flourish

EMPOWERMENT THROUGH **TRUSTED** SECURE MOBILITY

Findings from Workshops held with Older People considering participating in Connected Autonomous Vehicle trials

May 2018

Notice

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This document has 30 pages including the cover.

Document history

Work Package: WP3			Document ref: D3			
Document Lead Organisation: UWE			Document Lead Name: Ian Shergold			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Published to project team / website. Data from workshops 1-3	IS			CA	May 2017
Rev 2.0	Published to UWE Repository. Data from workshops 1-4	IS			CA	May 2018

Preface

The Flourish Project

The FLOURISH project has developed in response to Innovate UK's *Connected and Autonomous Vehicles Collaboration Research & Development competition*. It sets out to identify innovative solutions that address two distinct but related topics within the connected and autonomous vehicle (CAV) market that will help to realise market readiness of CAVs:

- Customer Interaction focusing on the customers' needs and experience when using the technology; and
- Connectivity focusing on effective data analytics and ensuring that the cyber security and wireless connectivity elements of CAVs are safe by design.

The project has the following principal objectives:

1. Develop an understanding and articulation of user needs and expectations of CAVs in order to maximize the mobility potential they offer.
2. Develop usable adaptive interfaces, performance certification processes, products and services that enable secure, trustworthy and private technology within CAVs.
3. Capitalize on the large volume of data created by CAVs to develop innovative new tools and products.
4. Leverage existing investment in the Bristol City-Region to expand validation and test capabilities in both urban and interurban networked environments and enhance the commercial opportunities this will deliver.

There are three core strands of 'research' in FLOURISH, each contained in a work package (WP). WP3 focuses on gaining an understanding of customers' needs and experiences when using CAVs. Older adults with ageing-related impairments are seen to be particular beneficiaries of such technology, allowing them to continue to be active contributors to the economy and society. Consequently, there is a deliberate focus on the needs of this group, which may help accelerate their ability to become early adopters of CAVs. It is expected that by addressing the needs of this demographic, the knowledge, services and capabilities that will be developed will in any case enable exploitation by a wide range of social groups, whether defined by age and needs. This report is a component of Task 3.4.2 in Work Package 3 of the FLOURISH project.

Levels of autonomy

It is important in discussions around autonomous vehicles to have a clear understanding of what the term means. For example, there is a significant difference between technologies that already offer some element of autonomy, and where emerging technology could take

vehicles in the relatively near future. SAE International[1] has looked to resolve this need for a 'common understanding' by developing and publishing a standard set of categorizations of the different levels of automation (See Figure 1).

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

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

(Copyright © 2014 SAE International).

The workshops described here were conducted on the basis of vehicles functioning at Level 5, and all information and scenarios put forward in the workshops were describing vehicles at this level.

[1] SAE International is a global association of engineers and technical experts in the aerospace, automotive and commercial vehicle industries. The organization has as a key function the development of 'voluntary consensus' standards in its fields of interest.

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The Workshop(s) with Older People

This series of events provided the opportunity to engage with older people who had expressed an interest in participating in the initial rounds of the Flourish CAV simulator and vehicle trials.

The workshop in context with other data collection activity

The workshops are one element of a wider set of qualitative information gathering activities within the Flourish project. These elements are summarised in Figure 2. Project partners OPM are undertaking the Stakeholder and Public Engagement activities, whilst activity around the trials and specifically these workshops is being led by the Centre for Transport and Society (CTS) at UWE[2].

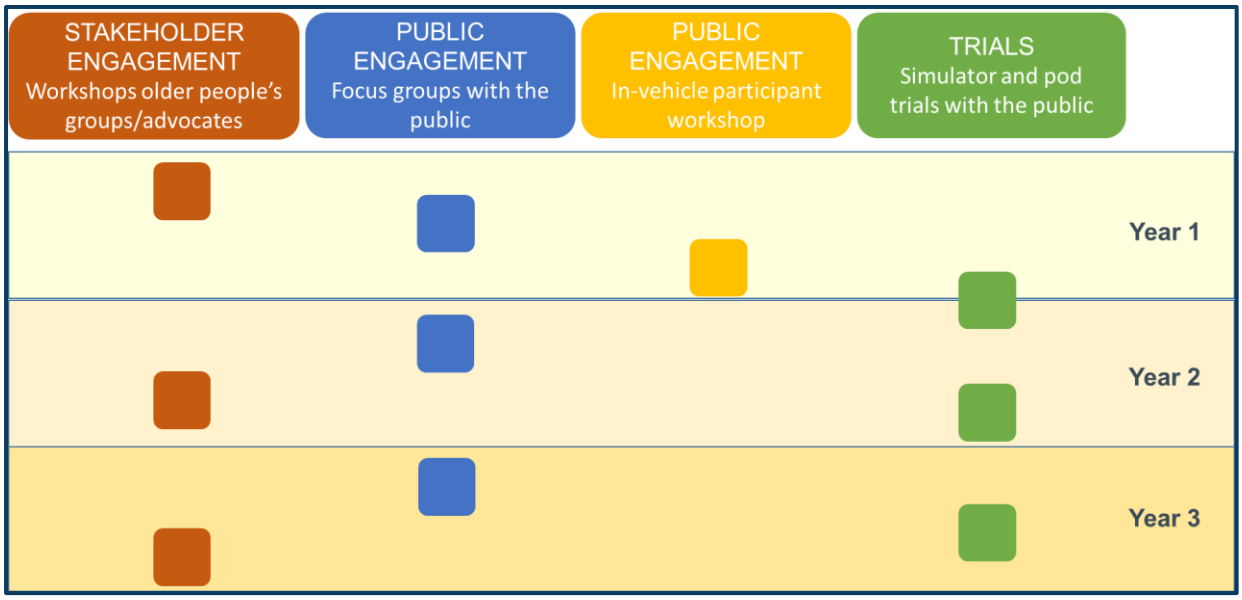


Figure 2. Qualitative research activity within the Flourish Project.

Note Year 1 = June 2016 - May 2017, Year 2 = June 2017 - May 2018, Year 3 = June 2018 - May 2019.

Purpose of the workshop

Each of the workshops included a mix of two activities[3]. The first was a series of short presentations from the research team (and recruitment partner AgeUK in the first workshop), to introduce the project goals, aims and objectives, and the purpose of the workshops. These were also an opportunity to clarify some terminology (AV and CAV for instance), and to make clear that it was a Level 5 CAV scenario being considered. The presentations also included more detail about the forthcoming trials and participation opportunities for older people. Interspersed with these presentations were a series of data-collection activities (see 1.6 below). Each workshop lasted for just over two hours.

[2] A team from UWE Psychology will undertake the data collection and analysis related to the trials.

[3] See Appendix 1 for a sample workshop agenda.

