



## CAV public acceptability dialogue

Engagement report

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Department  
for Transport



Centre for Connected  
& Autonomous Vehicles



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## Foreword

Britain is on the verge of a transport revolution. Radical new technologies are emerging that within a generation will transform how we travel. Self-driving vehicles, the focus of this report, have the potential to improve our travel experiences, to improve road safety, and allow disabled people and older people to enjoy the freedom to travel that the rest of us take for granted.

Technological advances are moving at an astonishing pace. The UK Government will continue to support businesses, engineers and academics in their development of innovative solutions to the transport challenges that we face. But an equally important priority is to ensure that the technology is developed in a way that people can trust. That is why the Department for Transport, in partnership with Sciencewise, undertook this study with members of the public from across the country. Only by building public trust can we be confident of achieving the full benefits promised by these technologies.

This public dialogue on connected and self-driving vehicles has been truly groundbreaking – a world first – and provides a strong indication of the UK Government's commitment to putting people at the heart of policy development.

I would like to express my sincerest thanks all the experts who took part in the workshops, and the members of the Oversight Group who ensured rigour and independence in how we approached the dialogue. But most of all I would like to thank the members of the public who dutifully and untiringly attended the workshops and gave their honest and considered opinions throughout. I can guarantee that your voices have been heard and will influence how we approach the design and development of these new transport technologies.

This public dialogue is not a one-off exercise. We will continue to engage with the public to ensure that this transformation in how we travel delivers in a way that keeps people's needs and aspirations at its very heart.



**Iain Forbes**

**Head of Centre for Connected and Autonomous Vehicles**



## Executive summary

The UK Government in partnership with Sciencewise, funded by UK Research and Innovation, commissioned Traverse to deliver a set of public dialogues on attitudes towards connected and automated vehicles (CAVs). The dialogues were held in five locations across the UK; Abergavenny, Glasgow, Leeds, Millbrook and Milton Keynes. Over 150 people were brought together across these locations, with each person attending three workshops between October and December 2018 – one evening, one full day and one half-day. In addition, 25 of those people took part in a post-engagement telephone interview.

Participants had the opportunity to interact and discuss the topic with policy-makers and specialists from industry, academia and government. The same discussion activities were conducted in all five locations. In three of the locations, some participants also had the opportunity to experience self-driving technology by riding in a simulator, a self-driving pod or a highly-automated car.

### **Many participants were positive, but views were nuanced and complex**

Overall, the majority of participants were generally positive about the possible impact of CAVs on themselves and on society. However, they were aware that the introduction of such technology raises a range of questions and concerns. They were excited by the potential benefits, yet sceptical that these benefits would be realised. The dialogue showed that there was no single thing that would help relieve concerns. As more of the participants' questions were answered, they were able to delve deeper into the topic and raise new questions and concerns.

### **Participants from different demographic groups expressed similar views**

While there were some differences between demographic groups early in the dialogue, these were not systematic. The overarching finding was that there was limited evidence of people's backgrounds (age, gender, socio-economic group, drivers and non-drivers) shaping their reaction to CAVs.

People from all backgrounds had the same key questions.

- Will it be safe?
- Will it be available to all?
- Who will be in control?
- How do we get to a future with CAVs on the road?

Each of these questions is outlined in more detail below.

### **Participants wanted to be confident that CAVs would be safe and secure**

Safety and security were of paramount importance and while participants felt that CAVs could potentially improve safety for road users, they were concerned about new risks emerging. Participants discussed connectivity, personal safety and data security concerns as well as implications for road



safety. While they saw potential road safety benefits, they were concerned about the reliability of the technology and how that could impact on safety for those inside and outside the vehicle. This concern was linked to uncertainty about accountability – who would be responsible and what options would be available if things go wrong? This lack of clarity around accountability drove conversations on data security and the security of the technology.

### **Participants want CAVs to be available for all**

At the start of the dialogue participants in each location raised the importance of equity and accessibility. Over the duration of the dialogue support for this view developed across all demographic groups. Participants felt strongly that CAV technology should be available and affordable for everyone. Participants thought that the technology would be available in cities much sooner than in rural areas and questioned the overall viability of CAVs in rural areas.

Participants saw potential benefits for people with mobility issues and other disabilities as CAV users, as one of the most important opportunities to be realised. They were concerned, however, that the potential for CAVs to be more accessible for more users than current forms of transport might not be realised, if the technology was directed towards the biggest markets rather than the greatest needs. Participants highlighted the need to consider a range of needs and disabilities when designing vehicles and software (including people with learning disabilities or visual or hearing impairments, or those who speak different languages).

### **Participants want to maintain control over their transport choices**

Participants, especially drivers, valued the immediacy and convenience of their current transport options. Some participants wanted reassurance that there would always be an option to take back control of a vehicle. Others were concerned that if a vehicle were not fully automated it could be a safety risk when switching between automated and non-automated driving, or would limit the value of CAVs to people without driving licences.

### **The desirability of sharing**

During the dialogue we explored views of different ownership models including shared ownership and shared occupancy.

While participants realised that sharing ownership or occupancy could help achieve many of the potential benefits of CAVs, they were often reluctant to give up their current transport for those benefits. Suggested cost-savings generally did not override this – unless it is a significant decrease of at least 25-50% compared with the current journey cost. For some, cost was not a consideration at all and the freedom to be able to go where they want when they want to, was the most important thing.

Some participants, especially women, highlighted personal safety in relation to other vehicle occupants, especially when discussing sharing vehicles.



## **The inevitability of automation**

Many participants believed the introduction of some form of CAV technology was an inevitable technological progression. They compared it to the advent of the motorcar: it could happen quickly and soon people would not be able to imagine life without it. While participants talked from a starting point of feeling that vehicle automation is inevitable regardless of public opinion, they wanted and believed they should be able to influence how the transition happens.

## **Transitioning to a future with CAVs on the road**

A key question across all locations and workshops was how the transition to an automated road transport network would happen. Participants thought this would be complicated. They were worried about CAVs and non-automated vehicles interacting on the roads from a safety perspective. They saw a clear need to update transport infrastructure to be compatible with CAV technology and were concerned about who would benefit and who would pay. These concerns led participants to believe that CAVs would not be a common feature of our road transport systems for at least 20 to 30 years.

This view was intensified for some participants by experiencing the technology. Travelling in a self-driving pod at ten miles an hour, or sitting in a highly-automated vehicle with a safety driver showed them the current limitations of the technology. This meant that participants saw a fully automated road transport future as being further away than perhaps they had assumed when their views were informed by the media and their imaginations.

## **How to introduce CAVs**

Many participants were positive about the introduction of CAVs, but were quick to suggest conditions which would make them more likely to welcome them. The conditions under which they were willing to change their transport choices centred around some of the key themes outlined above – if a world with CAVs is safer, fairer (in terms of who would benefit), more equitable (in terms of how the technology would be deployed and governed) and convenient then many participants would consider using them.



# 1. Introduction

## 1.1. Context

The UK Government believes that Connected and Automated Vehicles (CAVs) have the potential to contribute towards achieving significant social benefits to the UK which could include: fewer crashes on our roads; freedom to travel for those who currently find that difficult; and more efficient transport networks that are safer, smoother and swifter.

The UK Government recognises that the attitudes, behaviour and wider acceptability of the technology by the public will be critical to achieving the aforementioned benefits. A scoping study was commissioned in 2016 to explore the key social and behavioural questions associated with connected and automated vehicles.<sup>1</sup> The study provided research recommendations for future social and behavioural research not just for the Government but for the entire CAV sector to engage with.

A public dialogue exercise was commissioned to explore what factors shape participants' views on CAVs; and how, why and in what circumstances people's views change.

Traverse, working in partnership with researchers at University College London (UCL), were commissioned as the independent delivery contractor for the dialogue.

## 1.2. Aims and objectives

The UK Government required a public dialogue using deliberative research methods to develop their understanding of public attitudes towards the emergence of automated vehicle technology and participants' expectations, aspirations and concerns about future usage.

### 1.2.1. Project objectives

The objectives were to use the results of the dialogue to:

- inform the development of the Government's strategy and regulations in relation to CAVs, including how the different levels of autonomy are regulated, road technology improvements and road safety legislation;
- inform the development of the technology itself (including government-funded projects), helping to realise perceived benefits of CAVs (such as improved road safety) as well as mitigate against any potential concerns and disadvantages (such as cybersecurity fears); and
- plan future engagement and awareness-raising on connected and automated vehicles using language that is familiar to the general public.

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<sup>1</sup> Cohen, Jones, Cavoli (2017) Social and behavioural questions associated with automated vehicles



### **1.2.2. Dialogue objectives**

To achieve these project objectives, the dialogue needed to draw clear, coherent conclusions based on an understanding of the following:

- participants' current understanding of, and engagement with, the different terms used to describe the technology (for example autonomous vehicles, driverless cars, highly-automated vehicles, self-driving cars etc.);
- participants' current knowledge about the technology;
- participants' perceptions, aspirations and concerns about the development and use of vehicles and their reactions to different potential scenarios of how the technology could be deployed and the stages leading to full autonomy;
- how and in what circumstances participants' aspirations and concerns regarding CAVs might be addressed; and
- what circumstances make people more or less amenable to ride-sharing.

A question originally included in the objectives, relating to the role of government in the development and deployment of the technology was de-prioritised after discussion with the project team and policy stakeholders, to allow time to discuss shared ownership and occupancy as a separate objective. However, the team captured views around responsibility and accountability of government and other stakeholders throughout the dialogues where they arose.

## **1.3. Methodology**

### **1.3.1. Sciencewise approach**

Sciencewise (<https://sciencewise.org.uk/>) helps to ensure policy is informed by the views and aspirations of the public. The programme is led by UK Research and Innovation (UKRI) with support from BEIS.<sup>2</sup>

Sciencewise supports public dialogue on new and emerging technologies where opportunities exist to support policy-makers to develop socially informed policy.

Sciencewise public dialogues provide in-depth insight into the views, concerns and aspirations of a diverse and inclusive sample that reflects the UK population as a whole or the population in the area where dialogue activities are being held. Dialogues are designed to develop participants' understanding of a topic over several sessions – capturing top-of-mind

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<sup>2</sup> On 1st April 2019, during the course of the project, the Sciencewise programme transferred to UK Research and Innovation. UK Research and Innovation brings together the seven Research Councils with Innovate UK and Research England. Operating across the UK with a combined budget of more than £7 billion, it works in partnership with universities, research organisations, businesses, charities, and government to create the best possible environment for research and innovation to flourish. <https://www.ukri.org/>.



reactions at the start of the process, more considered views at the end, and revealing information and messages that resonate throughout the process. This allows decision makers to develop policy informed by public views.

For Sciencewise, public dialogue includes:

- involving specialists and policy-makers in discussion with the public to help explore issues, aspirations and concerns when shaping policy;
- talking with the public about ethical and societal issues related to public policy;
- requiring the instigators of the dialogue to be potentially willing and able to change their minds; and
- ensuring that public insights can inform policy involving science and technology issues.<sup>3</sup>

This programme of dialogues was conducted in line with Sciencewise Guiding Principles<sup>4</sup> and with input and scrutiny from Sciencewise dialogue and engagement specialists (DES) and social research professionals at Department for Transport (DfT). The project also benefited from input from an independent evaluator, 3KQ and oversight for the dialogues from an Oversight Group.

### 1.3.2. Oversight Group

DfT convened a group of stakeholders from industry, policy, public interest groups and academia, to provide oversight for the dialogues. Please see Appendix B for a list of members and Terms of Reference for the Group. The role of the group was advisory, with objectives to oversee the dialogue process and materials and to help ensure that:

- the dialogue material was comprehensive, balanced and accessible to the lay reader; and
- the engagement process was far reaching, accessible and targeted all relevant groups where possible.

The Oversight Group commented on the dialogue background and stimulus materials, outputs and the communications strategy for the outputs.

Table 1: Members of the Oversight group

Name	Role / organisation
<b>Iain Forbes (Chair)</b>	Head of the Centre for Connected and Autonomous Vehicles
<b>Michael Dnes</b>	Head of Road Investment Strategy 2
<b>Vikie Judd</b>	Senior Marketing Manager, Energy, Technology and Innovation at DfT

<sup>3</sup> Sciencewise & Department for Business, Energy & Industrial Strategy: The Government's Approach to Public Dialogue on Science and Technology

<sup>4</sup> <https://sciencewise.org.uk/about-sciencewise/our-guiding-principles/>



<b>Pauline Morgan</b>	Head of Road User Safety Delivery Programme, Road User Licensing, Insurance and Safety Division
<b>David Wong</b>	Society of Motor Manufacturers and Traders
<b>Mervyn Kohler</b>	Age UK
<b>Helen Dolphin</b>	Disabled Person's Transport Advisory Committee
<b>Jessica Uguccioni</b>	Disabled Person's Transport Advisory Committee
<b>David Skipp</b>	Ford Motor Company
<b>Lucy Yu</b>	Five AI – CAV software company
<b>Deirdre O'Reilly</b>	Highways England
<b>Dr Paul Cowie</b>	Centre for Rural Economy
<b>Josh Harris</b>	Brake – road safety charity
<b>Andy Cope</b>	Sustrans – walking and cycling charity
<b>Nick O'Connor</b>	Meridian Mobility

### **1.3.3. Specialist Group**

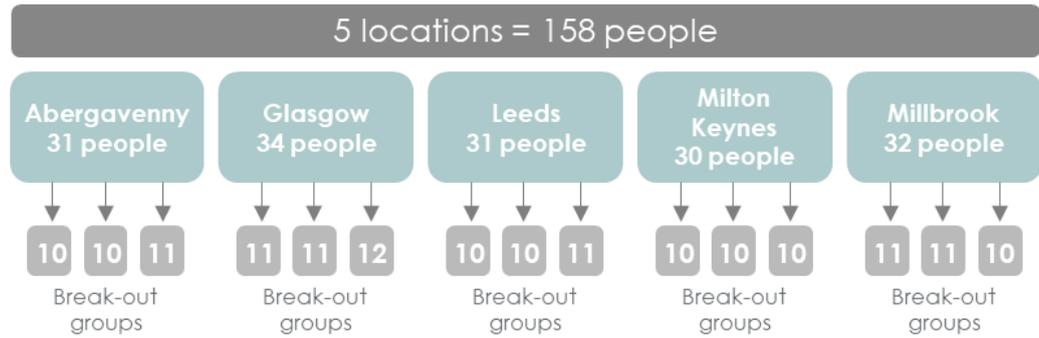
The dialogue delivery contractor (Traverse) convened an additional group to provide specialist expertise throughout the process. This group comprised industry experts, academics and other relevant bodies, covering a range of experience and interest in CAVs. Specialist Group members were recommended by Oversight Group members, DfT and the Centre for Connected and Autonomous Vehicles (CCAV).

The Sciencewise approach to public dialogues involves members of the public interacting with subject-matter specialists and policy-makers, to learn and explore together. Members of the Specialist Group were invited both to provide comment on the dialogue materials and to attend events with participants.

