interviewees were happy to use a level 5 vehicle if it was safe, tested, and reliable. Most were also happy to travel at higher speeds (e.g. motorway speeds) if there was sufficient trust in the vehicle. This might take some time to build though, with experience needed at lower speeds first. One or two people still asked for some degree of control over an autonomous vehicle, such as a stop button for example.

Perhaps the most prevalent concern expressed by people was around the time that level 5 CAV and non-AV vehicles would have to mix on the roads, and the problems that might lead to.

What sort of journeys would you make?

Often the response to this area of questioning was 'all journeys'. A few people expressed the opinion that they didn't think they would make any additional journeys. One individual suggested that not having to drive meant that everyone then becomes a passenger, and thus might be inclined to make more sightseeing type trips. Others noted that a CAV would allow people to access more distant locations, including cultural destinations that might have been too far away before. A couple of people expressed concerns about people becoming lazy, in particular a risk of replacing very short journeys with autonomous vehicle trips.

Would you share?

Several interviewees were happy with the idea of not owning their own vehicle - and this was seen as a positive for the environment as well. There was also some interest in a car-club type model. In respect of sharing a driverless vehicle with others (possibly strangers), this was acceptable in certain conditions. For example, when you know the other people, when it is a short distance, or where you are going to the same thing (an event). Sharing was not acceptable with others described as 'dirty', 'smelly', 'messy people', smokers, screaming children and 'murderers'. Sharing was also not seen to be suitable late at night or for women. Concerns were also expressed in respect of finding a shared vehicle was full of rubbish, and unclean, smelling of smoke or dogs etc. Aside from the strongly-felt concerns about who you might share with, one person also noted that shared trips might take longer than if you were only occupant.

Who else would benefit from a level 5 CAV?

Common responses here included the disabled, those less-able, the visually impaired, those unable to drive and those who would struggle to use public transport. There was mention of those experiencing dementia and mental health issues as well. For some of these groups the vehicles would though need to be disabled-friendly, with questions asked about whether you would be able to get a wheelchair in unaided for example?

A small number of interviewees mentioned using level 5 vehicles for schoolchildren - but with caveats about what happened if the vehicle broke down. There were seen to be benefits in respect of the school run - reducing congestion for example. One interviewee did question though if there would need to be restrictions on who you allow into a vehicle - maybe not allowing those under a certain age, or if they did not have sufficient cognitive ability.

An interesting observation was made that access to driverless vehicles might help older people with (social) activities at night, something that might be difficult now, whilst another saw potential for the vehicles to be beneficial in increasing mobility of older people in a local area - good for their socialisation. The ability to drink and drive if using a driverless vehicle was seen as an additional spur to social activity for older people.

It was thought more generally, that younger generations would just embrace the technology, but it would take longer for older people to build the necessary trust.

Concerns and general comments about CAV

General concerns expressed through the interviews often related to the change-over transition to all-CAV. How that might be managed, what will it be like when there are CAV and non-CAV on the

roads, and how will drivers in non-CAV behave when the autonomous vehicles are obeying the rules of the road (speed etc.).

Other potential issues included, what one person described as the 'human factor', vandalism, interference, hacking etc. and the common issues of surveillance and data collection. Who knows about the journeys you are making, and the 'big brother' aspect of CAV. Cost of ownership and use was also raised by a few, whilst being able to use a bus pass was seen as an incentive to use these vehicles. It was also noted, that CAV might just replicate issues caused by cars currently, including isolation from other people if travelling alone as opposed to being on a bus for example.

Overall Findings from participants in trials

4. Conclusions

The IVPW and post-experiment interviews have provided an important opportunity to collect the views of older people in respect of their potential use of CAV to meet their mobility needs. It has also allowed nearly one hundred older people to contribute their ideas on four key aspects of the interaction with a CAV through its HMI.

The limited numbers of older users of CAV in the UK to date make this a relatively unique set of responses at an important early stage in the development of these vehicles, which coincides with a growing interest in how an ageing population might best be supported going forward. It is of course noted that this was a cohort of people who are already interested in CAV, and who already had some knowledge of the concept. This has further developed over the IVPW, and their participation in the trials, making them 'informed' participants and interviewees.

The key message emerging from the IVPWs is an acceptance of the vehicles, albeit also an understanding that they may still be some way away from being commonplace on the roads. For some this is disappointing, as they would like to use the vehicles now if available. This view was expressed in particular by those with health issues that precluded or curtailed their ability to drive, and some older participants who were facing restrictions on their driving. Younger participants also had an understanding that CAV could be useful in meeting their mobility needs later - but they would happily remain driving for now. The data here, in common with other research in this area, highlights that for many there is a reluctance to address issues of reduced mobility to come - and little evidence of forward planning for it.