Flourish research participants

The specific social groups being considered in research by the Flourish project are:

A. **People who are 70 and above now**. It is likely that some members of this group will have age-related physical and/or cognitive impairments that may preclude or inhibit / prevent driving or other forms of mobility / transport[4].
B. **People of any age (over 18), who have physical and/or cognitive impairments** that may preclude or inhibit / prevent driving or other forms of mobility / transport.

Box 1 Flourish target user groups

This workshop activity has focussed on engagement with Group A above, to explore the role of CAVs for this group. As well as those who are 70 and above, WP3 has also recruited a sub-group of people currently aged 50-69, on the basis that they will likely be among the first who will be able to actually adopt CAV when they reach their 70s and 80s. People in this group were included in these workshops.

Recruitment

The participants for the workshops were recruited in conjunction with AgeUK, both in the central London office and through AgeUK Bristol. A range of recruitment methods were used; emails to existing lists of contacts, through contacts at partner organisations (such as Bristol Ageing Better, Bristol Older Peoples Forum etc.), via newsletters and local radio aimed at older people. Existing contacts and mailing lists proved to be the most successful recruitment mechanism for the March 2017 workshops, whilst personal recommendation to friends and family from the participants at the first workshop was a strong contributor to the April workshop. The November event attracted participants via a feature on the BBC radio Bristol breakfast programme.

Demographic characteristics of participants

In total, seventy-six participants took part in the four workshop sessions as follows:

Table 1 Workshop participants

20th March (1)	14	20th March (2)	5	24th April (3)	29	15th November (4)	28

The participants in the workshops had the following characteristics:

Table 2 Characteristics of participants

Gender		
Male	Female	Not classified
42	31	3
Age		
Aged 50 - 69	Aged 70 and above	Not classified
32	37	7

[4] Note: Older people who might be experiencing illnesses such as dementia and Alzheimer's disease are not within scope for this work.

The different group sizes may have influenced levels of contribution, in particular the second group being much smaller and sat at one table. The third and fourth workshops presented additional challenges in ensuring everyone participated fully.

Research Approach

Three specific areas of interest were pursued in the data-collection. These were:

1. General attitudes towards Level 5 Connected Autonomous Vehicles (CAV)
2. Planning for, and taking a Journey in a Level 5 Autonomous Vehicle
3. Views on the User Interfaces for a Level 5 vehicle

Each workshop included three 20-30 minute sessions where the participants were able to contribute individually, and as a group. The data being collected was primarily qualitative, but at the third and fourth workshop, the following additional 'quantitative' question was asked at the very beginning of the session, and again at the end:

How likely would you be to use connected driverless vehicles if they had been deemed safe to use by the government?

1. 'very unlikely'	2	3	4	5. 'maybe'	6	7	8	9.'very likely'

Please tick the box that best matches your view.

Figure 3 Attitude question for participants at workshop 3-4

This question had also been used in a series of focus groups held by project partners OPM, and was added to provide an opportunity to compare attitudes with their sample. It also provided a means to test possible differences in the likelihood of using a CAV in the future, as some of the workshop participants will be invited to take part in one or more of our planned simulator and/or road-based pod trials.

Participants were provided with formatted response sheets, and feedback given in group discussion was recorded on flip charts and whiteboards. The dataset generated is discussed in the next section.

Results from the workshops

The results discussed below flow from the three exercises undertaken in each workshop. 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 are capable of completing journeys without a human driver.

General attitudes towards Connected Autonomous Vehicles (CAVs)

Participants in all of the workshops were asked to give their general views in respect of CAVs, and their potential use of them. Those taking part in the third and fourth workshop (fifty-seven participants) were in addition asked to complete a question asking how likely they would be to use a CAV based on their current knowledge and experience. Figure 4 charts the response made to this question at the beginning of those events:

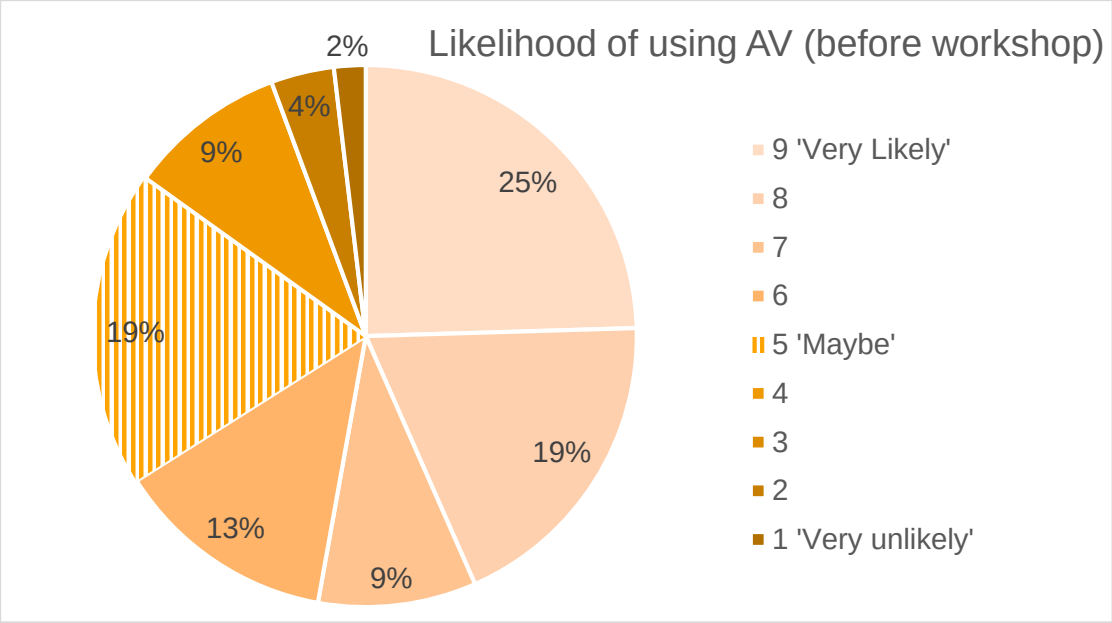


Figure 4 Participants willingness to use a CAV (if available and safe)

The overwhelming majority of responses were at the likely end of the scale, with just one participant suggesting they would be 'very unlikely' to use them. More of those aged 69 or less were 'Very Likely' to use a CAV (eight as opposed to five of the 70+ group), whilst eight of the 70+ group selected 'maybe' compared to only two of the younger group. Responses were broadly similar when analysed by gender.

Participants at all of the workshops were then presented with the following three questions.

What do you think about CAVs?

The initial question participants were asked to consider in more detail was:

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?