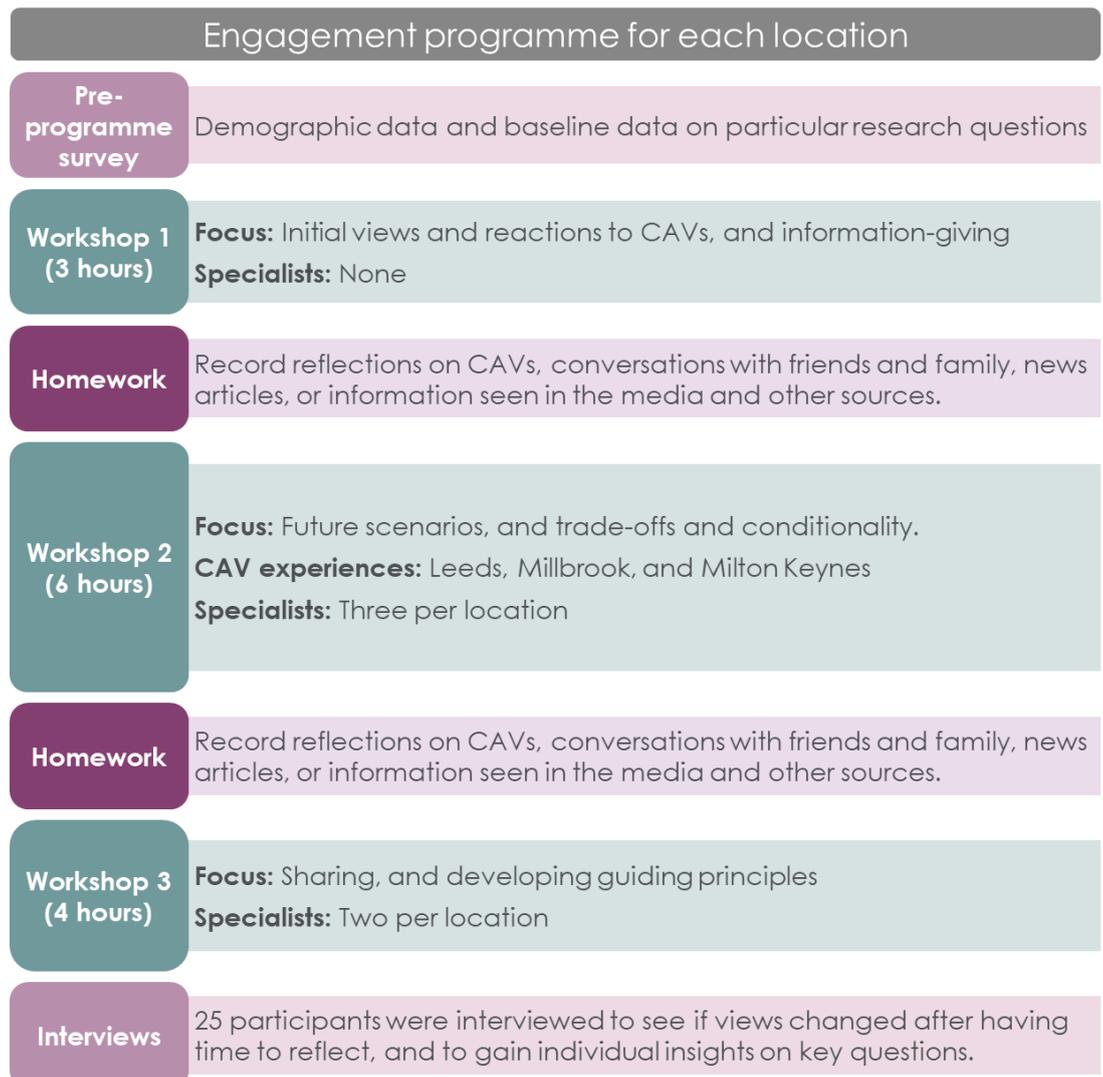
Specialists were recruited early in the dialogue process, with the option of participating throughout, or at certain points. Specialists were compensated for their time and travel expenses. For a full list of Specialists and the brief for the group, please see Appendix C.

### **1.3.4. Dialogue workshops**

The dialogue comprised 15 workshops, with three workshops in each of five locations: Abergavenny, Glasgow, Leeds, Millbrook and Milton Keynes.



The intended sample was 150 participants reflecting the UK population in age, gender, ethnicity and socio-economic group; and a mix of attitudes to technology, urban / suburban / rural dwelling, driving regularity and car ownership. A total of 158 participants completed two or more sessions. The content of the sessions is set out in the diagram below. Below we set out the key activities in each of the three sessions. Refer to Appendix A for comprehensive detail on the methodology and process design and sampling and recruitment. More information about how the discussion developed is included in Section 5.





## Lenses and scenarios

One activity frequently referenced in this report is the future scenarios activity from the second workshop. Participants explored three scenarios, with different levels of integration of CAVs into the road transport network. Prior to exploring the scenarios, participants selected five 'lenses' that were most important to them from 33 options (for example road safety, personal safety, affordability, environmental impact, accessibility, feeling in control). In each scenario they considered if things would be better or worse than today for each of their selected lenses. A full list of the lenses is included in Appendix F, Section 2. The scenarios are in Appendix A, Section 5.

## Voting and discussions

Participants voted on a set of closed questions (following and developing on those asked in recruitment) at the end of each workshop, using digital keypads. At several points in this report we note that participants' responses in the voting questions were relatively positive while in the discussions, they focussed mainly on their concerns. This could be because participants felt more strongly about voicing their concerns than what they were positive about. However, over time, discussions prompted participants to increasingly elaborate on the potential benefits of CAVs for society.

### 1.4. How to read this report

This report is divided into an executive summary and five sections.

- **Executive summary:** Overview of all findings
- **Section 1:** This introductory section, covering method and approach
- **Sections 2, 3, 4 and 5:** Four sections outlining the findings:
  - Attitudes towards CAV technology
  - Impacts of CAV technology
  - Managing the introduction of CAV technology
  - Making sense of the topic
- **Section 6:** Concluding section, discussing implications of the findings

Appendices are provided separately.

- **Appendix A:** Methodology
- **Appendix B:** Oversight Group
- **Appendix C:** Specialist Group
- **Appendix D:** Participant suggestions
- **Appendix E:** Guiding principles
- **Appendix F:** Quantitative data results

#### 1.4.1. Quantifiers

We use non-specific quantifiers to give relative weighting to qualitative data, instead of reporting on numbers or percentages of participants, because numeric quantifiers would be misleading given the small sample size:



- 'most' or 'majority' when a clear majority of participants shared a similar view; and
- 'some' when a minority of participants shared a similar view.

Where multiple views on an issue are presented, more prominent views are reported first. We use terms such as 'consistent', 'commonly held', or 'less common', to show the relative frequency of occurrence of views.

#### **1.4.2. Interpreting and extrapolating findings**

Public dialogues are a good way to engage the public with complex policy issues in a meaningful way. However, as with any research method, when interpreting the findings, it is important to bear in mind the potential limitations of the approach and how these have been mitigated. The approach is well respected for its ability to enable the public to fully engage with complex policy issues in a meaningful and informed way.

- The recruitment process (see Appendix A, Section 6) can introduce bias as people interested in the topic are more likely to attend. We intentionally used a broad description of the dialogue topic ("The future of transport"), and used quotas to reduce bias.
- Stimulus materials, specialists and activities influence participant views. This is both a strength and potential limitation of dialogue approaches as it can introduce bias. The Oversight Group and Specialist Groups, both of which had a diverse membership (see Appendix B and C) scrutinised all materials to mitigate bias and participants were asked qualitatively what was influencing their views.
- The number of participants (158) and deliberative approach, mean that findings should be considered illustrative rather than statistically representative of public views, as in all Sciencewise dialogues.
- The potential for statistically significant sub-group analysis is limited due to sample sizes within each sub-group, and because qualitative data was predominantly collected through group discussion without attribution to particular individuals. Where differences have been identified by demographic group or location these are highlighted in the text. Differences between locations should not be interpreted as geographical patterns, as they could be attributed to other variables, such as differing local samples, or location specific experiences.
- News and media coverage of CAVs over the duration of the dialogue is outside the research team's control. Instead, we monitored participants' exposure to media stories through a homework task. We found that apart from an incident prior to the dialogue (see Section 5.1), there was no significant media coverage at the time that was likely to have influenced their views.
- As with all research, this report is a snapshot in time. People's views (both positive and negative) may change significantly in the future, particularly given the potential for advancements in relevant technologies. While efforts were made to future-proof these findings, it



will be important to refresh this work as the technology develops.

Further discussion of these factors is available in Appendix A.

### **1.4.3. Finding your way around**

Findings are reported thematically, looking at the outputs of the discussions across all locations and across all research questions. Each chapter begins with a high-level summary.

The term 'CAVs' (connected and automated vehicles) is used throughout the report for ease. This was not the term used by participants (for a full discussion of terminology see Section 5.2).

*Verbatim quotes are used throughout the report to illustrate points (not replace narrative).*

**Take away messages** are highlighted at the end of sections in purple blocks like these.

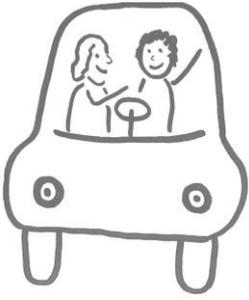
**Summaries** are presented at the start of Sections 2, 3, 4 and 5, in grey blocks such as this.

- Findings: Attitudes towards CAV technology, page 17
- Findings: Impacts of CAV technology, page 39
- Findings: Managing the introduction of CAV technology, page 58
- Findings: Making sense of the topic, page 65

### **Spotlights**

Spotlights are featured throughout the report in purple blocks such as this. These give more detailed insights on particular themes.

- Spotlight: What we learned about our demographic assumptions, page 18
- Spotlight: Automation in a rural setting, page 30
- Spotlight: Moral dilemmas and the ethics of automated decision-making, page 36
- Spotlight: The inevitability of automation, page 40
- Spotlight: Possible future scenarios, page 45
- Spotlight: Influence of experiencing the technology, page 69



## Sharing

Findings on sharing occupancy and ownership are included throughout the report under the relevant themes and pulled out in green boxes like this for easy reference.

- Sharing: Summary of views, page 18
- Sharing: Personal safety, page 24
- Sharing: Control and convenience, page 27
- Sharing: Reliability of services and journey times, page 28
- Sharing: Affordability, page 33
- Sharing: Booking shared services, page 33
- Sharing: Accountability of service users, page 37
- Sharing: Implications for tax, page 43
- Sharing: Impacts on communities and society, page 46
- Sharing: Importance in realising environmental benefits, page 55
- Sharing: Willingness to share, page 62
- Sharing: Making sense of sharing in the dialogue, page 72



## 2. Findings: Attitudes towards CAV technology

This chapter explores participants' attitudes towards CAV technology and some of the underlying values driving their views. Four themes appeared to underpin participant's attitudes towards CAV technology.

- Safety and security – including reliability of the technology, data security, road safety, vehicle testing and personal safety.
- Freedom to move – including control, reliability of transport services and long-distance travel.
- Equity – including disability and mobility, affordability and overcoming other barriers to use.
- Accountability – including justice, insurance, licensing, establishing fault and where accountability lies.

Safety and security were important issues for most participants for several reasons. First, they were concerned about the reliability of CAVs. Specifically, they expected there would be glitches in connectivity and wanted assurances that these would not put passenger safety at risk. Second, they had concerns about data security and the risk of hacking or terrorism. If these issues were addressed, they believed that fully automated road transport could improve safety overall, but were less sure how the transition could be managed. They also had specific concerns about how the vehicles would be tested. When considering shared vehicles, concerns about personal safety when sharing with other passengers was also an issue.

Most participants said they valued their current freedom and would not want to lose the control they have over routing, the convenience of being able to travel when and where they want, the perceived reliability of journey times when driving your own vehicle, or the ability to drive long distances or overseas. These issues were magnified when considering using shared CAVs.

Equity was a key concern for many. They thought that CAVs had the potential to improve lives of disabled people or people with mobility needs, although they were concerned these potential benefits would not automatically be achieved. They felt that the technology should be financially accessible to all and did not want to see CAVs worsen the schism between the haves and have nots. They also thought that the interface between passengers and CAVs could significantly influence whether they were accessible to all and had several suggestions for achieving this.

Finally, participants wanted reassurance around accountability. Given the uncertainty about how exactly the technology would work, they wanted to understand what would happen in an accident, where accountability



would lie, how insurance would work and whether you would still need a driving licence. Views were mixed about the optimal scenario, depending on how willing participants were to completely cede control to the CAV (Accountability is discussed further in Section 4.2).



### Sharing: Summary of views

Participants discussed sharing CAVs (both sharing ownership and occupancy) throughout the dialogue. Often participants generally did not differentiate between private ownership and different models of sharing. However, where there are findings specific to shared models these are highlighted. Many participants thought that shared ownership would be particularly challenging to introduce so defaulted to thinking about shared use when talking about the implications of sharing.

Overall, participants were relatively sceptical about the potential for sharing occupancy or ownership, particularly in rural locations. Sharing occupancy led to particular concerns about personal safety, while all models of sharing gave rise to concern about reliability and convenience.

### Spotlight: What we learned about our demographic assumptions

A portion of the dialogue activities was designed to collect identifiable data from participants individually, as well as through group discussions. This data included a pre-programme survey, individual notes within workshops, voting records and post-workshop interviews. This was added to the demographic information collected from participants before the workshops, to enable analysis by demographic group. We expected to see some patterns in the attributable data we collected from participants, but in fact there were very few. We hypothesised that people in rural areas may be more resistant to CAVs, as they were potentially less familiar with different types of transport options and infrastructure than those living in cities. We expected that younger people might be more open to CAVs, and older people less willing to try new technology. We supposed that people who drive regularly and own their own vehicles could have significantly different views from those who never drive.

Some of these expectations were echoed by participants, for example, some participants thought that:

- older people might be 'left behind' if they couldn't understand how to use new technology;
- younger people would be eager to adopt CAVs;
- younger people will be more accepting of the transition; or
- younger people would more naturally understand the technology.



However, on analysing the data, there were no strong indications that people's backgrounds and driving habits inform their reaction to CAVs and there was limited evidence to support our original expectations. While there were some differences between groups (reflected in the main body of the report) these were not systematic. Even the pre-programme survey, which provided some initial views before participants were exposed to all the information the dialogues provided, did not indicate any strong demographic differences.

There are various potential reasons why we did not observe many demographic differences, such as:

- having too few participants for robust sub-group analysis;
- additional (non-demographic) factors influencing views; and
- people have multiple identities influencing their relationship with transport options (for example commuter, parent, leisure).

There may have been too few participants in the dialogues for clear patterns to emerge. In addition, people who are keen to participate in public dialogues on the subject of transport may have different views to other members of the public.

However, it is worth considering that initial assumptions may have been misplaced, or that other more complex factors were involved. Younger people did have different views of new technologies, but that did not imply they were more positive. They were more alive to issues of data security, for example, and could scrutinise the choices they make about technology more carefully. Many older people expressed excitement about CAVs because of the potential for increased mobility and freedom. Likewise, some people who drove regularly were looking forward to the day when they could do something else with their time, whereas others were more strongly attached to cars and driving for enjoyment, which meant that a straightforward analysis by demographic group did not show any overarching patterns.

In addition, in considering a future with CAVs, participants were envisaging a complex system change. This involved not just their relationship to technology, but how they moved around their world, their relationship with the built environment, and how their personal and family needs informed their choices. To respond to our questions, participants needed to consider their multiple identities (for example, commuter to work, mum with kids, friend on a night out) when they shared their views, although they did not usually preface their responses with a particular identity, so it is not possible to bring these out in the analysis. It is worth keeping in mind that no one part of their identity could necessarily explain their choices.

In conclusion, this dialogue cannot provide any strong indications of differing attitudes towards CAVs from people of certain demographics or behaviours. Indeed, as the dialogue progressed many views seemed to converge. Due to the small sample size, this is not evidence of an absence



of patterns, but rather a suggestion that participant views may be informed by multiple elements, and that further research would be required to better understand and segment the population.

## 2.1. Safety and security

Safety and security were the most consistently important issues for participants, across all workshops and locations. Different participants had different views on whether CAVs would, overall, improve safety (reducing human error, fatigue, distraction, and drink-driving) or worsen it (by introducing new risks). Safety and security remained a topic of discussion throughout the workshops.

Discussions of safety covered four main themes:

- reliability of the technology;
- security of data and systems;
- road safety; and
- testing on public roads.

Sharing occupancy of CAVs with strangers also led to concerns about personal safety.

Safety and security were complex and critical issues when talking about CAVs. They were often the first issues raised and continued to be important throughout the dialogue. Perceptions of safety and security are likely to be key to overall willingness to use CAVs.

### 2.1.1. Reliability of the technology

In discussions and when voting for their top concerns in relation to CAVs (at the end of each workshop), 'Equipment failure or system failure' and 'Car fails to react to unexpected situations' were consistently among the main concerns. In discussions, participants were quick to imagine a variety of scenarios and risks that would be new or particularly challenging for passengers to respond to in a CAV, for example if someone became ill during a journey or there was an obstacle in the road. Participants did not feel confident that they would know what to do if a CAV broke down, and this underpinned many concerns about reliability of the technology.

Some participants acknowledged that all technology fails occasionally and can never be fool-proof, and drew on their own experiences to demonstrate: for example, they referred to a UK-wide outage of the O2 mobile phone network on 6 December 2018, and experiences of problems with satellite navigation, and driver-assist features in their cars. As such, they had concerns about both the vehicles and their connectivity-based systems (such as navigation and routing) being liable to fail and leaving passengers stranded.

Participants assumed that connectivity (via Wi-Fi, 4G or mobile signal) was an



inherent part of the functionality of automated vehicles<sup>5</sup>. Consequently, they worried that limited connectivity (particularly in rural areas) could cause problems with navigation or safe operation, and/or result in the vehicle stopping.

*“What if internet networks go down? Do we lose all transport?”  
(Abergavenny)*

A few participants felt the technology may pose new risks from user-error (such as mistyping an address, accidentally changing settings, or overriding safety features), and wondered how this would be prevented.

Participants had differing views on CAVs being designed for passengers to take back driver-control as a way of reacting to emergency situations. Some participants found it reassuring, while others felt it would not be appropriate as passengers would generally be unable to drive (unlicensed or drunk), or could be disengaged and unable to quickly regain control in an emergency.

*“If I have to take back control it could be more dangerous, I might be in my own world or reading a book. At the moment it seems that one has to almost be driving [in self-driving mode]. It's a disadvantage as it's hard to snap back. I'd rather be driving!”  
(Leeds)*

In order to trust that CAVs are reliable, participants would need to feel confident about how to interact with a CAV. They would want passengers to be given clear instructions about how to operate the vehicle, and whether they may be expected to take back control. Participants needed reassurance that CAVs could operate reliably in a range of environments and situations.