Some elements of 'revealed' mobility shortfalls, and potential new journeys do start to emerge though in the data here. Evidence of self-regulation of driving (at night, at busy times, long journeys etc.), and discussion of new journeys that might be made to visit the country, or cultural destinations seems to suggest that even amongst car drivers there may be suppressed demand which could be enabled through CAV use. Most commonly, when asked to imagine a CAV journey they might make the IVPW participants selected a discretionary trip, to see family or friends or visit somewhere - not shopping, or the doctors. Again, this might indicate greater desire to make these sorts of journeys, and potential constraints at present (or in the future). Some concerns about greater congestion through additional travel, and people using CAV in preference to walking short journeys were though identified as potential risks of CAV use.

Participants in the IVPW provided useful feedback on how an HMI suitable for an older population might look and function, and the key features they would like to see. The strong message that came through from that is that voice interaction is important and the first choice for many when communicating with a vehicle. There is still an underlying need for some element of control in the vehicle, even if it is only a (virtual) stop button - and the desire to be able to contact someone when it goes wrong. It is possible to see that many of the things that the older participants are asking for in their preferred HMI would be of benefit to other users, and perhaps the most important message that comes from this exercise is about making the HMI flexible, and offering a range of ways of communicating with it - messages which are important and relevant for designers of HMI for all potential users.

There is a general expectation that AV are coming, and most of the older people here would be comfortable with using them. There will be trust issues to overcome though before they would be willing to travel at motorway speeds in them. Older people can see how their mobility needs might be met by CAV in the future, as can those who are currently unable to drive (or use public transport easily). With a growing older population in the UK, CAV can offer a key mobility service which will help older people maintain (and perhaps improve) their mobility. This will provide benefits for them as individuals, and for wider society, and the data collected through Flourish will contribute to the development of appropriate CAV-based solutions for them.

Appendix A: Workshop Exercises

The following material was used to facilitate three short data-collection sessions during the workshops. Participants responded on formatted response-sheets, and in group discussion / feedback captured via flipcharts and on whiteboards by members of the research team.

1.1.1 Exercise 1. 'First thoughts on autonomous vehicles'

Please consider the following three questions, and tell us what you think.

There is no right or wrong answer to the questions, and we are all likely to have some different views. What is important for us is to capture that range of opinions.

Q1: Some people think that cars that will be able to drive themselves will be on our roads in the near future. What do you think about that?

Q2. What features and characteristics would you want a driverless vehicle to have if you were going to use one, and would that be any different to vehicles now?

Q3. If you personally had access to a driverless vehicle, what type of journeys might you make and where would you go in it?

1.1.2 Exercise 2. 'Taking a journey in a CAV'

Think about one or more journeys that you personally might make if you had access to an autonomous vehicle, and tell us a bit about the things you might do, and what you might need to think about in order to make the journey.

Journey 1: Where would you go in a CAV? ...*To.the*.....

Start from:

Any stops on the way:

Arrive at:

How far is that journey? (Miles, or hours / minutes if you prefer)

Would you just go back the same way to the start?

What information might you need when you are travelling (from the vehicle and from outside the vehicle)

What else might you need to do or have to help you to make this journey

Would you have any particular concerns about making this trip by CAV?

How would you address those concerns to make sure it all went ok?

This exercise was repeated for a second journey if people wished / had time.

1.1.3 Exercise 3. How would you like to interact / communicate with a CAV?

- a. Accessibility. Are there things that might increase your ability to interact with and use a CAV in-vehicle interface, or that might hinder your ability to interact with and use a CAV in-vehicle interface?
- b. Usability. How should the interface to the vehicle behave and what features should it have that would help you to understand what it is doing and to do what you want it to?
- c. Functionality. Are there particular functions and features you would like to see in the interface to the vehicle? Why is that?
- d. Adaptability. How should the interface to the vehicle work, and be set up so those who might be less able can use it equally well, or just make it easier for all of us to use?

Appendix B: Interview schedule

The following questions provided the basis for the semi-structured interviews undertaken with participants post-simulator and live trial experiments.

Q1: How did you find out about the trials?

Q2: What do people you know think about you taking part in the trials?

Q3: How do you normally travel around?

Q4: Do you use particular modes of transport for particular types of journey (e.g. discretionary / necessary trips)?

Q5: Do you find it more difficult to make certain types of journey now? (e.g. longer trips)

Q6: Are you self-regulating the type of journey you make, and how you make it nowadays?

Q7: Do you foresee that transport / making journeys might become more difficult in the future?

Q8: Are you making any plans / taking any steps to help avoid this creating problems for you?

Q9: Do you think you will be happy to use an AV? (Explained as / framed as a Level 5 vehicle)

Q10: What sort of journeys do you think you will make in an AV? (E.g. purpose / destination, discretionary / necessary)

Q11: Would you be happy to share a vehicle to make a journey, or would you want to travel on your own?

Q12: Would a level 5 AV help address any issues highlighted above? (E.g. as discussed in Q5-Q7)

Q13: Would a level 5 AV allow you to make journeys that you do not do now?

Q14: Can you see benefits of level 5 AV for specific groups / other groups of people?

Q15: Would you have any concerns about using AV? (E.g. privacy, safety, cost, etc.)

Q16: Anything else you would like to say on the topic of AVs, or the trials?

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