A sample of the responses to this question are captured in Figure 5 below:

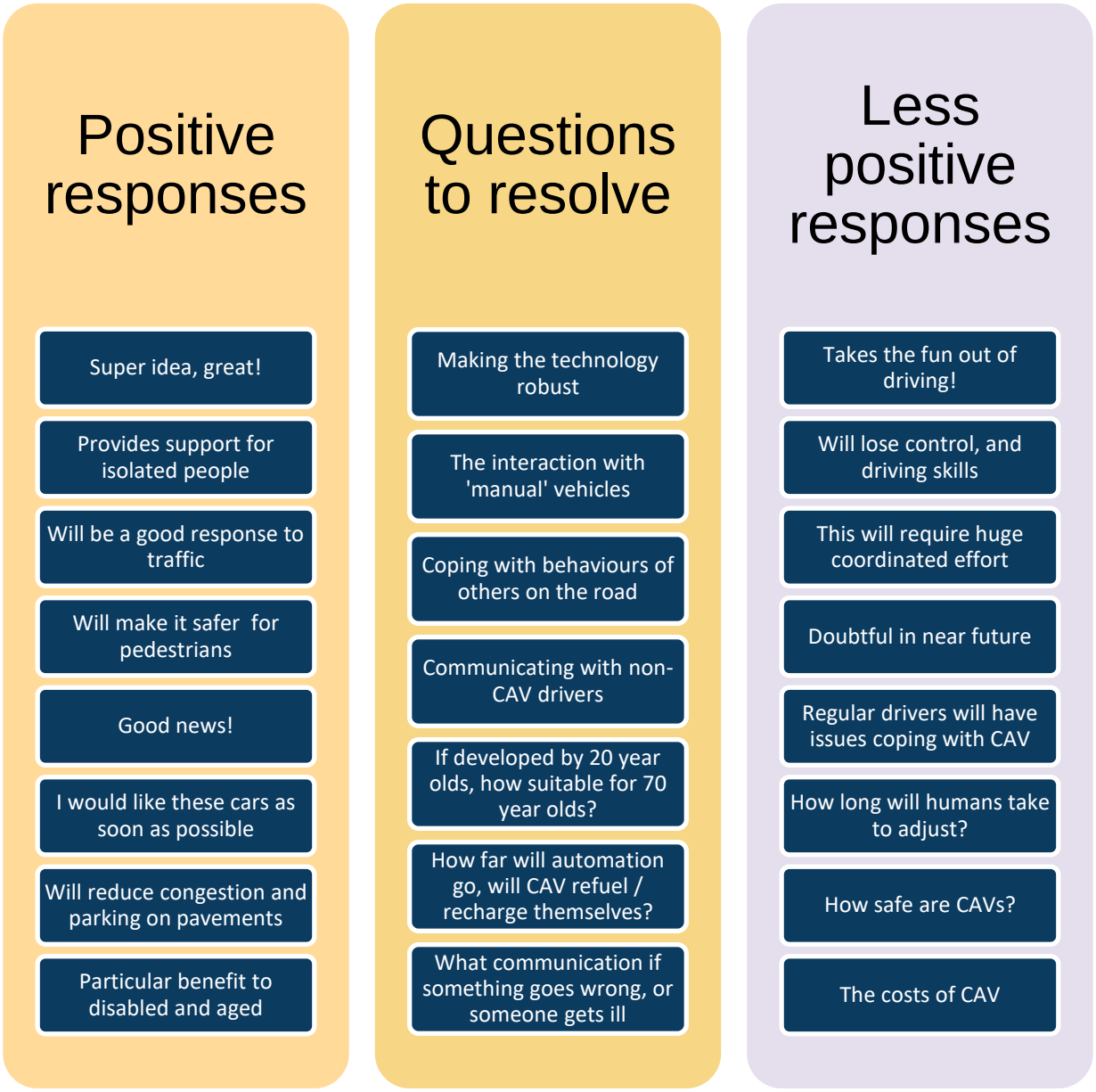


Figure 5 General views on CAV

Looking more closely at the individual answers that people had given in this session, there was generally a more positive commentary, with relatively limited negative feedback. Over half of the participants made positive or generally positive comments about CAVs. Of these, several specifically identified benefits for social inclusion, or for those groups less able to drive.

"Fantastic for those with impaired vision… (will) provide independence - important as older, disabled or lose partner as driver". (Ref MN4 Female, Age not recorded)

"Welcome anything that will help primarily older less able population to live more fulfilling life" (Ref JA6 Female, Age 57)

Others referred to safety, with one highlighting how CAV would improve safety for vulnerable road users. There was also a group who were 'sitting on the fence' to an extent: introducing caveats to

their support of CAV, or with unanswered questions that were perhaps making them less positive than some others.

"Need to see one working to understand its capabilities" (Ref SA1 Male, Age 66)

"Priorities must be safety and robustness" (Ref WO2 Male, Age 80)

Finally, a smaller group was mostly negative in their comments. For example, they did not think that CAVs would arrive anytime soon, and that the interaction with other vehicles would be problematic.

"My concern is more with the way other car users will interact with them"

(Ref WI17 Male, Age 80)

What characteristics and functionality would you want in a CAV?

Participants were then asked to think about the general characteristics and functionality they would want to see in a CAV.

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?

This produced a range of differing responses across the groups. Some of the key issues and characteristics are summarised under the following four broad headings of Control, Capability, Vehicle features and Accessibility / Space in the vehicle. There was also some discussion of 'ownership models' by participants, with some in favour of a more 'shared ownership' approach, akin to a taxi-type service. Others were not so keen and wanted to retain their own vehicles.

1. Control		
An Emergency Stop facility (if something goes wrong, or the vehicle doesn't spot a problem)	Different ways of interacting with the vehicle including voice-control ('Alexa' was mentioned[5])	Flexibility in setting destination, routes, stops and the ability to change whilst on a journey
Responsive to the needs of the traveller (if they feel unhappy with traffic, route etc.)	A personalised 'user interface'	Override functions in case the vehicle decided to go somewhere you didn't want it to

The strong message that comes through from these responses is that the participants are keen to retain what they see as the most important functionality in the vehicle: the ability to stop it and to determine where they are going and when. There was also a repeated mention of using 'voice control' and some also asked for voice response when controlling the vehicle.

2. Capability

[5] Alexa is a voice-controlled device offered by the internet company Amazon. It is capable of controlling various elements of home automation or a range of internet-based activities. Other technology companies offer similar services, and voice-controlled assistants. E.g. Siri on Apple smartphones and other devices.

Get in and go to where you want to go, when you want to go	Function like a taxi (not needed all the time), but should be easy to get one now or to book for later	Some form of interface / connectivity to emergency vehicles
The ability to tell me where it (the vehicle) is, and how long to reach me	An ability to interact with other transport systems to facilitate interchange	The vehicle should make it possible to sleep on an overnight journey
The potential to refuel itself – potentially on a journey.		