### **2.1.2. Data and systems security**

As mentioned in Section 2.1.1 above, participants saw both connectivity and related data-use as essential for CAVs to function; but the risk of data-misuse was still a significant concern. ‘Security concerns (hacking, terrorists etc)’ was the third most frequently selected concern in voting at the end of all three workshops. Participants raised questions as to what data would be needed, and how it would be collected, stored, used, and protected.

Participants worried that automated transport systems would be vulnerable to hacking and cyber-terrorism, particularly given that the data would ensure the safe operation of CAVs on the road. They thought government should be responsible for protecting the broader automated transport network from hacking and terrorism.

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<sup>5</sup> This assumption was likely driven by the focus of the dialogue on **connected** automated vehicles, and was not substantiated or challenged.



*“There will always be vulnerability in technological systems, so cyber-terrorism will happen. How do we safeguard to make people trust it?  
I wouldn't get in a plane without a pilot for this very reason.”  
(Abergavenny)*

While some participants were comfortable with the trade-off between providing personal data, and safety and convenience, some did not trust large corporations and/or government with such data, and were consequently less interested in using CAVs. They worried about a loss of privacy, and how the data would be used and protected, for example some believed their movements may be tracked. Although other participants acknowledged these concerns, it did not necessarily influence their views.

Participants sought reassurance that their privacy would be respected, and their data would be used responsibly and stored securely.

Participants felt that Government should protect the wider network against hacking and terrorism.

### **2.1.3. Road safety**

In the second workshop each participant chose five lenses (from a list of 33) through which they wanted to consider the impacts of future transport scenarios<sup>6</sup>, based on what was most important to them. The majority of participants selected the road safety lens as one of the considerations that mattered most to them. Participants saw improved road safety as one of the biggest potential benefits of CAVs, but related concerns persisted throughout the workshops.

In the electronic voting, 'Interaction of CAVs with pedestrians and cyclists' and 'Interaction with other human drivers' were never among the most frequently selected concerns (see Appendix F for quantitative data results), but these issues were discussed and considered important in a few discussions in each location. Almost all participants thought that a totally automated road network would be safer than a mixed-use road.

*“If [CAVs] are quiet (like electric cars) I would worry for pedestrians.” (Milton Keynes)*

Participants considered pedestrians and cyclists to be unpredictable (for example, unexpectedly jay-walking), and wondered how CAVs might interact safely with them without being connected. Some participants wondered if pedestrians may take more risks because they would trust CAVs to stop. Although some participants were initially very concerned about cyclists' safety, after further discussion they usually concluded that CAVs would be safer than drivers of non-automated vehicles, as they would keep a safe distance.

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<sup>6</sup> See explanation on Lenses and scenarios, page 11



*“Driverless cars would be more careful towards cyclists than human operated cars.” (Millbrook)*

Participants felt that a fully automated road transport network would increase road safety, but sought reassurance that in a mixed-use road network, CAVs would be able to interact safely with other road users.

#### **2.1.4. Vehicle testing on public roads**

Most participants agreed that extensive testing was important before public roll-out of CAVs, and that testing on public roads, under controlled conditions, is important. Some of those who had a CAV experience in the second workshop felt that testing in a simulated environment is not enough, as it doesn't reflect real-world conditions (such as weather, potholes, black ice, or other vehicles driving dangerously).

Many people were concerned that, in the race for technological advancement, CAVs would not be sufficiently tested. Some participants were surprised to learn that some CAVs were already being trialled on public roads, as they were not confident that it was sufficiently safe to do so yet. They wanted assurance that trials were being regulated. Some participants predicted accidents during the early years of consumer use of CAVs, and wanted to see other people using them before considering it for themselves or their family.

*“There will be risks, we will learn from accidents, but I do not want my family to be those on the back of which the learning happens.” (Millbrook)*



### Sharing: Personal safety

Personal safety was one of the main influences on participants' willingness to share occupancy of a vehicle. It was the second most frequently selected lens for considering the impacts of future transport scenarios (tied with affordability).

Participants thought it should be a key consideration in designing and regulating shared services. Participants were concerned about their personal safety, particularly in the absence of a driver who may deter threatening behaviour of other passengers or intervene in dangerous situations.

A few personal and situational factors contributed to feelings of personal safety, and willingness to share. Women and participants who would be travelling with their children were more concerned about personal safety, and less willing to share occupancy. Participants felt safer, and were therefore more likely to share in the following circumstances.

- There were more people in a vehicle (at least eight), and if the vehicle was larger (enabling them to move away from any uncomfortable situation), similar to the current situation in buses and trains.
- They knew who the other passengers in the vehicle were, particularly in smaller shared vehicles. Participants suggested small user-networks (such as a neighbourhood or office-wide service) where passengers are more likely to know each other, or background checks and passenger rating systems (however, most participants dismissed checks and rating systems as intrusive and prone to prejudice – see Sharing: Impacts on communities and society, page 46).

*"I am concerned about travelling as a woman in shared rides - how can I guarantee that I'll be safe late at night?"  
(Abergavenny)*

Participants struggled to agree whether it was safer to be dropped off at home or at a central stop. Being dropped off at home was often seen as a greater risk (particularly when sharing with a single stranger), as other passengers may see where you live and could follow you into your house more easily than if walking from a central stop.

For participants to trust and use CAVs, they would need to feel reassured that real-world conditions have been considered and that testing is regulated to ensure it is consistent across manufacturers, thorough and does not put road users at risk.

### 2.1.5. How did views on safety and security change during the dialogue?

Participants entered the first workshops with varied pre-existing views on the safety of CAVs. They were generally positive, although some were more negative, having potentially been influenced by media coverage of recent CAV incidents. Views on different aspects of safety and security shifted over the workshop series, generally towards a more mixed perspective where they could see both benefits and concerns. Participants' votes for their top concerns were generally consistent over time, with the top three choices related to safety and security.

The diagram below shows which safety and security issues were highlighted in each workshop (in no particular order of priority), and whether they were seen as benefits or concerns. It also shows the main activities or information sources that influenced opinions according to our analysis ('key influencers'). A full list of activities is included in Appendix A, Section 5 and discussion of the analysis approach is included in Appendix A, Section 8.



- Group discussions reassured some participants, while for others they raised concerns not previously considered, for example querying whether non-automated vehicles and CAVs would both use the same road network.
- The slow vehicle speeds that participants experienced in self-driving pods (Spotlight: Influence of experiencing, page 69), generally led them to feel more positive about road safety.
- Engaging with specialists clarified some issues (for example how CAVs might safely interact with cyclists and pedestrians) but given the current extent of unknowns about CAVs (for example, exactly how they will operate and navigate in rural areas), this did not reduce concerns overall.
- In discussing shared occupancy in the third workshop, participants developed a strong focus on concerns about personal safety.

Reducing unknowns in relation to safety and security, and normalising CAVs (through exposure to trialling), may mitigate these concerns.



## 2.2. Freedom to move

Most participants said they valued the freedom to travel where they want, when they want, and often articulated this freedom as a need, or even a right. The need for continued flexibility underpinned participants' views on CAV use and ownership. They talked about three related issues:

- impact on control and convenience;
- reliability of services and journey times; and
- long distance and international travel.

Participants thought that, if shared CAVs completely replaced private vehicle ownership, this would be likely to constrain most people's freedom to move. However, even privately-owned CAVs were perceived to potentially constrain people's freedom, for example by removing their choice of route, which was also a cause for concern.

### 2.2.1. Control and convenience

Participants wanted to feel in control of their journey: this was the fifth most popular lens (tied with 'Accessibility for people with sensory or mobility needs') for considering scenarios with different levels of integration of CAVs into the road transport network<sup>7</sup>. Some imagined autonomous vehicles running on pre-set routes and found this off-putting as they wanted the freedom to be able to change routes or destinations during a journey if their plans changed. They were not confident that CAVs would always select the best route, considering past experiences when personal knowledge provided quicker routes than other navigation tools, or different types of journeys and routes (for example, scenic driving compared to commuting).

*"There's no flexibility if [your] journey changes." (Glasgow)*

In contrast, some participants who lived or worked in cities and who used public transport regularly were more likely to see driving as a burden. These participants saw CAVs as convenient and believed they would be a natural development from current modes of inner-city transport. They talked about CAVs improving their freedom by letting them 'do their own thing' without worrying about parking or congestion.

*"I currently use my car as public transport is unreliable and does not give me the same level of freedom as a car...I would be able to just call a bus. Would not have to look for parking so public transport would be more convenient" (Millbrook)*

Some participants were most optimistic about 'Being able to do other things while travelling'. It was particularly appealing to participants living in suburban areas, men, and younger (under 35s) and middle-aged (35-55s) participants throughout the dialogue. Examples of alternative activities included interacting with their children, sleeping, drinking, or socialising.

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<sup>7</sup> See explanation on Lenses and scenarios, page 11



### Sharing: Control and convenience

Participants worried that forgoing vehicle ownership would limit the way they travel, and perceived convenience as critical to their willingness to transition from private vehicle ownership or use, to any model of sharing. To consider sharing, many participants wanted assurances that:

- vehicles would be available at all times;
- they would not have to wait long for the vehicle to arrive after booking; and
- there would be a variety of vehicle types (different sizes, levels of interior comfort, and luggage space) available to cater for different journeys.

Most participants wanted to be able to make unplanned trips and travel spontaneously with minimal forward planning. They worried that booking every journey in advance would be impossible, especially for young families or those with busy lives and therefore did not see how shared services would work for them.

Some participants highlighted other advantages of owning a vehicle including using it as a living area, a form of storage, and a way of travelling with lots of things (especially if travelling with children or pets).

*"Why should I agree to a system that restricts my choice to go where I want when I want, and with my dog?" (Abergavenny)*

Some participants, particularly those in smaller towns and rural areas, felt strongly that owning a vehicle is critical to their independence, and would not want to share vehicle ownership or occupancy, even if it was much cheaper.

Some urban participants who were accustomed to public transport were interested in sharing to improve their freedom without worrying about cost, as they saw owning a vehicle as expensive and burdensome.

Participants did not want to compromise control or convenience, and this strongly influenced their willingness to use or share CAVs. Therefore, CAVs and related transport systems should be developed to maintain or improve on current levels of control and convenience in order to encourage people to adopt the new technology.

#### 2.2.2. Reliability of services and journey times

Most participants wanted journey times to be predictable and reliable. They wanted to know they would arrive at their destination on time, especially if travelling to work, meetings, or other travel connections such as trains or flights. This meant they were apprehensive about giving up control of route selection and driving, as it would limit their ability to adjust journeys if delays arise.



Some participants in rural areas had negative views of current public transport services. Some therefore assumed automated public transport would also be inadequate, but others were excited that it may be an improvement. A group of participants in Abergavenny said that public transport services are so difficult to use and unreliable that automated public transport services would definitely improve reliability, and in turn more people would use public transport. Participants sometimes made comparisons to train services, which they regarded as unreliable.

*"It's easy to say that it will run smoothly and on time, but in reality, it could be like British Rail – delays, delays and then people avoid riding it." (Milton Keynes)*



### Sharing: Reliability of services and journey times

Participants' views of sharing occupancy were influenced by their expectations of reliability and journey time estimates. They wanted to be sure that a vehicle would be punctual. Most participants believed shared occupancy would make journeys longer and/or less reliable. They worried about being picked up first or dropped off last, long journeys to cater to other passengers or routing through areas they would otherwise avoid.

A common discussion was about how a shared service could be both flexible and reliable. Some participants would want the vehicle to wait for them for a few minutes, but at the same time they would not want to be made late if other passengers held up the vehicle. Similarly, some participants worried that sharing occupancy would stop them changing their journey, as it would affect other passengers.

*"With human drivers, there is a degree of flexibility. If there's a chance I might miss it by 2 minutes, it seems too rigid. Also, the reverse; can I trust that the pod will be on time? Especially if it picks up other people" (Milton Keynes)*

Participants' willingness to use or share CAVs was strongly influenced by whether they believed journey times would be predictable and reliable. They needed to be confident that they would arrive at their destination on time, and typically trusted their own driving more.

### 2.2.3. Long-distance and international travel

A few participants identified potential benefits of CAVs relating to long distance travel. Several people wondered if long-distance or international travel in privately-owned CAVs would be similar to that of current, non-automated vehicles. Participants often discussed CAVs and electric vehicles interchangeably in this context, worrying that the need to charge a vehicle could limit the distance they could realistically travel.



In response to prompts in scenarios introduced in the second workshop, some people expressed concern that international travel could be challenging unless a global system was in place, so vehicles would work in other countries. This was particularly important for Europe, as lots of people drive there for holidays. Participants wondered if CAVs would know to drive on the other side of the road when necessary, and worried about giving up their driving licences and then wishing to travel to a country without CAVs.

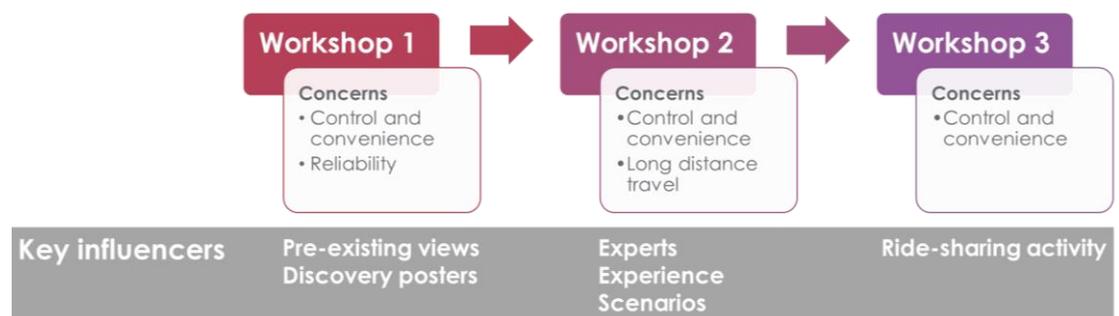
*“What about when I want to take my car abroad - will there be a global system? If I give up my personal car, how do I even drive to Europe on holiday?” (Abergavenny)*

Overall participants were more open to sharing CAVs for longer journeys. This is discussed further in Sharing: Willingness to share, page 62.

Participants wanted reassurance that their long-distance travel, and ability to drive overseas, would not be affected by a transition to CAVs. They expected systems to be internationally compatible, particularly between the UK and Europe.

#### 2.2.4. How did views on freedom to move change during the dialogue?

Participants expressed concerns about control, convenience, and reliability early in the dialogue. While nuances emerged over time, concerns remained fairly consistent throughout the dialogue.



- Restrictions on freedom to move were one of the most common perceived disadvantages of CAVs at the end of the first workshop. This could be a result of the stimulus about sharing, which may have encouraged them to associate CAV technology with sharing ownership or occupancy.
- The loss of convenience and being able to do what you want when you want emerged as a concern almost immediately. This grew as a concern throughout the dialogue, particularly when discussing sharing.
- In the second workshop, older people (aged 55+) were particularly likely to say that their concerns would be mitigated if non-CAV options remained available, although by the final workshop around one in ten of all age groups mentioned this.



- 'Reliability' was a concern initially, but when explored further participants defined their concerns more clearly and it was realised that it fed into other issues – for example, separating out the reliability of journey times from the safety aspect of the reliability of vehicles breaking down or leaving passengers stranded.
- The scenarios in the second workshop (see Section 1.3.4) prompted many discussions about convenience, but this did not shift participants' views to be more positive or negative.
- Participants who placed a high value on the independence of private vehicle ownership were least likely to change their views on CAV technology over the course of the dialogue.

Participants remained concerned throughout the dialogue about CAVs compromising their freedom to move.

### Spotlight: Automation in a rural setting

Participants (both from rural and urban areas) thought that CAVs would be less likely to come to rural settings than urban ones or that their introduction would be slower. They found it hard to imagine how the technology would work in such settings. Some participants suggested that if rural areas lacked the necessary road infrastructure or CAV services were not readily available, that people may be pushed to move to urban areas or risk being left behind by technological progress.

Participants discussed many perceived barriers to CAV technology working effectively, reliably, and safely in rural areas.

- They believed that rural roads were generally in poor condition, and satellite or mobile-phone connectivity was inconsistent. They were sceptical about this infrastructure being upgraded and feared it may compromise safety or leave passengers at risk of being stranded.
- They also thought there would be a trade-off between safety and journey time, due to complications such as animals on the roads and narrow lanes (where vehicles could face other vehicles, cyclists, or pedestrians). They thought if CAVs were programmed to operate more cautiously in these situations, journeys would be significantly slower than they are with human drivers (who can use conversation, eye contact, or gestures to navigate interactions, particularly with cyclists, pedestrians, and non-automated vehicles).