People had picked up on the 'connectivity' element of a CAV, and a number seem interested in the notion of the vehicle refuelling itself during a journey. The comment about being able to sleep in the vehicle raises some interesting issues about how much interaction will there need to be and how soon it might be potentially reduced. It also provides something of a contrast of views; between those seeking control, and those willing to take a passive role, potentially for hours.

3. Vehicle Features		
Comfortable, quiet and safe	Affordable, good fuel economy	Good visibility and heating (the latter brought up 3 or 4 times)
Telephone / Internet communications (but need to be secure)	Info about re-fuelling (re-charging possibly) and when on the journey.	Knowledge of my 'favourite' journeys
Good in-journey information about progress through the journey	Able to predict progress (e.g. delay as a result of congestion)	Can respond to forward congestion and hold-ups
Able to plan routes with intermediate waypoints.		

Much of the commentary provided in respect of this theme focused on features desired in existing vehicles, as well as many of the features and functions of 'Sat-Nav' systems that many participants may already be familiar with.

4. Accessibility and space in the vehicle		
Easy to use – and to get in and out of	Wheelchair accessibility.	Capable of carrying aids and equipment needed by older and disabled people to facilitate mobility
The vehicle should know where the disabled spaces (or other parking facilities that can be safely used) are located.	Plenty of space for luggage, friends, dogs and easily changed from being a passenger holder to a functional carrier of gear	Video cameras showing perimeter of car when parking to ease exit from car

For those living with other impairments, such as blind, deafness, loss of limbs etc. would like to see vehicle that is inclusive to all.

Participants therefore identified accessibility features that they might well be looking for in a conventional vehicle now – and not unique to using a future CAV.

What sort of journeys might you make in a CAV?

The next question looked to uncover the sorts of journeys that older people might think about making in a CAV:

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

"I think you would have a restless elderly population zooming all over the place"

(Ref SY13 Female Age 67)

Responses were a mix of actual locations, or types of location, as well as some characteristics of journeys that people would like to make – for example journeys after dark. Shopping, visiting family and a range of leisure destinations proved to be popular choices.

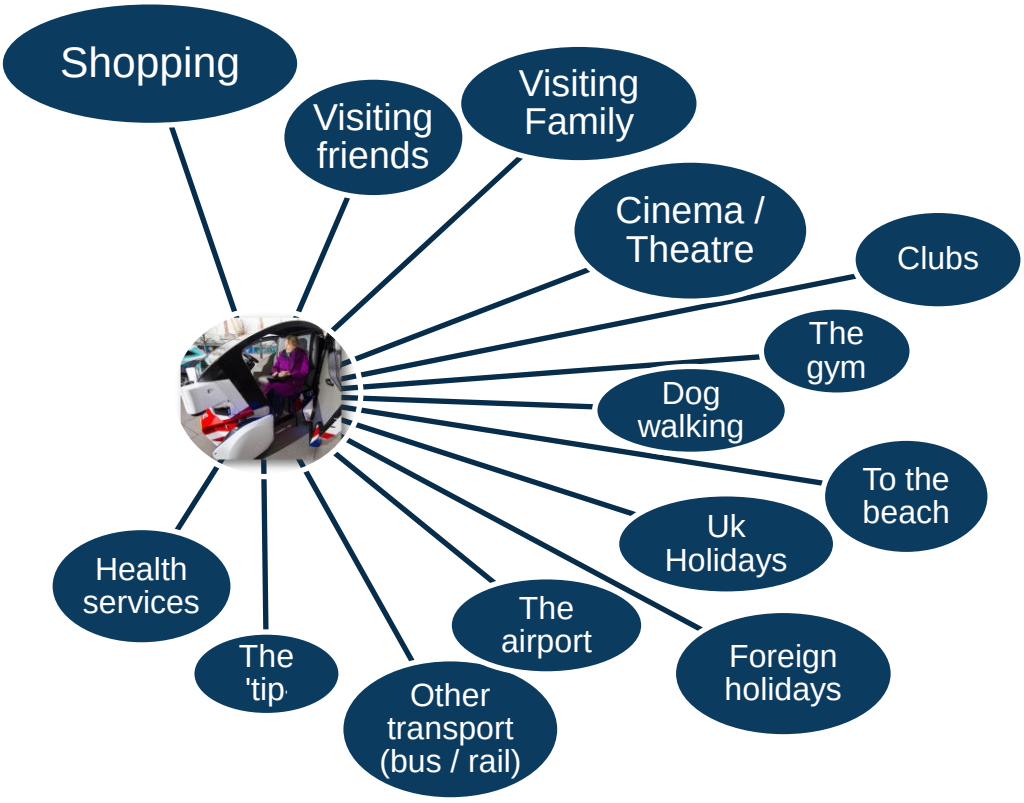


Figure 6 Destinations for trips in a CAV

Where people expressed an opinion as to how far they might travel in a CAV, the majority talked about short or local journeys, with fewer explicitly mentioning long journeys, or travelling longer distances.

In response to being asked if a CAV might have any particular features that would make journeys more appealing to them, participants mentioned the following characteristics:

Table 3 Characteristics of CAV that would encourage use

They could go to places that buses don't go, places not accessible by public transport
It would enable them to travel at night or in the dark
It would mean that they would be able to drive on Motorways
Travel at school times would be more feasible
They would allow those who don't have a license – for health reasons to have access to a vehicle
It would facilitate journeys in heavy traffic or in unfamiliar areas
People could collect things, and make journeys you can't do by bicycle
It would facilitate long journeys which are becoming harder to do, and allow driving further in one session
It would allow journeys to the countryside – somewhere seen as inaccessible now
They would help where and when parking is a problem
They would (ideally) interface with other transport modes (interchange)
They could be used by a service, for example, a rural GP could collect their patients
They could provide a 'magical mystery tour' – to just take you somewhere

In the main, the responses in Table 3 are highlighting the range of issues that older people often face when driving. For example, travelling at night, on the motorway, or at busy times. Alongside that, there are some responses that highlight the issues that those who do not drive, or who have given up might face in respect of their mobility, and how a CAV could potentially refresh that mobility. Getting to places not easily accessible by public transport for example. The final two responses are also interesting, in that participants have begun to think beyond just replacing current mobility needs and patterns and started to explore the opportunities that level 5 automation might mean.

One additional comment made by a participant was how it might be nice to able to buy trips in a CAV for someone else as a gift, or as a way of providing transport for them.

Taking a Journey in an Autonomous Vehicle

In the second exercise, workshop participants were asked to think in more detail about one or two journeys they personally might make in a CAV. They were asked to explicitly describe these trips, and talk about the other factors they would need to consider in order to plan for, and undertake them. Whilst everyone provided details of at least one journey, a small number managed to detail two and some included more than one purpose in a journey. All of this information is included in Fig 7 and Fig 8 below.

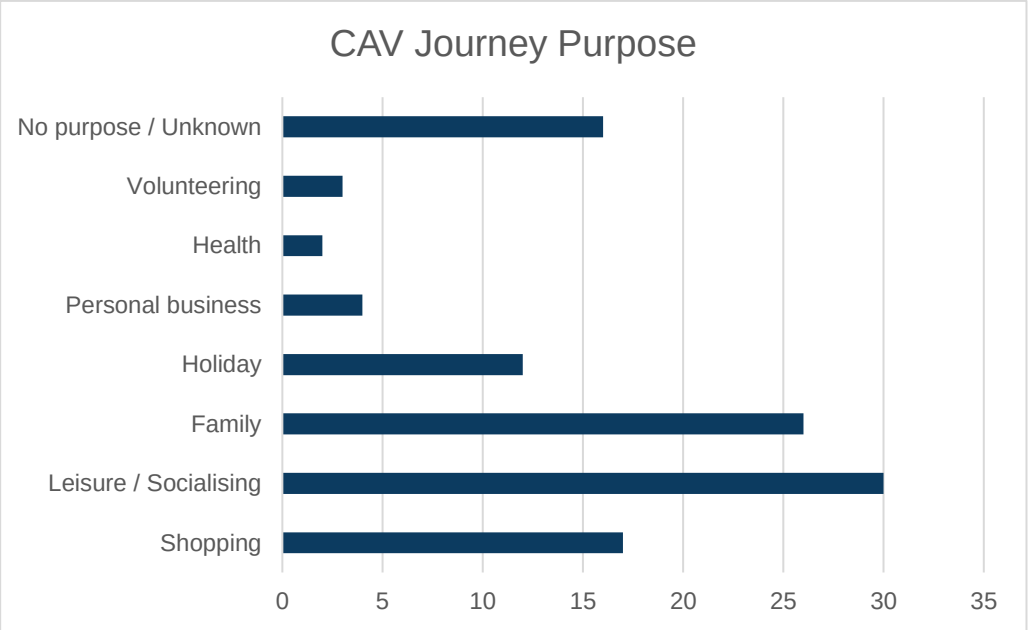


Figure 7 CAV Journey Purpose

The most common purpose given was for a 'leisure' type trip, an outing, or visit to somewhere, or just a drive. Whilst the journey purpose listed in Fig 7 were the 'headline' reasons for making a journey, some of the participants also noted that they would do other things on the way, such as shopping, visiting friends or, for one person, a stop for refreshments at a tearoom.

Several people suggested they would make journeys relating to holidays (in the UK), and it would be interesting to explore in later work whether they were journeys that people couldn't make at present, or they would be substitutes for current car or possibly coach journeys?

Participants also gave some indication as to the distance they envisaged travelling in the CAV to make a journey, which is captured in Fig 8 below.

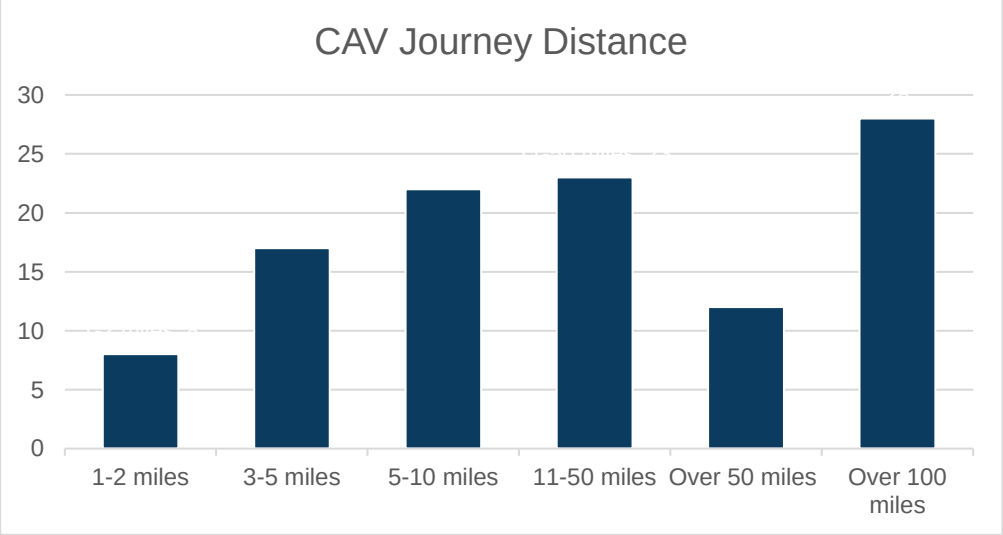


Figure 8 Journey distance by CAV

The longer journeys were for holidays, or to visit relatives in other parts of the UK. These are journeys that some people were finding more problematic as they were getting older. Relatively few

people suggested very short journeys by CAV, sometimes perhaps because they were thinking of carrying out several tasks or visits during a journey.

Participants were also asked a specific question in respect of 'how long' a journey they might be willing to take in a CAV, with no clear trend in the responses. Answers ranged from minutes to several hours and 'all-day' in respect of one trip to a coastal resort (although the drive might only be a couple of hours each way).

Things you would need to think about when planning a journey by CAV

As well as providing information about the specific journeys they might make, the workshop participants also gave additional feedback on things they might need to think about in connection with making these journeys. These are summarised below in Figure 9.



Figure 9 Things to think about when making a journey in a CAV

The ability to find toilets on the route was a common (and important) theme, as were concerns about the carrying capacity of a CAV. Many people assume CAV in the future will be powered electrically, and this meant some people were interested in where they might recharge, whilst others just wanted to know if a conventionally fuelled vehicle would refuel itself! There was also an undercurrent of concern about leaving in time to get to the destination, whether it was to the airport, or to school to pick up the grandchildren.

Other issues raised by participants

Some other concerns were raised during this exercise, which perhaps again reflect a degree of anxiety or uncertainty at present about future use and function of such vehicles:

1. The vehicle being there whilst they were at a destination, and when they came out of a shop for example.

"If I stop off at a supermarket, will my car still be there to put my shopping in during my shop?" (Ref CE5 Female Age 77)

"In each shop I would want flexibility as to how long I stayed, but I would want to come out and get in the car straight away. I.e. it is waiting for me" (Ref MN4 Female Age not recorded)

2. The vehicle letting others know your movements:

   "The family need to be informed you have left home at start of journey" (Ref ME3 Male Age 77)

   "Need to phone ahead on leaving to say I will arrive" (Ref SY13 Female Age not recorded)

3. Safety in general:

   "(I) feel safer if in 12 mile radius from home" (Ref TA14 Female Age not recorded)

Views on the Human-Machine Interface (HMI)

The third exercise for participants was focussed more specifically on the way in which they might interact or communicate with the CAV through a HMI. This provides some early indications of areas that might be important for older users of CAVs.