When discussing ownership and sharing, participants (both from rural and urban areas) generally assumed that people in rural areas would have to own their own CAVs. Participants felt that there would not be enough demand for shared services, worrying it would mean smaller fleets and longer waiting times. Participants from smaller towns and rural areas were consequently more likely to raise concerns about forgoing the



independence and convenience of having their own vehicle.

*"I live in a rural area, so I can't see those pods impacting me, I would still need a car." (Milton Keynes)*

## 2.3. Equity

The equity of transport systems strongly influenced participants' attitudes towards CAVs. It was very important to most participants that everyone should have access to and benefit from the technology, at a price they could afford. Otherwise they were concerned CAVs could widen social inequalities. This section addresses several different aspects of equity: disability, affordability, and interacting with CAVs.

### 2.3.1. Disability and mobility

Participants were initially positive about the potential benefits of CAVs for disabled people and people with mobility needs. Participants believed that CAVs would enable people who could not drive to travel independently. In voting, participants consistently saw the primary beneficiaries of CAVs to be people with mobility issues, and were most optimistic about them making it 'Easier for elderly or disabled people to travel'.

*"[It would be] positive [for people who are disabled]; a driverless car would give more freedom." (Milton Keynes)*

However, in exploring how CAVs might be used, participants became concerned that these benefits may not be realised due to practical barriers related to the lack of a driver including:

- where a driver is required to perform a secondary role (such as carer); or
- a lack of help available for people to get in and out of vehicles.

*"For people with disabilities, who will help them get in and out like the bus or train driver does at the moment?" (Abergavenny)*

Some participants suggested that because CAVs may help people with mobility needs to get to medical appointments and social opportunities more easily, it would improve their physical and mental well-being. A few disagreed and emphasised the importance of interaction with drivers for some people.

Some participants were concerned that the potential for CAVs to be more accessible for more users than current forms of transport might not be realised, if the technology was directed towards the biggest markets rather than the greatest needs. Participants felt that, though making vehicles accessible (to wheelchair users, for example) would be necessary to improve mobility, it would not be enough, and that CAVs and their software must be designed with a range of needs in mind to enable everyone to fully benefit as users. For example, people with learning disabilities or visual or hearing impairments would also need adaptations to be able to use the vehicles).



In the second workshop about a third of young participants (under 35s) and a third of participants aged over 55 believed people with mobility needs would benefit most from CAVs. By the final workshop, the proportion of young participants holding this view increased to over half.

Participants were optimistic that CAVs could primarily benefit people with mobility issues, but were sceptical that such benefits would be realised. They concluded that, as a minimum, there would need to be services and vehicles designed for a range of needs.

### **2.3.2. Affordability**

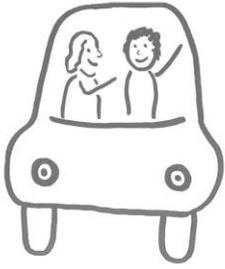
When asked which aspects of CAVs were most important to consider, affordability was the second most popular, after Road Safety (see Appendix F for quantitative results). Most participants assumed that CAVs would be expensive and unaffordable, based on media coverage and advertising they had seen. This led them to fear increasing social inequalities (with wealthy people benefiting and people with existing financial barriers facing greater challenges). However, many participants came to think that CAVs could improve affordability of travel if the technology were used to improve public transport and reduce costs.

Many groups discussed how prices for new technology typically reduce over time (making comparisons with mobile phone and computer prices). While a few participants felt this was a common and acceptable pattern, many were concerned that CAVs would be an exclusive luxury initially, that might never be available to those with low incomes.

*“Cars were liberating for the working classes and older people. This seems to be restricting choice.” (Millbrook)*

Some groups considered whether making privately owned CAVs affordable could reduce the likelihood of achieving other benefits, such as reduced traffic congestion and related environmental benefits (see Section 3.4 below).

This discussion revealed a clear hierarchy of preferences for CAVs with privately owned identified as the preferred option for most people, followed by shared-ownership and finally shared journeys. As outlined elsewhere, this is mostly driven by perceptions of the convenience and flexibility of the different options.



### Sharing: Affordability

While some participants saw cost-savings in not having to own a car, affordability did not strongly influence participants' willingness to share ownership or occupancy. For example, many participants would rather pay more for a privately-owned or private-use shared-ownership service to ensure their personal safety or for the convenience it offers.

*"Cost just doesn't come into it" (Abergavenny)*

Some participants worried that ownership and sharing models would act as 'class markers' – where privately-owned or privately-occupied, shared ownership vehicles would be a privilege that many people could not afford. Some felt uncomfortable that people with less money would have to choose the most affordable option even if it made them feel unsafe.

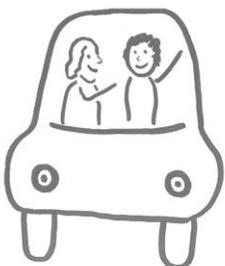
Affordability was one of the most important issues to participants, and strongly influenced their views on CAVs. They wanted reassurance that cost would not limit people's choices for vehicle use, as this was seen to lead to social division and inequality.

### 2.3.3. Interacting with CAV technology

Some groups discussed how users might interact with CAVs, as passengers during a journey and when booking or planning journeys. Some participants were concerned about ensuring the vehicles are usable by everyone, particularly to deliver benefits for disabled people (see Section 2.3.1, above). They suggested various features that could enable better interactions, including CAVs communicating in several languages to avoid excluding people who do not speak English.

*"[It] will need to be accessible to [...] people who speak other languages." (Milton Keynes)*

In discussing future scenarios, participants felt that if public transport were to run 'on demand' there should be a system available that did not rely on an app (such as buttons at bus stops) to ensure everyone could use CAVs, even though they believed an app would be easiest for most people.



### Sharing: Booking shared services

In discussing sharing, many groups considered how users might book shared services. Some participants thought people without smart phones could be significantly restricted, as many services and opportunities are only accessible via smart phone apps. They suggested that while apps would be easiest for most people, other systems should be available for people who don't use smart phones or those who are caught without one (for example if their battery died).

*"A section of society could be left behind if they can't or don't want to join in. Like those who don't have a smart phone now."  
(Abergavenny)*

The topic of how people interact with CAVs was not raised frequently, but it further highlighted the extent to which participants valued equity in the roll-out of CAV technology and services.

### 2.3.4. How did views on equity change during the dialogue?

Equity was a persistent theme throughout the dialogue, particularly in the second workshop and during the Guiding Principles session in the third workshop. It was among the earliest themes of discussion. The two main equity themes throughout the dialogue were affordability and accessibility for the disabled and people with mobility needs, while the topic of how users would interact with CAVs when inside the vehicle (user interfaces) arose intermittently.

When participants voted for who would benefit most from CAVs (at the ends of workshops two and three), 'people with mobility issues' was the top choice, increasingly so at the end of workshop three. Participants in Glasgow increasingly voted for 'people with mobility issues' and decreasingly for 'wealthier people in society', implying they became more optimistic that CAVs and CAV services would be affordable.

Participants' views on what they were most optimistic about stayed similar over time. The top choice was 'Easier for elderly or disabled people to travel' and this peaked significantly in popularity at the end of the third workshop.



- Improved accessibility for people with mobility needs caught participants' attention early on as a benefit, but the reality of this in practice was questioned later in the dialogue as they thought through the practicalities such as not having a driver present.
- In the first workshop participants thought that CAVs would not be affordable, but after engaging with specialists, scenarios and examples of sharing they started to think they could be.
- Accessibility and affordability were both important considerations for participants. 'Affordability' ranked joint second and 'Accessibility for people with sensory and mobility needs' joint fifth among the most frequently selected lenses through which to consider future scenarios in

the second workshop.

- Participants who chose to consider scenarios through the accessibility lens<sup>8</sup>, and therefore who had a self-identified interest in accessibility, were more likely than others to believe benefits for elderly and disabled people was a reason to be optimistic.

Equity was a consistently important issue for participants, and strongly influenced their views on the development and roll-out of CAVs. Participants had preconceptions about accessibility and affordability which changed over time – some became more positive, while others developed concerns about users with particular needs that might not be met.

## 2.4. Accountability

Many discussions over the course of the dialogue related to the question of what would happen – and who would be held accountable – if things went wrong and related implications for insurance.

### 2.4.1. Establishing fault in an accident

Many participants wondered who would be at fault in an accident and how fault would be determined. Some groups discussed accidents between CAVs and non-automated vehicles, with a few participants raising concerns that drivers could be assumed to be at fault against a CAV. In some groups specialists mentioned a 'black box' system tracking CAV activity, so that after an incident the cause could be identified. In other groups some participants made this suggestion without being prompted. Participants generally agreed with this idea, seeing it as a more straightforward way to establish fault than current processes.

*“Will driving law and accountability become far too complicated?” (Abergavenny)*

Despite many participants agreeing with the suggestion of a black box system, there remained some questions about how it would work and concerns about data use. For example:

- where would the data be sent;
- what would happen if the black box were to malfunction; and
- would the black box know who was in the vehicle?

Participants felt concerned that, for a black box system and insurance to work, vast amounts of intrusive and detailed data may be needed. Some did not trust the Government or large corporations to store and use their data responsibly and were concerned about hacking and loss of privacy (see Section 2.1.2 above).

The question of who would be at fault was integrally linked with the question

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<sup>8</sup> See explanation on Lenses and scenarios, page 11



of how insurance would work. Insurance was initially one of the most confusing topics for many participants – they struggled to imagine how it would change as they were used to a system that insures drivers. Following much discussion and input from relevant specialists about how insurance and accountability could work in practice, the majority became more comfortable with how it may work (refer to Section 5.3.3, below) for more detail on the specialist input). However, they did feel it would be a major change for the insurance industry. The majority of participants expected that insurance would be much cheaper for CAVs as there would be very little risk or unpredictability.

*“You shouldn't be having 'bumps', the manufacturer needs to have the insurance.” (Abergavenny)*

Participants sought clarity on how fault would be established in an accident, worrying that drivers, owners, or users may be unfairly held liable, and suggested vehicle monitoring systems to mitigate this.

### **Spotlight: Moral dilemmas and the ethics of automated decision-making**

Some participants raised moral dilemmas, such as how CAVs would react if forced to decide between two bad options, although these weren't discussed at length.

*“I saw a programme about AI's inbuilt ethics – who would you choose, an old person or a child?” (Leeds)*

Some groups discussed the ethics of automated decision-making in life or death situations, and many participants were uncomfortable with the concept of CAVs being programmed to prioritise some lives over others. While participants generally considered CAV technology to be a form of artificial intelligence, they recognised that the programming and protocols would still be established by humans.

Participants considered whether an automated road transport system may be programmed to give priority to vehicles with passengers in medical emergencies. They wondered how or if CAVs would be programmed to respond to such situations.

#### **2.4.2. Licensing**

Participants were interested in the change in the role of the driver with CAVs. They questioned whether users would need to have a driving test and licence, if an age limit would be needed, or if young people would need parental consent.

Participants agreed that if the vehicles are fully automated without any way for a human to take control, then licensing would not be necessary. They felt that people of any age and ability should be able to use them, particularly if CAVs were to benefit people with mobility needs.



*"If I had points on my licence, I could drive again." (Millbrook)*

However, as discussed in Section 2.1.1, many participants felt strongly that CAVs should be designed in a way that allows passengers to take control of the vehicle if they feel unsafe or if there is an accident, in which case passengers would still need driving licences.

Participants felt that driving licences would not be necessary if CAVs were fully automated. Some thought a continued requirement to have a licence might unfairly prevent non-drivers benefitting from CAVs. However, others wanted to take control in an emergency and thought this would only be possible if users had a driving licence.

### **2.4.3. Where should accountability lie?**

Participants felt very strongly that CAV manufacturers and programmers must be closely regulated and held accountable for their actions and the accidents of their products. Some participants were concerned that companies would prioritise profit over safety, particularly in a race to put CAVs on the road. Some participants referred to media coverage about fatal accidents during testing and felt that in response to that, development should be slowed down. Most participants felt that unless a user had control of the vehicle during an accident, the passenger should not be at fault. However, one area where participants thought that individuals would continue to have a responsibility, was maintenance. They thought owners would have to maintain their privately-owned CAVs, ensuring they are safe for use on the road.

Some participants were sceptical about the Government's ability or intentions to regulate the CAV industry and roll-out. They did not think Government is held sufficiently to account for mishandling important issues (without elaborating further or providing examples) and thought that Government lacked any real incentive to ensure the transition would be safe and fair.



#### **Sharing: Accountability of service users**

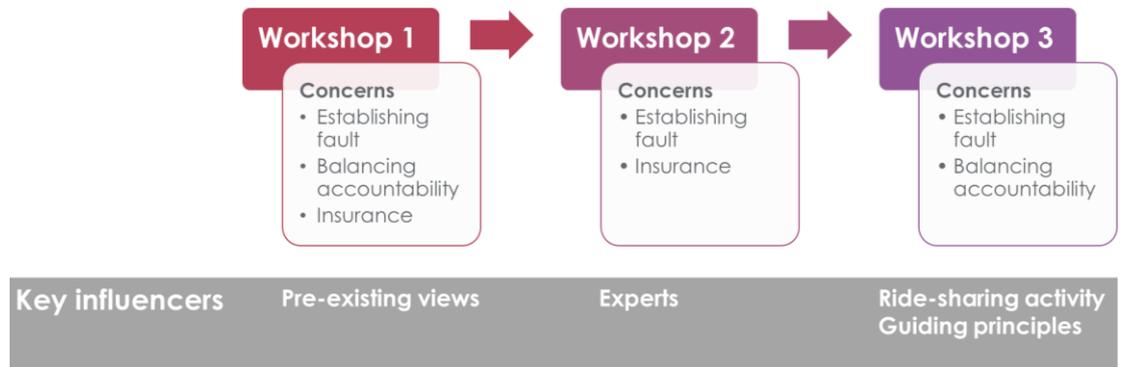
Most participants felt that in a shared occupancy service, if a CAV is in control and an accident occurs, the users should not be at fault. They felt that responsibility lies with the vehicle owners (if it was a problem caused by poor maintenance) and manufacturers.

Some participants wondered how accountability might work with shared ownership (for example, who would be ultimately responsible for regular maintenance and ensuring road-safety status). This was one of the reasons they thought shared ownership would be too complicated to introduce.

Participants did not think the introduction of CAV technology would happen safely if it was driven by market forces, as they did not trust manufacturers in the race to get their products onto the road. They felt that manufacturers, the Government, owners, and users would all be accountable in different ways for the introduction and use of CAVs in the future.

**2.4.4. How did views on accountability change during the dialogue?**

Participants expressed significant concerns about accountability in the first workshop, but in the second workshop it was not discussed as much.



Some participants spoke to specialists who explained how insurance and accountability might work and as participants felt reassured this became less of a concern. The following key messages are some examples of those which reassured participants.

- Legislation had been passed regarding insurance and liability.
- Major insurance companies were already looking into CAV insurance.
- Legal professionals were already investigating liability and insurance.
- Transitioning to CAVs could improve insurance or reduce premiums.
- CAVs would provide data as proof of fault at the time of an incident.
- Fault would be established based on vehicle data, without an automatic assumption that drivers would be at fault.
- Much of the liability would lie with the manufacturer, so insurance would come with vehicles.

This is an example where more information led to reassurance, rather than more uncertainty. Those participants who did not have similar opportunities to explore the topic with a relevant specialist were less reassured and continued to see it as a concern.

Communication and transparency about accountability, fault, and insurance was an important influencing factor on participants' likelihood of using CAVs.



### 3. Findings: Impacts of CAV technology

This chapter explores participants' views on the potential impacts of CAVs.

- The transition – including timeframes of transitioning, interactions between CAVs and non-automated vehicles and financing.
- Societal impacts – including jobs, mental and physical well-being, and economy.
- Individual impacts – enjoyment and identity, routines, and choice.
- Environment – including congestion and waste.

The anticipated impacts of CAVs depended on participants' assumptions around transition. Some supported a quick transition (minimising the overlap between CAVs and non-automated vehicles for safety reasons), while most favoured a slower approach (allowing people to make a personal decision of whether or when they wanted to switch to a CAV). However, most participants had major concerns about the amount of work, money, time, and coordination needed for a successful transition and wanted reassurance about how the work would be financed.

On balance, the majority of participants believed that CAVs would have a positive impact on society, although they also identified a number of risks. They were concerned about job-losses, but saw this as part of a wider societal trend towards automation, not specific to CAVs. They had mixed views on the impact on mental and physical wellbeing, driven by concerns about a loss of skills, impacts on social interaction, changes in physical activity levels and changes to mental health and stress levels. Finally, some identified wider impacts on the economy which were mostly positive, including sectors that could benefit from use of CAVs.

Participants found it harder to think about the personal impacts. When prompted to consider personal impacts, more participants were positive than negative. Concerns included the loss of the joy of driving and the sense of identity people derive from car ownership. However, participants could also think of several ways in which CAVs might have a positive impact on their travel and routines, for example enabling less confident drivers to use motorways and travel at night, enabling people to do other things while travelling and making routine journeys simpler. Some thought that CAVs might make commuting easier and would enable them to live somewhere different. Consequently, participants felt strongly it was important that they should have the right to choose if/when to transition.

Potential environmental impacts of CAVs did not emerge spontaneously in discussion. Most participants assumed CAVs would be electric, with associated environmental benefits. When prompted they could see other potential benefits, especially if there was a shift to more shared journeys. However, people worried what would happen to non-automated vehicles and thought it was important these were not scrapped until such a time as



they would have been in a world without CAVs.

Participants primarily expressed views from a societal perspective, followed by their personal perspective and focussed on social impacts and opportunities, rather than economic or industrial impacts and opportunities.

### **Spotlight: The inevitability of automation**

Over the course of the dialogue, participants consistently felt that, whether they liked it or not, at some point CAV technology would be the norm and that they had no influence over such a change. Many participants likened the change to the introduction of the mobile phone, a technology that became ubiquitous in just a few years and completely changed how people thought about a whole range of different activities, not just how they used a telephone. They saw CAVs as having the potential to bring about a similar scale of change in society and in people's lives.

Some participants were not concerned about their perceived lack of influence over whether CAVs would be rolled-out, as they were open to progress and change. While they would like to influence how the transition happens, they recognised that, at some point, they might be compelled to adopt CAV technology and were open to this.

*"It's part of embracing the future." (Glasgow)*

Other participants worried that CAVs could cause similar divisions as other technology, isolating those who did not adopt, until they feel forced to do so. They wanted to have influence over how the transition happens to mitigate this. Some participants who took pleasure in driving were unhappy about the perceived inevitability of CAVs, feeling that something they enjoy would be taken away from them.

Alongside these feelings of resignation, some participants expressed a concern that CAV technology was being introduced without a strong rationale. They questioned why CAVs were necessary and challenged the assumption that new technology always results in positive outcomes, making comparisons to advancements in other technology, such as mobile phones. They compared the inevitable adoption of CAVs to the fast adoption of other technology (again, primarily mobile phones). They thought that with a rapid pace of change, people may not understand how it might change their lives nor make informed choices.

While views varied as to when CAVs might become the norm, there was a strong sense that once the technology reached a certain stage, the change would be rapid. However, they felt that this point was a long way off, particularly if they experienced trials of the technology. This perceived pace of change partly meant participants did not feel they would have a choice about whether to adopt the technology when the time comes.



### **3.1. Transitioning<sup>9</sup> to a road transport system with CAV technology**

How to achieve a safe and affordable transition to a road transport system with CAVs was a key question and concern for most participants. They had mixed views and it was the basis of many discussions. Participants had major concerns about the amount of work, money, time and coordination needed for a successful transition to a fully automated road network. As discussed elsewhere (Section 2.3 above) they had particular concerns about equity and ensuring nobody became less mobile as a result of the transition.

#### **3.1.1. Timeframes and speed of transition**

Participants' concerns about transitioning to a fully automated road network strongly influenced their views on when CAVs could be commonplace.

- The majority of participants saw high levels of automation as inevitable, although a few did not think full automation would ever happen.
- Most felt a highly-automated road network was at least 20-50 years away, despite thinking driverless technology already existed (for example, parking and lane assist and the Docklands Light Railway in London).
- A few participants predicted that CAVs could be available in the next few years, but believed ownership would be uncommon for another decade. They compared the uptake of CAVs to electric car ownership.

Participants felt that the transition would probably happen at different times and/or different speeds in different areas. For example, they thought that urban centres would transition much sooner than rural areas (see Spotlight: Automation in a rural setting, page 30). In Glasgow, some participants thought the city would transition much later than other places, if at all, as they saw it generally as being deprioritised by Government or behind with technological advancements.

Participants regularly referred to other significant technological transitions, such as mobile phones and the replacement of horses by cars, to illustrate how they expected CAVs to become mainstream. They reflected that such changes may have seemed unlikely to people, but once introduced, they caught on rapidly and drastically changed people's lives.

Participants had mixed views on whether transitioning to fully automated roads should be slow or fast.

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<sup>9</sup> Whilst there was much discussion of a possible future in which only fully automated vehicles would be allowed on the road network, the dialogue identified other possible futures. When we speak of transition, this must not be taken to mean that participants (or indeed we) necessarily had in mind a period of adaptation followed by a well-defined steady state. It may be more helpful to think of transition as a process during which the technology becomes more mature, its implications become better understood, and systems and behaviours begin to reflect its growing influence.



- Most felt strongly that the process should not be rushed, allowing for proper testing, regulation and building public trust.
- Some, recognising the complexities of mixed road use (with both CAVs and non-automated vehicles), thought a fast transition would be best to maximise benefits.
- Some believed that, unless the transition is carefully regulated and managed, corporations would rush to get their own CAVs on the road, which could change the transport network in a reckless and uncontrolled way.

Most participants felt that gradual infrastructure upgrades would be important to give people time to replace their vehicles, so nobody would be stuck with a vehicle that was not compatible with, or legal on the road network. This linked strongly to views on equity, as participants worried that sudden changes could disrupt the lives of people who, for financial reasons, might not be able to afford new modes of transport.

A transition via a gradual roll-out of vehicles with increasing levels of automation and connectivity was only mentioned by a few participants in this context, during a focussed Q&A session with specialists.

Participants thought that a highly-automated road transport network was a long way off, and most thought there were a number of advantages to a gradual introduction despite concerns about mixed road use.

### **3.1.2. Interactions between CAVs and non-automated vehicles**

Different scenarios in workshop two prompted discussions about interactions between CAVs and non-automated vehicles and how these might be achieved safely in a transition period. Participants favoured the concept of separating CAVs from non-automated vehicles, suggesting separate lanes or exclusively automated zones in cities. Separate lanes were considered particularly relevant for motorways, where they could enable CAVs to travel at higher speeds.

Participants wondered what would happen to non-automated vehicles over time and whether people would still be able to drive them. Some participants suggested that they could need some obligatory adaptations (such as advanced driver-assistance systems) to interact with CAVs and reduce the risk of human error in a mixed transport system.

*"If you come to a junction and one vehicle is autonomous, and another isn't, how do they communicate with each other in the absence of hand gestures?" (Leeds)*

Although participants generally sought a slow transition, they were concerned about CAVs and non-automated vehicles interacting on the roads, and wanted reassurance that this could be achieved safely.



### 3.1.3. **Financing road network adaptations and development**

Participants often debated the possible cost of transitioning, reflecting on what aspects of current infrastructure may need to be adapted or replaced and how maintenance may differ. They perceived that road infrastructure would need to change for CAVs to function effectively (converting current lanes to be compatible), some infrastructure would no longer be needed (such as road signs or traffic lights) and some new infrastructure would be needed (such as adding new lanes to enable a mixed-use network, or electrical charging points).

Some participants thought that the extent of necessary infrastructure changes could make a fully automated road transport network too expensive to implement and a few questioned if the business case was sound. A few participants thought that changes to infrastructure would not need to be as drastic as others assumed, as the new infrastructure would be mostly digital not physical.

Many participants wanted to know how infrastructure changes would be funded, worrying about the potential cost to society and individuals. They generally felt this would be up to the Government but that organisations within the CAV industry who stand to profit must contribute significantly.

Many participants were concerned that if local councils had to pay for local infrastructure upgrades it would be at the cost of other community needs. Some recommended that infrastructure changes should be managed top-down from a national government level, with council-level collaboration, to ensure consistency while also understanding local issues. Participants worried that without nationwide consistency, systems would be fragmented, different regional systems would not seamlessly share information, or certain areas may not be upgraded at all.

*“Will there be fragmentation through privatisation like with the rail network? Will the different systems be able to talk to each other effectively?” (Abergavenny)*

Some participants were concerned about how the ownership and management of different infrastructure components might work (such as the data centres needed to power an automated road network), particularly if funded by different organisations.



#### **Sharing: Implications for tax**

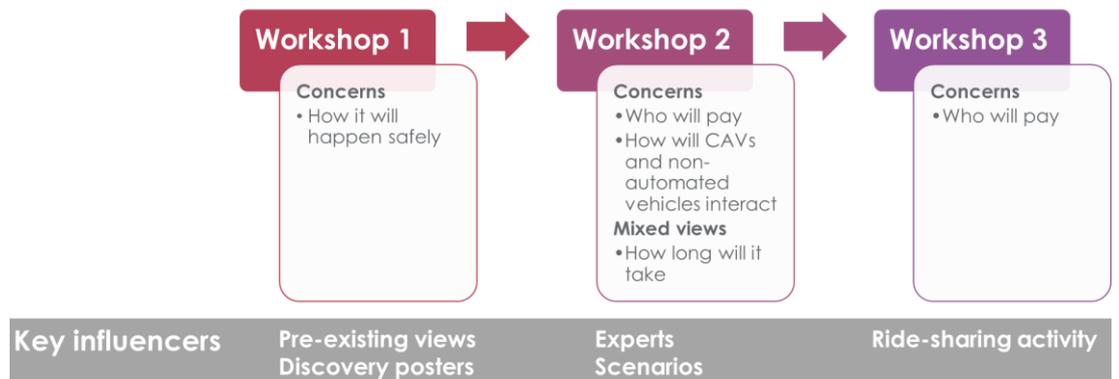
Some participants discussed whether a move to shared vehicles would impact on road tax revenues. They consequently thought a different tax system may be required, but did not explore what this could look like.

Participants worried about the cost of transitioning the road transport network. They thought the cost of any required infrastructure should be funded by Government and those organisations who would benefit from an automated road transport network, but were not convinced the investment was a good use of taxpayer money. They wanted the transition to be nationally co-ordinated.

### 3.1.4. How did views on transitioning change during the dialogue?

Participants struggled initially with a lack of information around the costs of transitioning and how it might work, and this was among the first concerns they raised. As they explored different possible routes for transitioning and some of their questions were answered by academics, policy-makers, and industry experts at the dialogue, participants became less concerned and were better able to explore their attitudes and values in other areas of CAVs. The most common questions sought clarity on how a mixed road transport network (with CAVs, non-automated vehicles and other road users) would work. Other key questions were whether the intention would be to progress to a fully automated road transport network, and how long it might take to achieve that.

Transitioning to a road transport system with CAVs was a multi-faceted issue, and views of how the transition would work in practice were closely related to other themes in the dialogue. Consequently, there were no clear trends in changing views over the course of the dialogue.



Participants did not initially understand how transitioning to a fully automated road network would work. They thought that everything would need to be rebuilt.

- The discovery session and discussions with specialists (including academics, industry experts and policy-makers), answered some of the participants' initial questions and they started to focus more on connectivity and how CAVs and non-automated vehicles would interact. A full list of the specialists who contributed to the dialogue is included in Appendix C, Section 3.



Participants had some important questions about transitioning that needed answers before they were able to fully explore other aspects of a fully automated road transport network. For example, what infrastructure changes would be needed, how those would be paid for, and whether there would be a period of both CAVs and non-automated vehicles on the roads.

### **Spotlight: Possible future scenarios**

In the second workshop we introduced several different scenarios for participants to think through transitioning to automated road transport. They helped participants to think about the personal practicalities of what using a CAV might be like.

In a future scenario of primarily non-automated road transport, similar to the current situation, participants were generally frustrated that nothing had changed. They hoped for some progress to have been made by 2030.

In a scenario with a road transport network involving both CAVs and non-automated vehicles, the majority of participants thought the situation would be better than it is today for their chosen lenses. Although most participants said that they felt a mixed-use network would be a road safety risk, in scoring they still felt road safety would be better in this scenario than it is today – seeing CAVs as less of a risk than drivers. They felt it would be worse than it is today for feeling in control, vehicle ownership, government and law enforcement of road use, and employment, reflecting their general concerns that CAVs may have negative impacts on control and convenience, and employment in the transport sector.

Participants felt that in a scenario of nearly full automation of road transport, that road safety, environmental impact, reliability of transport service, and traffic flow and congestion would be better than they are today. However, there were mixed views on affordability, with some participants thinking it would be better than it is today and others thinking it would be worse. The most negative views were on feeling in control, the enjoyment of driving, and employment. Again, the scoring of lenses generally reflects the views shared on these different issues throughout the dialogue.

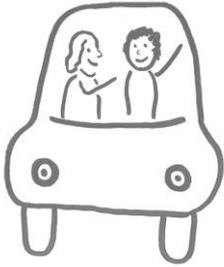
## **3.2. Societal impacts**

Societal impacts were mentioned throughout the dialogue, though to a lesser extent than safety, freedom to move, and equity. Although participants had some concerns, this did not influence their willingness to use CAVs.

Most participants expected CAVs and automation would have both positive



and negative impacts on society. In the voting questions, the majority of people thought on balance CAVs would have a positive impact on society. However, in the discussions, they focussed mainly on their concerns.



### Sharing: Impacts on communities and society

Some participants thought that sharing could bring communities together if services were organised in a certain way, such as community specific sharing networks where neighbours would get to know each other.

However, participants often raised concerns about racism and/or homophobia in the context of shared services. This was of particular concern when a passenger rating system was suggested as a way of improving user safety, as participants worried that racism and other prejudices may cause people to receive unfairly low ratings and in turn limit their choice or ability to get a ride.

Some participants thought vehicle ownership is generally changing regardless of CAV technology, as vehicles are expensive and people are increasingly choosing not to be a vehicle owner. Some comparisons were made to housing, where younger generations are less likely than previous generations to be able to buy a home due to high costs and more likely to rent throughout their lives.

#### 3.2.1. Impact on jobs

Potential loss of jobs was the main concern about societal impacts of CAV technology in the first workshop, and particularly amongst older participants (aged 55+). Participants' views on the issue were not prompted and their sources of information were not always clear but appeared to be based on both media coverage and personal experience of the impact of changes to major industries, such as mining). Few participants were employed in driving professions at the time of the workshops.

Participants did not spend much time talking about job losses because they saw it as a wider societal issue resulting from automation, rather than an issue specific to CAVs. Some participants made comparisons to adverse impacts on jobs in other industries such as supermarkets and print. A more detailed exploration of analogies is included in Section 5.2.2.

Participants were concerned that CAVs may result in job losses, particularly in occupations connected with driving (such as driving instructors). Some participants felt strongly enough about job losses that they brought newspaper clippings and statistics to the workshops. However, these concerns were generally mitigated by participants' knowledge of successful redeployment in other industries, or a view that job losses due to automation are part of human development.



Over the course of discussions, participants concluded there would not necessarily be fewer jobs available, but that jobs connected with driving would be replaced by roles in the new CAV industry. Participants predicted that programmers, engineers, CAV production factory workers, fleet maintainers and cyber-security experts would be in high-demand. However, they worried that if British people were not qualified to take these jobs, the work would be outsourced to other countries and that therefore the CAV industry would not be a source of jobs and profit for the UK. A few participants felt that with significant job losses, the economy would suffer even if the technology created a new profitable industry for the UK.

*“All the automated tech industry is outsourcing data jobs to other countries; we need the Government to prioritise keeping these jobs here. 1 million people will lose jobs... we need to keep the balance. The Government needs to be proactive now and focus on building the right skills in schools and for the industries.” (Leeds)*

Most participants thought it would be important to invest in building the right skills and expertise in the UK, by retraining people who are currently in driving professions and adapting school and college education. They believed both Government and the organisations that will benefit from the introduction of CAVs have a duty to invest in retraining people in driving professions. Some participants believed that staggering the transition to CAVs would make it easier to retrain people, but wanted Government to have a plan in place as soon as possible. A few participants felt that retraining is the individual's responsibility and that nobody should expect a career for life.

*“Avoid what happened to the miners – foresight, forward planning.” (Glasgow)*

Many participants also thought that the Government should adapt the national school curriculum as soon as possible. They suggested that science, technology, engineering and maths (STEM) subjects be strengthened and should include automated technology so that young people are equipped and enthusiastic for careers in the CAV industry. Some participants thought that specific college courses should be made available and that engineering courses should cover specific CAV topics.

Participants generally based their views on job-losses on what they have seen happen in other industries. Concerns about job-losses did not affect participants' transport choices or interest in CAVs. However, they felt strongly that the impact of job-losses needs to be mitigated by starting to prepare people for CAV careers now.

### **3.2.2. Mental and physical well-being**

Participants saw potential for both positive and negative impacts of CAVs on mental and physical well-being, but overall believed the potential impacts would be more negative. They believed CAVs could result in:



- a loss of skills and 'dumbing-down' of society;
- changes in opportunities for social interaction (positive and negative);
- worse physical health including a reduction in physical activity and increased alcohol consumption; or
- changes to mental health and stress levels (positive and negative).

As noted above (Section 2.3.1), people also saw the potential for people with mobility needs to benefit from the introduction of CAVs.

Taking each idea in turn, many participants were worried about CAVs leading to a loss of skills (such as map reading). They made comparisons to other technological advancements such as mobile phones. They were concerned that if people stop driving manually it could result in decreased coordination skills, reflexes and decision-making abilities, and a general 'dumbing-down' of society.