Workshop participants were asked to consider four different factors relating to the HMI[6]. These were Usability, Accessibility, Functionality and Adaptability. Each is described below with some of the feedback/comments received. More than one participant raised most points, unless indicated as a direct quote.

It is worth noting that individuals often used the term 'driver' or driving' in their responses here. There was not time in these sessions to follow up in more detail what people were describing when using such terms; did they still envisage 'driving', or does this also embrace notions of 'operating' or 'being an interested passenger' as well? This would be a useful area of investigation in future data-gathering activities.

Q1 – Usability

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?*

"*Robust, robust, robust*"	Robust, not prone to uncertainty
Standard approach, so all CAVs can be 'driven' easily	Consistent with existing technology
Easy to use	Avoid jargon or computer speak[7]

[6] In reality, the boundaries between them are not fixed, and responses might sometimes appear across categories. Where this occurred, some limited reorganization has taken place in the analysis to re-align answers more clearly under the four headings.

[7] This noted by 5-6 participants

"*I understand English, so instructions in English*"	
Clear information	Uncluttered, no overload
Clear guidelines shown for basic functions	Recall of info entered on request
Large Commands clearly confirmed	Pictures as well as words
Prefer text to icons	Multiple languages available
Pictograms / picture on screen not all words	Common interface across vehicles
Interfaces need to suit different learning / mental styles so several versions required - also easy to switch to the one you want	
Different levels of interaction required depending on a person's understanding and requirements. From simple to complex choices	
Ability for fellow passengers to take over part way through journey	Easy changeover to another driver en-route
Have personal setup downloadable from the cloud or your own memory card	Ability to reconfigure screens to suit driver
Should be able to explore alternative or amended routes without interrupting current route	HMI should ask easy questions (at start of journey): • Where are you going? • Do you want to stop on the way? • Will you want to go to the loo? • Do you want to go to friends, or home, or library?
Pre-programmed trips (and addresses) to download	Multiple back up
Perhaps pre-available instructions so could study beforehand	Would want training apps / simulator to try at home + telephone help to program it
From push-and-go to high degree of interaction depending on ability	

Perhaps few surprises here in this set of responses, with the participants wanting an HMI that was easy to use, clear and robust. Not using jargon, or computer-speak came across strongly as a message, and there was quite a lot of responses that were looking for a degree of flexibility in the interface to suit different users. Two people focussed on a slightly different aspect, that of being able to learn about the interface in advance of using it – reflecting perhaps on a finding from an earlier review of literature in this area that older people are more likely to reference a 'manual' of some kind when using new technology.

Q2 – Accessibility

***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?*

Be Visible, audible	The background / ambient colour
(controls) Easy to reach	Close reach but not 'bumpable'
Adjustable brightness	Brightness of screens to vary with outside light levels
Screen with large enough icons with labels and pics	Screen good size with large font
Would like windscreen to be the interface, and everything to be displayed on that	
Big enough to read without glasses	Reasonable size screen, or multiple screens
Physical button for ON and STOP / On / off not on screen	
multiple interfaces - methods of interaction	Speak or touch or joystick control
Option to use touch screen, voice, or type with keyboard.	Not just touch screen - buttons as well because as age skin gets drier[8]
"*Sometimes my fingers don't work on touchscreens*"[9]	Tactile, user should feel it
Would like it to be like existing interfaces in other tech like iPad	Some older people are frightened of iPad type interface
Voice command alternative	Possibly voice-activated too
Voice control – provided it is able to filter out background voices	React to varying voices, BUT stop other voices taking over
Touch control with integrated voice control to avoid mis-selection due to vibration etc. in vehicle.	
"*Not a dashboard like a jet plane*"	"*I don't want to interact with it. I want it to take me to my destination*"

[8] There are known issues with some people not being able to use some types of touchscreen effectively because of a range of issues (dry skin, temperature etc.).

[9] The participant suggested that this might be because of a '*lack of blood*' in their fingers, but issue is more likely as above.

Again, few surprises in this feedback, with responses reflecting a range of issues that people might experience as they get older – poorer eyesight, and the need for clear interfaces. There was also a reasonably strong call for voice-based control, although some concerns about who would be listened to in the vehicle. Again a small number of people are looking for simplicity, to the extent of the individual who did not want any interaction at all – just to be delivered to their destination (although presumably they would like to be notified they had arrived).

Q3 – Functionality

***Functionality**. Are there particular functions and features you would like to see in the interface to the vehicle? Why is that?*	
Ability to stop car	Ability to stop, get help, go to safe place of haven
Inbuilt mobile phone	Phone that could automatically phone nearest help Centre if you breakdown
Tracker beacon for RAC / breakdown	Manual controls that might be concealed but instantly available for emergency / limp home
Pin card access and alternate driver and master key for emergency services	
Route options during journey - Local routes and short cuts,	Able to find service station, restaurant shops, fuel etc.
Interactive, informative, warning of hazardous conditions ahead	Traffic news and updates available
Road blockages ahead, impact on journey time of jam / accident etc.	
Awareness for factors such as speed, braking, danger, everything OK.	Ability to regulate speed
Possibility to amend routes during journey	'Slow down' toggle to look at view
Need maps - could point out things you are passing. Point out places of interest on journey	Tell time, arrival time, map showing where you are
Very accurate navigation / maps so I know exactly where I am and where I am going	Want it to give a running commentary of what it is doing
Journey distance and time showing, including elapsed time and distance	Progress reports on journey with predictions or arrival time etc.
Visual record of journey and how far it's gone plus how far it has yet to go	

"*Checking command so I know I have programmed it precisely enough, and am not going to a similarly named road somewhere else*"	
Separate devices - i.e. for entertainment. Radio, TV, games etc.	
No software freezes - cannot reboot	No software 'auto-updates'
Health monitor	Heart monitor needed – to monitor driver's health
Security system that recognises you as the user	Allow the driver to add functions to interface if they want them (i.e. rev counter)

The strong message coming through in these responses is the desire to retain some degree of control over the vehicle (the ability to stop it or to change what it is doing whilst in the vehicle). Also functionality that would allow those in the vehicle to call for help – perhaps automatically. Quite a few responses related to monitoring progress, and being able to follow the journey in various ways, and an interesting request to be able to check what commands the vehicle thought the user had given. A couple of responses brought up the idea of having some form of inbuilt health monitoring functionality, and this could be an area worth exploring in more detail in future qualitative work with participants in the Flourish project. In particular, how this might relate to those managing the network.

Finally, it is worth noting that one participant also suggested "*the less the better*" in respect of this question.