*"I'm afraid it will have the same negative effects on society as mobile phones – brains will waste away, human interaction will lessen, we won't have the same capacity for decision making."  
(Abergavenny)*

Many participants worried that changing travel habits and an increasingly automated world would reduce human interaction, resulting in social isolation and loneliness and related mental health issues. Participants felt that the impacts of CAVs on social isolation would depend on how and where people currently interact, for example:

- it would worsen for people who currently interact in supermarkets, as deliveries become the norm;
- it would worsen for people who interact at bus stops if public transport systems change how they pick up passengers; and
- it would improve for people who currently struggle to access social opportunities due to an inability to drive.

*"We've lost human interaction already, and people don't talk to each other as much anymore." (Leeds)*

Some noted that the replacement of face-to-face, real-world interaction in this way is not new and is already normalised in many other aspects of life.

Most participants were concerned that if public transport was replaced by CAVs and if this made getting around easier, people would be less likely to use non-motorised transport (such as cycling or walking), thereby reducing physical activity and associated well-being. However, some participants felt that physical activity is an individual responsibility, without reflecting on any potential role of infrastructure in enabling physical activities.

Another occasionally shared health concern was a potential increase in alcohol consumption (and associated health and societal impacts), as no one would have to worry about drink-driving.



*“People could socialise more, drink and drive – however, would it make people drink more?” (Milton Keynes)*

Some participants felt mental health would improve because commuting would be quicker and less stressful for many people, providing them with more leisure time. This was particularly true among people living in towns. However, others rebutted this idea, believing that if journey time was freed up, people would be expected to do more work remotely, contributing to increased social isolation, stress and pressure.

Overall participants were concerned that CAVs have the potential to negatively impact on health and well-being and believed CAVs should encourage healthy behaviours. This is a potential tension with views expressed elsewhere in this report that people will only use CAVs if they are seen to be convenient.

### **3.2.3. Economy**

Although some people were concerned about the negative impact of CAVs on jobs (see Section 3.2.1 above), they also thought of several industries that could benefit from CAV technology. For example, participants' votes on who would benefit most from CAVs remained generally similar over time, ranking car manufacturers second.

Many participants thought leisure and tourism industries would benefit if people had more free time, flexible working, and less trouble travelling to destinations. Some participants suggested that stadiums arrange automated shuttle services for concerts or sporting events, with routes calculated using ticket purchasers' postcodes.

*“Good to use at large events like a concert, a shuttle bus.”  
(Leeds)*

Some participants thought the freight industry would benefit from lower operational costs and increased efficiency, as freight vehicles could run without regular stops for drivers and/or run in convoys at steadier and possibly faster speeds.

A few participants suggested that high streets might be revitalised if CAVs were to remove the need for parking, as currently parking near high streets can be expensive and stressful.

Even though participants saw potential positive impacts of CAVs on local and national economies, this did not influence the likelihood of them saying they would use CAVs.

### **3.2.4. How did views on societal impacts change during the dialogue?**

Throughout the dialogue, participants' opinions about impacts on society were more positive in voting and more negative in discussions and activities.

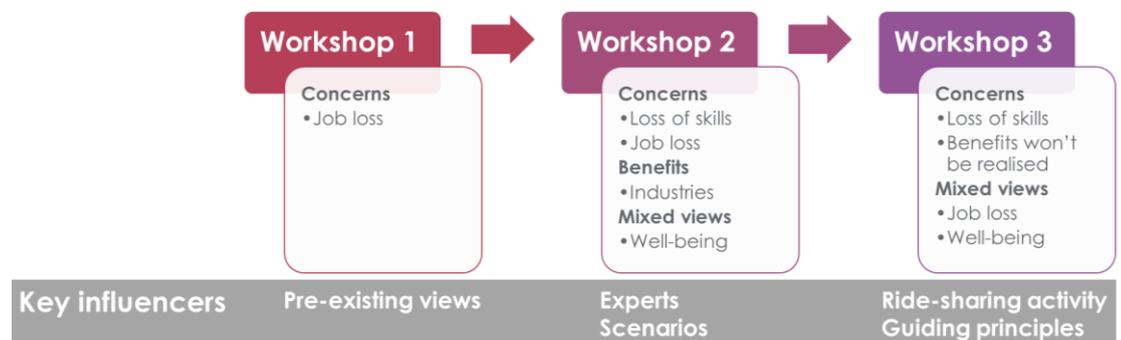


For example, at the end of workshop one most participants voted that the impact on society would be positive, but in an activity to identify the pros and cons of CAV technology, which happened before people voted, the most common perceived disadvantages related to societal impacts. Over time, discussions prompted participants to increasingly elaborate on the potential benefits of CAVs for society.

In voting, most participants felt this technology would have a positive impact on society, before the workshops and at the end of each workshop (see Appendix F for quantitative results). There was a small decrease in positive views from before the workshops to the end of workshop one, perhaps as the initial discussions revealed many questions and concerns people had about the technology, followed by an increase from workshops one to three. Approximately half of participants did not change their view on this question throughout the dialogue. Participants consistently voted 'The impact of CAVs on jobs / drivers losing their jobs' among the top four concerns in each workshop, superseded only by concerns about safety.

In voting there were some demographic differences in views with respect to societal impacts.

- Men were more likely to be positive than women (three in five men compared with half of women were positive at the end).
- Older people (aged 55+) were more likely to say the impact would be neither positive nor negative and over the course of the dialogue younger people (under 35s) moved from both extremes into the middle ground.
- Middle-aged participants (35-54 year olds) were more likely to be positive. Three quarters were positive about the impact of CAVs on society by the end of the dialogue.
- There was no difference between attitude of drivers and non-drivers at the start, but occasional drivers were much more likely to think the technology will have a positive impact on society. By the final workshop views of all participants converged and became slightly less positive.



- Despite being an important and early emerging societal impact, job-loss was not a strong focus in discussions, because it was seen as a result of a bigger trend in automation.
- There were very few specialists with a societal focus and participants



were sceptical of specialists' views on potential societal impacts. This may have contributed to such concerns persisting through the dialogue.

- The scenarios activity in the second workshop prompted discussions about what society might look like, but it didn't change views overall.
- When discussing sharing in the second and third workshop, participants could see benefits for community building, but became concerned about potential prejudices between users.
- Over time, participants became concerned that if plans were not put in place, that the potential benefits of CAVs for society would not be realised or would be outweighed by negative impacts.

Participants saw the potential for CAVs to have a positive impact on society, but were sceptical that these would be realised. They acknowledged that some negative impacts could come from a general increase in automation, but wanted CAV introduction to be managed to mitigate any negative impacts on society.

### **3.3. Individual impacts**

Participants found it relatively easy to imagine the impact CAVs could have on society, but found it harder to imagine the personal impacts of this technology. They did not explain why this was, but might be because they currently have too many unanswered questions to understand how the technology could fit into their lives.

When prompted, specific areas of people's lives that they thought might change due to CAVs included impacts on their enjoyment and identity, the journeys they would take and also where they could choose to live. The discussion was underpinned by a clear message that people should have the right to choose whether to transition to CAVs.

#### **3.3.1. Enjoyment and identity**

Losing the joy of driving was among the top disadvantages of CAVs identified at the end of workshop one. Those few participants who perceived driving as a key part of their life feared a loss of the joy experienced when driving. However, this was a divisive issue as some found driving a stressful chore: these participants were happy to forgo driving in order to do something more enjoyable while in a vehicle, such as interact with their children, sleep, drink, or socialise.

Some participants questioned how vintage car ownership and motorsports might work and some worried they would not be able to drive such vehicles. In one of the scenarios it was suggested that there may be tracks for non-automated 'leisure driving'. Some participants were happy with that idea, while others still wanted to be able to continue driving their vintage cars on the road.



*"I like driving a car, you get a sense of enjoyment – there is no pleasure or enthusiasm in using a driverless car." (Millbrook)*

Some participants, particularly those who enjoyed driving, highlighted the importance of vehicles for some people's identities and self-expression; communicating image and status. Some also made the link between vehicle types and personal hobbies such as camper-vans. As outlined in the previous section, participants therefore wanted to ensure that they would still have choice of vehicle type and style.

*"What about young lads who want to show off and buy a Porsche?" (Leeds)*

Participants had different views on whether they would want to give up driving, dependent on their current relationship with their vehicle. This further contributed to their view that choice would be important.

### **3.3.2. Impact on travel and routines**

When prompted, some participants observed how CAVs could change their current travel and routines. For example, some drivers found driving at night or on motorways to be stressful and said they would be pleased to use a CAV in these situations.

The future scenarios in the second workshop helped participants to think about CAVs in the context of their personal travel and routines. Some participants were excited at the prospect of simpler transport to the hospital or airport without the expense and stress of parking. Many parents said they would benefit from automated school transport, but felt such transport must be supervised carefully.

*"I think it would be great for getting to hospital and doctors' appointments – hospital transport is currently dreadful, and parking is expensive. It would have a significant positive impact on my life." (Leeds)*

Many participants felt that automated deliveries might be more convenient for the customer, while others felt they would be less convenient as drivers often help bring groceries into the house and manage any discrepancies. In response to some of the identified challenges, participants suggested that a robot deliver to the door and that there be an interface on the vehicle for troubleshooting. The transition to automated deliveries was easier for some participants to imagine, as they were familiar with current innovations in the sector, such as box services accessed with a PIN and drone deliveries.

*"Delivery shopping would be more difficult as currently someone brings in the groceries." (Abergavenny)*

Many participants discussed whether CAVs would make it easier to live somewhere different, shifting patterns of settlement. Some participants would consider living more centrally if CAVs improved urban transport networks, while others felt that if commuting became easier and cheaper, they might



choose to live rurally or further away from their workplace. Some participants suggested these changes would happen in the context of work being increasingly flexible and less office-based, which may also impact on where people choose to live.

Participants' views on how CAVs might impact their own travel behaviour and routines were mostly prompted through scenarios and, for some, experiences in CAVs. Views were mixed and did not have a strong influence on willingness to use CAVs.

### 3.3.3. *Right to choose*

For the reasons identified above and because of concerns about convenience (see Section 2.2.1 above), participants felt they should have the right to choose not to transition to automated travel. Some perceived driving as a right and feared that they would be forced to stop driving. Participants generally thought that this would have implications for transitioning and discussed the importance of balancing people's choice with a sufficiently rapid progression to realise the benefits of automation. Overall, only a few participants felt that the improved safety and reduced congestion of a fully automated road transport network would be more important than maintaining people's choices.

Several groups suggested that Government could put schemes in place to encourage take up of CAVs without compromising choice or disadvantaging people (similar to the diesel scrappage scheme), such as:

- Incentives;
- part exchanges;
- compensation schemes; and
- higher taxes on non-automated vehicles.

*"It's difficult to put into place without being a dictatorship."  
(Abergavenny)*

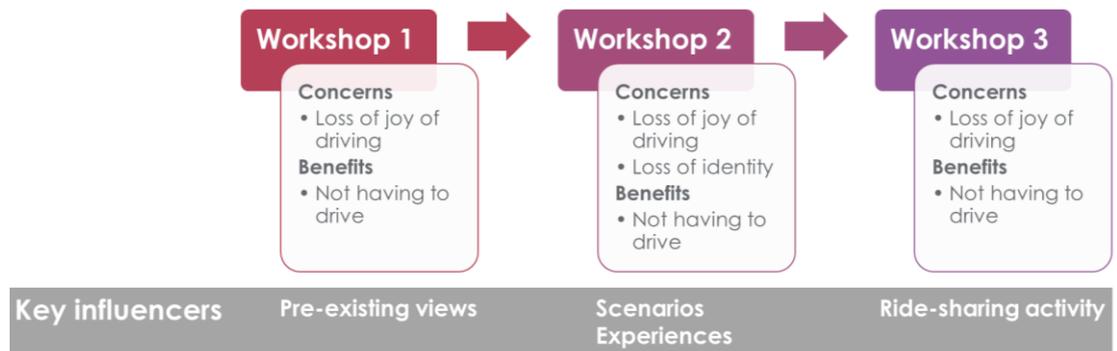
Participants valued their ability to choose what vehicle to use and strongly believed that this should be protected. Only a few thought the potential benefits would be sufficiently valuable to justify taking away people's choices. However, they thought that CAVs could improve choices of where to live, by reducing current limitations of commuting.

### 3.3.4. *How did views on individual impacts change during the dialogue?*

Participants did not initially share their views from a perspective of owning or using CAVs personally and typically referred to people or society generally rather than themselves. It was possible that the futuristic nature of CAVs and the open-endedness of when they may be rolled out led to a detachment from personal activities. Participants' views may have been shaped by their

current behaviour and preferences, but were projected onto generic future 'users', rather than relating specifically to their own lives. Discussions about personal practicalities needed prompting, for example through playing out scenarios, seeing driverless pods and considering where shopping may go, or discussing sharing.

Participants indicated before the dialogue and at the end of each workshop, the extent to which they thought CAVs would have a positive or negative impact on themselves and their families (see Appendix F for quantitative results). Most participants were positive prior to the dialogue (particularly men and occasional drivers) and while there was an initial decline in positivity by the end of the first workshop, the majority of participants remained positive throughout the dialogue. Demographic differences were not significant in the final workshop as views tended to converge, although as was seen in societal impacts, middle-aged people were slightly more positive than the younger and older age-groups. There was no clear pattern of why this was the case.



- At the end of the first workshop, the individual benefits participants identified related to transport being easier and providing more leisure time.
- The scenarios in workshop two had several specific prompts to encourage participants to consider CAVs from a more personal perspective. Participants were generally drawn to discussing school transport and grocery shopping or deliveries, as these were the more easily relatable and more routine parts of their lives.
- Participants were most likely to say 'You can do other things while driving' was a reason they were optimistic in workshop two (when it ranked third), while 'Less stressful / don't have to worry about driving' peaked in workshop one (when it ranked second) declining in the following workshops.

Impacts on participants' individual way of life were generally not the most prominent feature in the dialogue unless specifically prompted with clear examples or aspects of life to consider. This could be because CAV technology felt too far off to relate to in that way.



### 3.4. Environment

At different points through the dialogue participants considered the implications of CAVs for the environment. The environment was not as prominent in discussions as other issues, perhaps because people tended to focus on negative aspects of CAVs.

Many participants expected that CAVs would be environmentally beneficial and assumed that that they would be electric. Participants thought that electric vehicles would be more sustainable (if using renewable electricity) and quieter. They also thought investment in CAVs would support wider advancements in battery technology.

#### 3.4.1. Benefits and impacts

Participants did not specifically talk about environmental issues, such as air pollution or climate change, but rather approached the topic indirectly, through issues such as the number of vehicles on the road.

Some participants believed that CAVs would improve traffic flow (through road management and information sharing) and that with more people using public and shared transport there would be fewer vehicles on the roads and less congestion. However, some participants felt that peak times would not be affected and wondered if CAVs would lead to an increase in vehicles on the road because they would enable more people to use vehicles (for example non-drivers). Participants assumed decreased vehicle numbers overall (due to increased use of public transport and sharing) and improved traffic flow would be positive for the environment.

*“Congestion would be more, not necessarily less. More traffic flow but more vehicles.” (Millbrook)*

Some groups discussed the possibility that more space would be freed up, when prompted in the scenarios activity about the possibility that car parks may not be needed, or that CAVs may take up less road space by safely driving closer together. Participants hoped that such reclaimed land would be used to create more green spaces, but thought it was likely that reclaimed land would be developed instead.



#### Sharing: Importance in realising environmental benefits

Participants thought sharing occupancy and/or ownership would enable CAVs to have a positive impact on the environment. They acknowledged that sharing would lead to fewer cars on the roads, reduced congestion and reduced need for car parks. However, when thinking about current models of sharing, these benefits were not enough of a motivator for participants to change their transport choices.

*"I live in a complex of eight people... At the moment we've got 16 cars in the car parking and you can guarantee that 12 of them would be going to exactly the same place... it seems to me that a driverless or autonomous car would be perfect to do that. Environmentally it would be a help too I imagine...It would be like the community was running its own fleet, in a small more private way." (Glasgow)*

Some participants feared that by automating the transport system, large numbers of existing, non-automated vehicles would be made redundant, creating large-scale waste. They sought reassurance that a plan would be in place to prevent this from happening (for example, by converting vehicles).