Q4 – Adaptability

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?*	
Flexible adaptability	Meet as many impairments as possible, maybe tailored to individual
Adaptable for use with different disabilities or limitations (e.g. sight impairment, restricted movements).	
Able to use it whatever state I am in day to day	Able to change with my day-to-day condition. E.g. confusion, onset of medical condition, distraction etc.
Sensibility to passenger's vulnerable characteristics and whether alone or with a carer.	
Learn 'my preferences' and build-up database of individual requirements so vehicle could adjust seat to right height for passenger for example, or know favourite journeys	
Ability to put interface where it suits you	Quick, easy change to different user

Left or right hand control	Screen at a distance suitable for long and short arms and limited movement
Touchscreen with large icons for those with poor eyesight or tremors	Ability to use voice interface for visually impaired and if blind, voice active
Eye movement control	Need visual and vocal options for commands
Visual / audio / tactile redundancy	Must allow for users who are slow or unclear (dementia, mental impairment)
Audio controls for various hearing levels	If deaf, buttons to press or keyboard
Controls suitable for those with arthritic hands / fingers	Room for fixed knees, leg space.
Physical mobility might be restricted - so can't reach the screen, maybe not got the control to touch the screen or see the screen	
Hand held control, or on a big lever that can be pushed to one side with a screen on it	

Suggestions were made in respect of a range of potential health problems and conditions that people might be experiencing that would require the HMI to be accessible in one form or another. One interesting perspective is that of a person's abilities varying from day-to-day (or perhaps even within a day), and the demands that might place on an HMI. Several comments that picked up on physical issues related to problems such as arthritis also highlight the fact that being less-able to use an HMI can relate to simple physical dexterity issues.

Although not specifically related to the HMI, there were also many responses given in respect of 'adaptability' that referred more generally to physical access to the vehicle, and the ability to carry walking and mobility aids. These included:

Seat on the door or slides out	*Door on the back - car park access*
Ramp access for wheelchair / Ramps	*Adjustable seat to help getting in and out*
Space for a walking frame or rollator	*Capable of taking all mobility aids*
Space for Zimmer frames.	*Capable of taking wheelchairs*

Likelihood of use revisited at end of workshop three

As noted above, the participants in the third workshop were asked a question at the start and end of the session to see if their views on using a CAV might have changed. The results illustrate some change, and suggest a move towards people being 'very likely' to use a CAV if they were available (See Fig 10 below). Potentially the discussions, and opportunity to think in more detail about how they personally might use such a vehicle made them more positive towards them. It is worth noting though that a small number of people remained unlikely to use them.

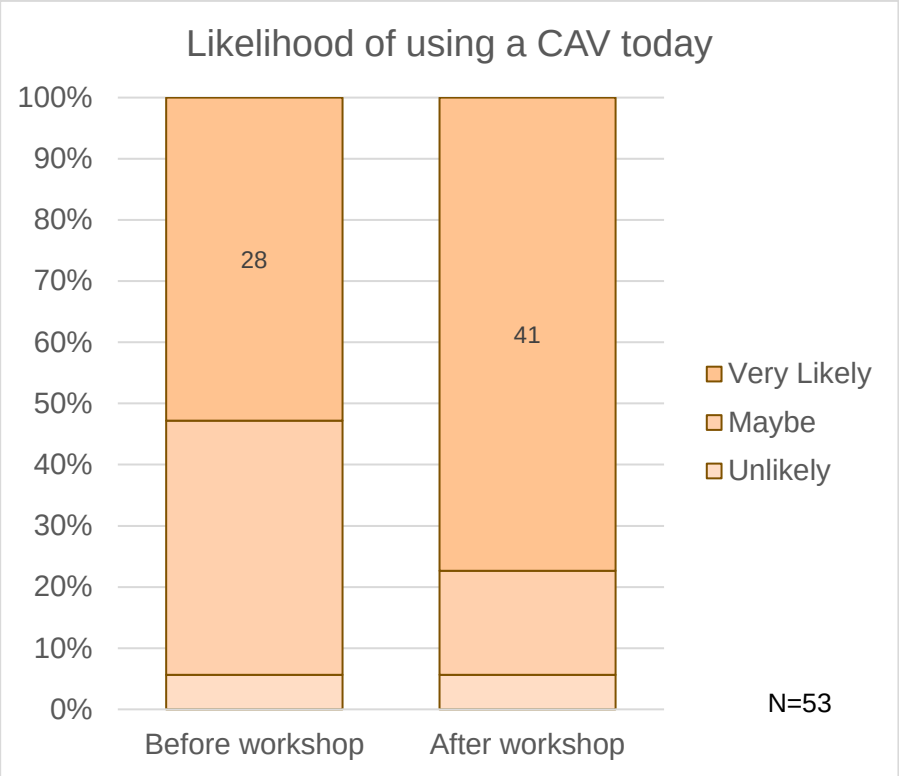


Figure 10 Likelihood of using a CAV if deemed safe by the Government. (Before and after workshop)

Looking at the same results from an age group perspective suggests broadly similar levels of acceptance across both groups.

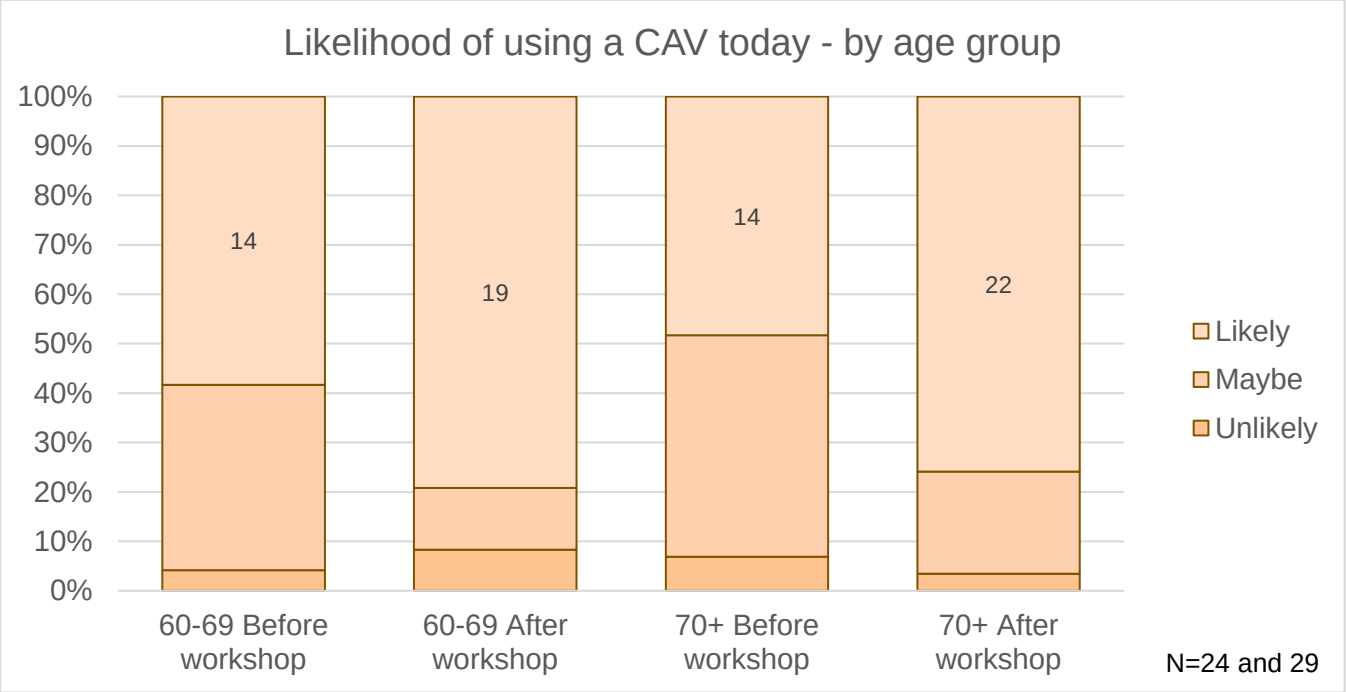


Figure 11 Likelihood of using a CAV by age group

Discussion and Conclusions

The four workshops with older people recruited as potential participants in the Flourish simulator and 'pod' trials have provided a useful set of insights into how this group view the potential for CAVs. It must be acknowledged though that the participants may not be a very representative group. Also, as with most social research, selection biases will be present resulting from some people approached agreeing to be involved, and others not. In terms of knowledge about CAVs, the participants received some explanatory material (e.g. an information sheet) from the project in advance of the workshop sessions. Thus, they had some understanding already of what a CAV is, and of the benefits that are being claimed for such vehicles. Then, once participating in the study they were further informed about the future potential technologies and services. Hence, they were intentionally more informed about the research topic than a typical citizen would be. This in order for their judgements to be more like those of older people in the future, when sophisticated CAVs (Level 5) do become available to the general population. The results detailed above should be seen in that light.

For these participants at least, the idea of a driverless vehicle is in the main seen in as a positive possibility. However, when given more time to think about their attitudes to autonomous vehicles, the workshop participants did note a wide range of issues and unresolved questions that they thought would need to be addressed before such vehicles would be commonplace. Not surprisingly, this included concerns over safety and cost. It was also clear that being able in some way to maintain 'control' over the vehicle was a common theme, which emerged throughout the different exercises in the workshop.

Whilst there was no clear message from the workshops as to the duration of journeys that people might make (examples given being a mix of long and short trips), it is possible to get some insights into journey purpose. When asked to think about the sort of journeys that they might make, 'Shopping' was a common response. This is consistent with wider understanding (and statistics) on older people's travel in the UK which shows a greater distance being travelled for shopping on average for those over 70[10]. Alongside shopping which is a key journey purpose for older people (either by car or by public transport), it was also possible to see that leisure trips, including those to cultural activity such as the theatre / cinema / museums etc. also featured. For some older people, mobility for these purposes is seen as problematic[11], and the ability to undertake what might be seen as more 'discretionary' journeys (as opposed to 'necessary' travel to the doctors for example) is often foregone as mobility becomes more difficult for older people. This is particularly the case for destinations that might be less well served by public transport, where journeys might need to be undertaken at times of the day when older people are less likely to drive (i.e. after dark), or when they feel less safe using other modes of transport. Such shortfalls in discretionary journeys can affect older people's social participation and their wellbeing[12], and reductions in 'social' leisure

[10] DfT National Travel Survey 2014

[11] Shergold, I., Parkhurst, G. and Musselwhite, C. (2012) Rural car dependence: An emerging barrier to community activity for older people. Transportation Planning and Technology, 35 (1). pp. 69-85.

[12] Gaffron, P., Hine, J., Mitchell, F., 2001. The Role of Transport in Social Exclusion in Urban Scotland - Literature Review. Central Research Unit. Scottish Executive

activities away from home are seen to lead to a lower level of life satisfaction[13]. Whilst alternatives may be found for necessary journeys (such as access to healthcare), the discretionary trips that also contribute to quality of life and offer the psychological benefits of '*getting out and about'*, may be lost with reduced mobility[14], with potentially negative effects on wellbeing[15]. It is clear that CAV could potential play an important role in reducing such mobility shortfalls, and it is very interesting to see these sorts of journey purposes being discussed by the participants in the workshops.

Participants also gave a broad range of input in respect of how they thought they might want to interact with the vehicle via the HMI, and the sort of functionality it should provide. Again the issue of remaining control is visible through the responses, with one person noting that they were a 'nervous driver' and thus likely to be a nervous passenger. Whilst the capabilities of the vehicle requested were perhaps very similar to what people would look for in a conventional vehicle today (especially one equipped with driver aids such as sat-nav for example), there were some useful pointers in respect of adaptability in the HMI. Responses considered not just the issues of declining vision and hearing, but also issues of physical impairment and decline. So for example the ability of some older people to be as dextrous in touch (re touchscreens and other controls) or in their movement because of issues such as arthritis. Many people made comments about the HMI being capable of supporting a variety of different mechanisms of control, and of being flexible to cope with different circumstances (even different states of ability in the same person from day to day). This need for flexibility is probably the key message emerging from this particular exercise.

The participants in these workshops have provided the Flourish project with further useful insights into the appetite for CAV amongst the older population. These older people have shown themselves to be broadly positive in their outlook on such vehicles, but not without some key questions over their safety, cost and in particular control. Throughout the exercises, that made up the workshop retaining some degree of control was a constant theme that emerged. Notwithstanding this, people could see how CAV might fit into their lives and provide mobility (as well as potentially addressing current or future shortfalls). They do though highlight that real consideration will have to be given to how the vehicles and their participants interact, and in particular that for this group to be effective users of CAV the HMI will need to reflect their needs.

[13] Liddle, J., Gystafsson, L., Bartlett, H. and McKenna, K. (2012) Time use, role participation and life satisfaction of older people: Impact of driving status. *Australian Occupational Therapy Journal*, 59 (5), p.384-392

[14] Davey, J. A., 2007. Older people and transport: coping without a car. Ageing and Society, 27(01)

[15] Musselwhite, C. and Haddad, H. 2010. Mobility, accessibility and quality of later life. Quality in Ageing and Older Adults, 11(1), 25-37.

Appendix A: Material used in Workshop

A.1 Sample Workshop Agenda

Time	Activity
13.00	Arrival and Refreshments
13.05	Health & Safety & Agenda
13.10	Meet The Flourish Team - Introductions
13.15	Introduction to Flourish
13.25	Exercise 1: Some First Thoughts
13.45	Questions
13.50	Break
14.05	How we are Running the Research Study
14.20	Exercise 2: Taking a Journey in an Autonomous Vehicle
14.40	Exercise 3: CAV User Interfaces
14.50	Next Steps
15.15	Closing Remarks & Questions

A.2 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.

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?

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 is people wished / had time.

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?

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