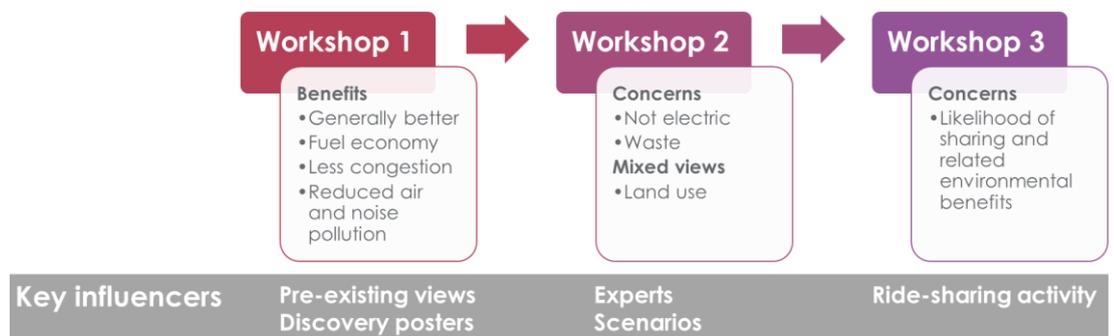
Participants were optimistic about CAVs having a positive impact on the environment, but unsure that those benefits would be realised. They sought reassurance that plans would be in place to mitigate the risks of negative impacts including non-automated vehicles becoming obsolete.

### 3.4.2. How did views on environment change during the dialogue?

Participants' environmental attitudes and values did not surface immediately in the first workshop and were not a strong feature in discussions throughout the dialogue. However, it was an important issue to them. It featured strongly in quantitative activities throughout the dialogue (see Appendix F for quantitative results), where it was:

- among the most commonly listed benefits in the first workshop;
- fourth most frequently selected lens in scenarios in workshop two; and
- among the top choices for what participants were most optimistic about at the end of each workshop.

This popularity peaked significantly at the end of workshop two. Over 55-year-olds were more likely to select the environment as the thing that they are most optimistic about, although it was not clear what led to this pattern.



- Participants assumed that CAVs would be electric, with related environmental benefits, such as decreased air and noise pollution.



- For a few participants engaging with specialists raised the point that the vehicles may not be electric, which became a minor concern, but did not affect views overall.
- Discussing shared vehicle occupancy prompted discussion on environmental benefits.

Despite limited discussions, participants remained optimistic about potential benefits of CAVs to the environment throughout the dialogue. Prompts stimulated discussions about environmental impacts, but (as with other societal impacts outlined in Section 3.2) environmental impacts were unlikely to influence whether or not most people choose to use or share CAVs, being outweighed by issues of safety and convenience.

## 4. Findings: Managing the introduction of CAV technology

Throughout the dialogue we explored what may make participants more or less comfortable with fully automated road transport. In the final workshop, groups (with support from industry experts, academics and policy-makers) developed guiding principles for the development and potential roll-out of CAVs, based on issues that were most important to them. Refer to Appendix E for a full list of the guiding principles produced in the workshops.

Although most participants, talking as citizens as well as potential users, could see that using CAVs could be beneficial, their comfort with a transition to fully automated road transport was conditional. There were six main conditions which, if satisfied, would make people more comfortable.

- CAVs must be proven to be safe and secure.
- Benefits must be accessible by all.
- CAVs must be good for society and good for jobs.
- People must remain in control of their transport choices.
- There must be clear guidance on accountability.
- New bodies for oversight should be created.

Participants' willingness to consider sharing was influenced by how safe they thought it would be when sharing a vehicle with strangers, how convenient it would be to make a journey and what the experience of sharing would be like. Price seemed to be less important than these other factors for most participants.

### 4.1. *Would participants be comfortable using CAVs?*

Participants fell into one of three groups relating to CAVs as shown in the diagram below.



Overall, most participants across all locations were generally positive about the possible impact of CAVs on themselves and on society. However, all participants were quick to articulate the conditions under which they would be more or less inclined to use individual or shared CAVs (Sharing: Willingness to share, page 62).

Participants who were most enthusiastic about CAVs felt relieved by the thought of no longer having to drive. They believed that spending less time behind a steering wheel, particularly for long journeys, would make life more comfortable and convenient.



Participants who normally used taxis or public transport to get around were happier with the idea of using CAVs than participants who normally drive their own car. They believed that automation would improve public transport services, thereby improving their mobility.

A few participants said that they would only use CAVs as a last resort, for example, if it was impossible for them to drive a non-automated vehicle or if they were stuck with no other transport options.

Participants believed that people who drive regularly and older people (who might not see the point in transitioning to a new system), would be more resistant to using CAVs. However, while there were a few participants who disliked the whole idea of CAVs and said there were no circumstances under which they would use them, they were not necessarily only regular drivers or older people. Some of those participants who would not use CAVs, thought that investment in current public transport and infrastructure was more important than automated technology.

## **4.2. What might make people more comfortable with the introduction of CAVs?**

### **4.2.1. If the technology is proven to be safe and secure**

In all locations, participants developed guiding principles on safety. They wanted to know that CAVs would bring safety benefits and wanted to see Government regulations on safety standards and data security.

Some participants said they would be happy paying a bit more to replace a non-automated vehicle with a CAV if safety improvements could be guaranteed. They were aware that driving a non-automated vehicle carried risks, but their concerns about CAVs related to possible new risks and new questions about how to deal with things going wrong.

For most participants, it was not enough to know that on average the new technology would be safer than non-automated technology. Participants varied in their opinions of how safe would be safe enough and this related not just to road safety, but also system security and personal safety in shared vehicles.

In the development of CAV technology, participants expected manufacturers to carry out rigorous safety testing and trials in carefully chosen locations.

*“Self-driving vehicles should not be allowed on the road until it's proven that they meet safety standards and can deal with unexpected situations.” (Abergavenny)*

They stressed that users need to know how to respond in emergencies, that safety features (such as emergency buttons and back-up systems) and regular, strict safety tests (like the model of the MOT test) should be in place. Participants highlighted that the standards of such safety tests should be reviewed as the technology further develops.



#### **4.2.2. If the benefits of the technology are widely available**

Participants felt that everyone should be able to become a CAV user if they want to, regardless of age, location, income, or disabilities. Most participants were concerned that the technology would not be evenly distributed, expecting it to benefit urban communities long before rural ones and that people with limited transport options (due to costs, accessibility, or disability) may not benefit from CAVs at all.

*“Ensure that the technology is open to everyone and accessible to people with disabilities by promoting joined up services/technologies.” (Millbrook)*

Many participants were concerned about the price they would pay for using CAVs as well as the costs of bringing CAVs into the world. Participants wanted equity in financing any required changes to infrastructure. They felt that an infrastructure plan would need financial contributions from the private sector, with government regulations in place to ensure funding is shared fairly across the country. Many participants felt that public transport should be prioritised over private-use CAVs and did not want to see any transition at the expense of affordable public transport. Participants suggested that the Government subsidise CAV services to make affordable options available to everyone in society, although some worried about the public cost of doing this. Some public transport users stressed that there should be financial support in line with current provision, such as freedom passes, discounted travel cards and senior citizens' cards.

Some participants (and people external to the workshops that they had spoken to, such as family and friends) struggled to see real benefits to CAVs, or how the societal and individual benefits would outweigh the potential negative impacts. Participants emphasised that CAVs need to be beneficial overall and that the benefits and the uncertainties or unknowns need to be clearly communicated to the public.

#### **4.2.3. If the technology is good for society and good for jobs**

Many participants felt that a transition to an automated road transport network should provide wider social and employment benefits, although few were interested in the possible economic benefits for the UK overall. Participants felt that to be more acceptable, CAVs must improve both:

- mental health (through reducing stress and increasing leisure time); and
- mobility for people with conditions that make non-automated transport limiting.

They also thought that measures to prevent laziness and social isolation should be further investigated.



Many participants were concerned about impacts on jobs, which could increase inequality and felt that national policies to deal with job-losses and changes would be an important condition for acceptability of CAVs. They wanted education and re-employment opportunities for people whose jobs might be affected.

#### **4.2.4. If we are in control of our transport**

Some participants' willingness to use CAVs was influenced more by efficiency and convenience, than by price or societal impacts. A few participants were excited that CAVs could achieve more efficient journeys as vehicles reroute to avoid congestion and avoid the need for passengers to spend time parking.

The loss of independence and control, believed to come from switching from a non-automated vehicle to a CAV, was a big concern to some participants. These participants struggled to embrace the idea of CAVs and wanted the ability to control their journeys or switch from driverless to manual control. Participants thought that one way to maintain independence in a driverless world would be to ensure people have choices – by offering access to privately-owned CAVs and the ability to choose different types of vehicles with different features (such as size and level of comfort).

#### **4.2.5. If there is clear guidance on accountability**

Participants want clear guidelines (according to different situations and/or different levels of automation) explaining who is accountable if things were to go wrong.

Participants saw central government as responsible for legislating and manufacturers, network operators and data holders as liable for technical faults.

*“Accountability [should be] enforced by the government with legislation regarding the changing responsibilities depending on levels of automation.” (Milton Keynes)*

If using a public or rented CAV, participants thought users should not be accountable if an accident occurs; and that insurance should only be in place to cover personal safety such as theft or assault. However, it was recommended that CAV owners should be responsible for keeping CAV software up-to-date and ensuring their vehicles meet road safety standards through regular checks and services (similar to MOTs).

#### **4.2.6. If new regulatory bodies are created**

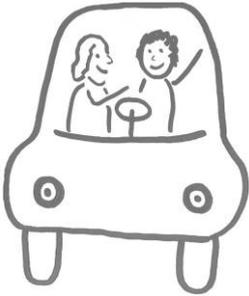
Participants thought a new regulatory authority should be created to develop and enforce regulations relating to CAVs including rules around safety and accountability. They thought this body should include a range of perspectives from the public, private and third sectors, as they saw the responsibility and accountability for the safe roll-out of CAV technology as being shared across sectors. Some thought that this should be an



independent non-governmental organisation.

*“Develop and communicate a set of transparent protocols, rules and regulations, driven by an independent and impartial organisation.” (Millbrook)*

Participants often referred to a ‘universal system’ and stressed the need for setting standards to ensure transparency and technological compatibility between manufacturers when developing the technology.



### Sharing: Willingness to share

Participants tended to conflate shared ownership and shared occupancy. They primarily discussed shared occupancy (where passengers may share parts of or a whole journey), rather than shared ownership (such as private use of a vehicle from a sharing service, or the use of a vehicle owned by a group of people in a community).

Most participants were less comfortable with using shared services, than with using a privately-owned CAV. Their views on sharing were particularly influenced by concerns about:

- personal safety (safety and security in the context of sharing with strangers);
- freedom to move and convenience (being able to go where they wanted, when they wanted, without having to plan in advance);
- personal space and privacy; and
- condition of the vehicle (whether it would be clean and well maintained).

A few participants felt that sharing would save them money and could be more convenient, particularly when out drinking or in areas with limited parking.

Participants were more likely to consider using shared services if:

- travelling during the day;
- sharing with familiar people;
- vehicles are guaranteed to be clean and well maintained; and
- smaller vehicles have internal compartments for passengers to be separated from one another.

### Ensure freedom of movement

Many participants were worried that in relying on shared services, they would lose their independence and the freedom and flexibility to make last minute decisions, for example to go to the shops or visit a friend.

Interest in shared ownership and shared occupancy models depended on geographical location. Participants were concerned that, as with taxis at the moment, in small towns and rural areas fleets would be smaller and therefore less able to respond which would limit freedom of movement.



### **Ensure the personal safety of passengers**

In general participants were apprehensive about sharing cars with strangers. For some participants this risk was heightened if there was no driver and therefore nobody to support or protect passengers. Some participants provided specific suggestions to improve personal safety in shared services, such as the introduction of identity verification and a passenger registration system (for a detailed account of all suggestions, refer to Appendix D).

### **Accountability if things go wrong**

Participants felt that users of shared CAV services should not be accountable if an accident occurs and therefore should not need to insure themselves against accidents, only for personal safety cover (for theft or assault) should they wish.

### **Ensure there is choice**

Participants' willingness to share ownership and/or occupancy of a vehicle was generally influenced more by safety, control, efficiency and convenience, than by price; particularly when discussing night-time or longer journeys.

Participants thought that one way to maintain independence in a driverless world would be to ensure freedom of choice. Users should be able to choose different ride features (such as vehicle size, shared or private occupancy and level of comfort) based on the intended journey. For example, someone may want a private-occupancy, larger and more comfortable CAV service for a long journey with their family.

### **Make it cheaper**

A few participants believed that 25% cheaper journey costs would be incentive enough for them to use a shared CAV, while others thought shared services need to be at least 40-50% cheaper than their current journey cost. A few participants said it would have to be free before they would agree to switch from their current transport mode to a shared CAV. There was no clear relationship between views on cost and the transport mode that would be replaced.

### **Sharing occupancy on different journeys**

Participants discussed sharing for different journey types: travelling into work (or a similar daily trip), visiting family about 200 miles away, or returning from a night out. We asked participants about their current travel and whether they would consider changing to a proposed shared option for that journey.

### **Travelling into work or making a routine journey**

Initially, very few participants said they would change to a shared-occupancy door-to-door service to travel to work or make a routine journey. However, under certain conditions, two thirds of participants



considered switching to a shared service. The main issue that influenced participants' willingness to share was who they would share the vehicle with: colleagues or friends were more acceptable than strangers. Cost was an influencing factor, but to a lesser extent. A third of participants would not consider sharing under any conditions. Participants in Milton Keynes and Millbrook were most resistant to sharing in this scenario, although there was no clear reason for this pattern.

### **Travelling to see friends and family 200 miles away**

Overall, participants were more open to switching to shared-occupancy transport to make a 200-mile journey, than to travel to work or make a routine journey, or to return from a night out. This may have been because many were used to sharing on trains or buses for long journeys. About half of participants immediately stated they would consider sharing. When exploring other factors that might influence this choice, for this journey, cost was the most important factor. While it was not a key influencing factor, the availability of entertainment in the vehicle was more important than for the other two journeys. Choosing who you travelled with was still important and the possibility of 'quiet' vehicles was important for some participants.

### **Returning from a night out**

Very few participants were initially interested in shared transport to return from a night out, although after discussions about half of participants would consider sharing occupancy under certain conditions. The conditions varied from person to person with no clear patterns. Some would be more comfortable if they were able to travel in a group with friends. Cost was less of an influencing factor and, while safety was a concern, the possibility of a security officer in vehicles didn't influence many participants. In general, individual circumstances influenced participants willingness to share and there was less consensus about what levels of safety and convenience would be acceptable.

### **Who is willing to share?**

Some participants who live or work in cities and use public transport regularly rather than driving saw owning a car as an expensive, logistical burden; and felt that sharing would improve their freedom to move without worrying about parking or congestion.

Overall, more participants in Glasgow were open to sharing options than in other locations, particularly compared to Milton Keynes and Millbrook. This may have been because there were more non-drivers in Glasgow than the other two locations. Apart from this, there were no clear demographic patterns indicating whether some groups of people may be more or less willing to share vehicles.



## 5. Findings: Making sense of the topic

Participants came to the workshops with some knowledge of CAVs. This knowledge was mostly gained from media coverage, pop culture and science fiction. This suggests that media monitoring could help to keep abreast of public opinion.

Different activities in the dialogue helped people develop their views. Exposure to specialists who could answer some of their questions was particularly helpful for enabling participants to move beyond particular issues they were concerned about. While it is not possible to enable every member of the public to engage with specialists, finding ways to communicate answers to the key questions participants raised will be a positive way to address concerns.

This is the first Sciencewise dialogue in which participants had the opportunity to experience emerging technologies. The impact of this was mixed, as while it made the practical considerations of CAVs more tangible, it also gave participants the impression that the technology was less advanced than they had assumed.

'Self-driving vehicle' was the most familiar term to participants at the start of the first workshop. At the end of the third workshop, most participants voted 'driverless' or 'self-driving' as the most easily understood terms. Therefore, it would be helpful for government to use these terms, rather than referring to CAVs.

The rest of this section sets out these findings in more detail. Sections 5.3 and 5.4 have an emphasis on methodological learning which will be particularly relevant for dialogue practitioners and people seeking to understand the approach in more depth.

### 5.1. How participants found out about CAV technology

Participants had gained most of their knowledge about CAVs from media coverage, pop culture and science fiction (for example television series and films which depicted CAVs talking and with a digital personality) and also some personal experience. Early in the dialogue participants referred to a fatal Uber collision that occurred in the US on 18 March 2018<sup>10</sup>. Participants also quickly associated Tesla and Elon Musk with CAVs, given their media prominence.

Participants who were interviewed after the final workshop reflected that their perspectives changed over the course of the dialogue. They also told us their views are continuing to evolve in response to discussions with other people and new information obtained through self-directed investigation.

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<sup>10</sup> [https://www.washingtonpost.com/news/tripping/wp/2018/03/22/fatal-crash-with-self-driving-car-was-a-first-like-bridget-driscolls-was-121-years-ago-with-one-of-the-first-cars/?noredirect=on&utm\\_term=.7959667ae979](https://www.washingtonpost.com/news/tripping/wp/2018/03/22/fatal-crash-with-self-driving-car-was-a-first-like-bridget-driscolls-was-121-years-ago-with-one-of-the-first-cars/?noredirect=on&utm_term=.7959667ae979)

They said that the dialogue had sparked an awareness of the topic and that they had since been noticing CAVs on television and in conversation more often.

## 5.2. How people talk about CAV technology

### 5.2.1. Terminology

'Self-driving vehicle' was the most familiar term to participants at the start of the first workshop (Figure 1). At the end of the third workshop, most participants voted 'driverless' or 'self-driving' options as the most easily understood terms for this type of technology, with a preference for 'vehicles'.

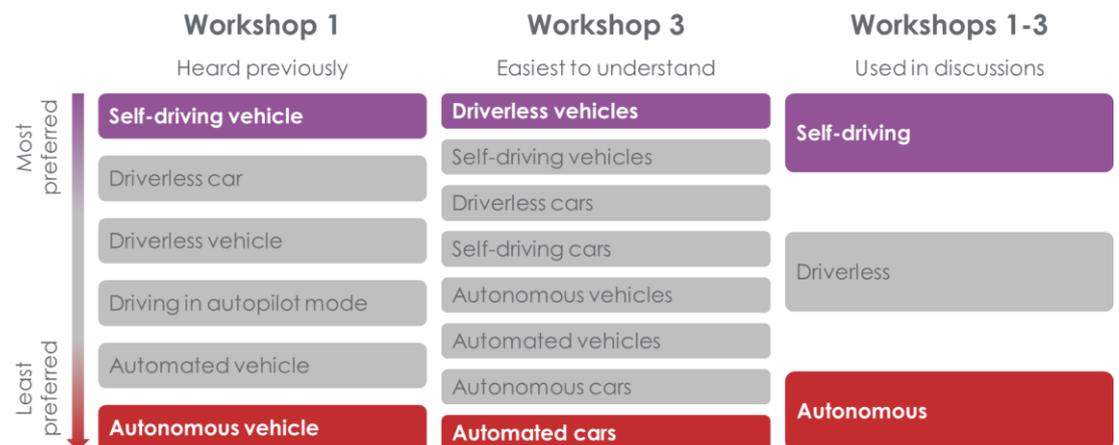


Figure 1: Different terminology tested with and used by participants at different workshops

Participants generally preferred using the term 'self-driving' when talking about CAVs themselves. They said that while 'driverless' was familiar to them, 'self-driving' made more sense because the vehicle would not be without a driver, it would be the driver itself. Participants felt there was no need to include 'connected' in the terminology.

Participants felt that the terms 'autonomous' and 'autopilot' were more unclear as to how involved a passenger may have to be in driving. They suggested that if passengers were expected to perform any driving tasks, 'assisted' or 'supervised' should be used.

### 5.2.2. Analogies

Participants used many analogies and comparisons to make sense of the transition towards CAVs, particularly mobile phones and the motorcars. They introduced these comparisons spontaneously and were not prompted by facilitators.

- The progression of mobile phones – inevitable, rapid and leading to dependency – was used to imagine how CAVs may influence society. Participants spoke of how a generation ago people could not have imagined modern smart phone technology and how even those who resisted the change eventually found themselves owning smartphones.
- Participants used the uptake of the motorcar and swift change from horses dominating streets to help them think about how the road



transport network might transition once CAVs were rolled out.

- Participants used automation in other transport, such as aircraft and trains, to consider how it might feel to use CAVs. For example, although flights have automation, participants said they would not feel comfortable on a plane without a pilot.
- Job-losses from automation in other industries, such as print and manufacturing, were introduced by participants to anticipate potential impacts on society.
- Current shared Uber services or vehicle subscription services were used as a basis from which to understand potential sharing models.

When talking about CAVs, use the terms 'driverless vehicle' or 'self-driving vehicle' rather than 'autonomous' or 'automated'. Making comparisons to other transitions in technology that people may be familiar with may be beneficial to help them connect with the topic and understand potential impacts.

### **5.3. How we explored CAV technology**

#### **5.3.1. Influence of pre-workshop communication**

Participants tended to consider drive-assist features (such as cruise control or automated parking) as being self-driving technology. This may be because they were asked whether they had heard of various driving technologies as part of the recruitment process:

- fully driverless or self-driving;
- lane assist;
- automated parking;
- automatic emergency braking;
- adaptive cruise control;
- in-car Wi-Fi connection;
- remote control drive or remote-control parking; and
- traffic jam assistant.

#### **5.3.2. Influence of early workshop stimuli**

Early in the dialogue, there were three main points that may have framed participants' thinking.

- The dialogue was a government-led project, and exercises were designed to help people to think about other points of view, which together will have encouraged participants to think about the consequences for society and equity.
- Although a wide variety of photos were provided for the mood-board activity (featuring expressions, icons, technology, road signs and cartoons), this initial exercise and the images chosen may have framed the concept as an abstract future, rather than a more immediately

relatable possibility.

- While the posters in the discovery session were designed to be neutral and non-controversial – focussing on information giving, not influencing – the inclusion of a poster on sharing may have encouraged participants to believe that sharing would be a significant part of the transition to an automated road transport network.

Participants' views were already fairly well developed by the end of the first workshop, by which point they had put forward almost every advantage, disadvantage and question that would surface over the course of the dialogue. This may be why some participants told us they found a few activities repetitive. However, the evidence from the voting clearly shows changes in opinion between each workshop, suggesting people's thinking did continue to develop as they were exposed to more information and ideas.

### **5.3.3. Engaging with specialists and policy-makers**

Participants found engaging with specialists and policy-makers and exploring unknowns of the technology with them to be very valuable and enjoyable. Specialists (academics, industry experts and policy-makers – a full list is available in Appendix C Section 3) helped answer some of the groups' key questions, as outlined in relevant sections above. This enabled participants to let go of those concerns for a period, allowing them to delve deeper into the topic, and often leading to new questions and concerns. For example, a new concern about traffic control and technical failure developed after discussing a centralised system for controlling CAVs.

Some participants were concerned that some questions remained unanswered, or that there was no way to check if the answers were accurate. However, others accepted this as natural for emerging technology and overall participants found specialists' general experience in the sector to be reassuring, even if their job was not specific to the questions, or if they were not able to give detailed answers.

*“The one chap there who's one of the experts ... and his job is to look at flows of traffic and stuff. I wouldn't have even known that job existed! It was really interesting.” (Leeds)*

### **5.3.4. Later workshop activities and stimuli**

Some time was set aside in workshops two and three for participants to specifically consider what mitigation measures could be put in place to ease their concerns. They were not given options for solutions, but were prompted to develop their own solutions. Groups initially struggled to form the guiding principles (outlined in Section 4.2 and Appendix E), this may have been because:

- they did not feel confident in their knowledge to create solutions;



- they were not willing to 'solve' their concerns through principles, as they wanted to be sure that government and/or manufacturers acknowledge and address them; or
- different concerns were interrelated, which made it challenging to know which part of the concern to address.

When framed as 'messages you would like the government to hear', given a set of words and phrases to start sentences (for example, 'prioritise' or 'ensure that') and supported and validated by facilitators, they were increasingly able to form such principles. However, in framing it as messages for government, even when prompted to think about manufacturers and users, this may have influenced groups to focus on what they expected of government. Many of the guiding principles (refer to Section 4 and Appendix E for more on the guiding principles) related to the views that participants started with, which may have been a result of providing them with materials to reflect on the discussions from the previous workshops.

For insight into the influence of the experiences refer to the Spotlight: Influence of experiencing (page 69) and for the influence of scenarios, refer to the Spotlight: Possible future scenarios (page 45).

### **Spotlight: Influence of experiencing the technology**

In a first for Sciencewise dialogues, participants in three of the five locations had direct experience of automated vehicle technologies as part of the dialogue, rather than hearing about it from specialists and in stimulus materials.

- **Leeds, self-driving simulator:** Due to the length of the simulation and its limited capacity, nine out of 31 participants had an experience. The simulation programme allowed them to hand over control to the vehicle and take back control.
- **Millbrook, highly-automated car:** All participants, (except one who chose not to) had a test drive, seated in the back of the vehicle. They were driven by a safety driver to the test track, control was given to the vehicle.
- **Milton Keynes, self-driving pod:** All participants experienced a journey on an off-road test track. Two or three participants were in a pod at a time.

Although the experiences did not significantly change participants' views on the key themes emerging in the dialogue, it seemed to make them feel more valued, and give them more confidence to share their views and form Guiding Principles.

The experiences helped participants understand how the technology worked and prompted them to visualise future transport – imagining how, where and when CAVs might be used. The different types of experiences prompted different ways of thinking, with a trade-off between being able



to imagine the scope of use and being able to form clear views on the technology.

The simulator (Leeds) was not bound by current limitations of CAV technology and so expanded participants' ideas as to what might be possible. But given its conceptual nature, it was further detached from participants' personal perspectives, it had the least clear take-away messages and made the transition feel a more distant prospect.

Tangible experiences like the self-driving pods and highly-automated car, enabled participants to consider basic practicalities of using the vehicles (such as where to put the shopping or a pram). However, these experiences limited participants' views on the scope of use for CAV technology. Participants could see how pods might be suitable for park-and-rides, airport shuttles, or similar short journeys, but as they found the pods to be slow, they struggled to imagine uses beyond that. Participants who experienced the highly-automated car struggled to imagine how such automation would be used, as the driver needed to be ready to take back control at any time.

The tangible experiences had mixed influences on participants' perceptions on when CAVs may be rolled-out. The self-driving pods made the transition feel much more imminent, but with a different future to what participants had been imagining. While the highly-automated car aligned with the future participants had been imagining, it made the transition seem longer away because the technology seemed to still have a long way to go before being fully automated.

Participants quickly felt comfortable in the experiences, but pointed out that this was after two workshops and that it was difficult to imagine an average member of the public feeling comfortable without prior exposure to CAVs. The fact the technology is still in early phases of development meant the demonstrations did not make the introduction of fully automated CAVs feel more imminent or 'real'. However, it did give people an opportunity to explore some of the more practical aspects of the technology and as such was valuable for the dialogue process.

Discussion with specialists reassured participants that some concerns were already being addressed. This enabled participants to go deeper into the topic, returning to their concerns when forming guiding principles.

Providing policy options for participants to respond to, rather than asking them to generate their own ideas to mitigate their concerns, could have encouraged participants to focus on solutions rather than problems. To support participants to design solutions, it would also have been helpful to identify underlying causes of concern for them to respond to.



#### **5.4. How participants shared their views**

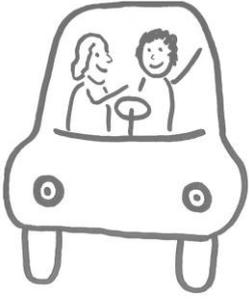
Participants absorbed information quickly and found it easy to shape their views, quickly moving on to asking questions and voicing their concerns, as they were interested in the topic. For example, they quickly formed an understanding that automated vehicles would need connectivity to operate effectively and then progressed to questioning how the road transport network would transition to accommodate that.

Dialogues are designed to help people think from a citizen perspective alongside their personal perspective, but in this dialogue, participants needed less support than usual to think from a citizen perspective. Unless prompted, participants tended to not put themselves in the future or consider the personal practicalities of using CAVs, because the roll-out seemed unlikely to occur in their area or lifetime (particularly with older participants). Their discussions and views therefore tended not to be grounded in personal impacts, but rather from a broader, societal or conceptual perspective. Views on personal practicalities had to be prompted through scenarios and experiences.

As noted in Section 1.3.4, there was an interesting contradiction at times between the quantitative and qualitative data from the dialogue, as participants held more positive views in quantitative, closed-question activities and more negative or concerned views in qualitative, open-question activities. They also spent more time talking about issues that were less tangible and had greater uncertainty. Positive views overall should not be taken to mean that participants' concerns would not influence their willingness to use CAVs, nor that concerns discussed in less depth were not still important or urgent. Participants were not confident that some of their concerns would be addressed, so they remained wedded to them throughout the dialogue.

There is a low barrier of entry into discussions on CAVs, but participants need prompting to connect the topic with their personal lives. Participants focus more on issues they are uncertain or concerned about, not necessarily those most important to them.

For balanced insights into people's opinions on CAVs, use both closed- and open-questions, and communicate information focussed on the aspects of who they are, making it relevant and immediate.



### Sharing: Making sense of sharing in the dialogue

Sharing was not a topic that came up naturally, therefore participants generally needed prompting to discuss it. They found it challenging to imagine sharing ownership of a vehicle with a few other people, so tended to focus on shared occupancy, or to not differentiate. The sharing activity focussed more on different models of shared occupancy than different models of shared ownership to enable participants to relate to the topic more easily. In trying to visualise what shared occupancy and ownership might be like, participants more easily connected with services like UberPool (an Uber service where you can share a ride with other passengers going in the same direction for a reduced cost) or Zipcar (a car sharing club) respectively.

In the scenarios activity, private-use shared services and the people who use them were referred to as 'solos' and shared-occupancy services were referred to as 'poddies'. We expected that these would be an easier way of differentiating shared-ownership and shared-occupancy, that participants may incorporate into their language. While they found these terms more personable, they did not tend to use them when talking naturally about sharing. The terms did however separate these services from other experiences or concepts of sharing, such as public transport.

In using the terms 'poddy' and 'solo' participants were able to explore connections between identity and sharing. This prompted discussions about how different types of shared services, being closely linked to cost, could be socially divisive.



## 6. Conclusions

Overall, the majority of participants were generally positive about the possible impact of CAVs on themselves and on society although they thought that it would be a long time before the technology becomes commonplace.

The introduction of such technology raised a range of questions and concerns and they were sceptical that the potential benefits would be realised. The dialogue showed that there was no single thing that would help relieve concerns. As more of the participants' questions were answered, they were able to delve deeper into the topic and raise new questions and concerns.

Our analysis identified six key conditions which government and other stakeholders should consider when overseeing the introduction of CAV technology.

### 1. CAVs must be proven to be safe and secure

Safety and security were the primary concerns and influenced whether participants thought they would ever use CAVs themselves. Safety was a multi-faceted issue, incorporating reliability, road safety and personal safety. Data and systems security were also significant causes for concern. Most participants felt it would be more important to understand new risks presented by CAV technology, than to focus on whether the transport system would be more or less safe than currently.

### 2. Benefits must be accessible to all

Participants were not clear how much CAVs would cost or whether they would be accessible for people with mobility needs or other disabilities. They insisted that automated vehicles should not be allowed to reinforce current inequalities. Consequently, there was a strong demand for government to ensure the introduction of CAVs would be equitable and would take into account the need of minority groups.

### 3. CAVs must be good for society and good for jobs.

Participants thought that the changes associated with CAV technology would be substantial. They were particularly motivated by benefits to society and employment, and less so by potential environmental or economic benefits. They anticipated significant costs associated with any needed infrastructure upgrades, however this did not have a strong influence on views. Participants generally concluded that vehicle companies should contribute to implementation costs, as they believed that car companies would benefit significantly from the introduction of CAVs.

### 4. People must remain in control of their transport choices.

Participants recognised a tension between their desire to maximise the benefits of CAVs and their desire to ensure nobody would be forced to change to a CAV before they were ready. There was a sense that once



CAVs were the dominant form of transport, more of their benefits could be realised. However, a fast pace of change and a world where people could not choose to drive themselves was worrying to some people.

The majority agreed that personal choice should be maintained, but without compromising safety. The implication was that the introduction of CAVs would be dependent on being able to prove they are safe in mixed technology contexts. A related source of tension which was not resolved was whether the user should be able to take control: for some this was a vital safety measure, while others believed it would make the vehicles less safe.

It would be important for future travel to be at least as convenient and flexible as current options to convince people to change. Participants were reluctant to cede control over journey planning as they did not trust CAVs to choose the best, most reliable, or preferred routes. In addition, many participants associated vehicle ownership with personal freedom, and feared that shared CAVs would be much less convenient.

#### **5. There must be clear guidance on accountability.**

Participants had a lot of questions about accountability, particularly in the event of an accident. Many of their concerns were allayed in discussion with academics, industry experts and policy-makers but this information would need to be communicated widely for people to understand the significant changes that would occur. Helpful information shared with participants related to existing legislation, progress in insurance and liability research, the potential for insurance and premiums to improve, and fault being established using vehicle data. Participants concluded that different parties each have their own responsibilities – manufacturers must make sure the technology and software is safe, owners must keep the vehicles maintained and updated, and government is responsible for overseeing the successful and safe introduction of the technology.

#### **6. New bodies for oversight should be created.**

Participants were not confident in government's ability to manage trials and the roll-out of CAVs to ensure prioritisation of safety over market pressures to get products on the road. A new oversight body with powers to ensure concerns were taken into account would assuage some of these concerns.

#### **Communicating change**

Enabling participants to experience examples of developing CAV technology helped them to think about the practicalities of the design, leading to questions such as 'What will it be like to share with strangers?' or 'Where will I store my shopping?'. However, it gave them a sense that CAV technology will take longer to develop than they had initially assumed and led to more questions about rolling-out the technology. This suggests that wider exposure to the technology will not automatically assuage people's concerns, and for many people time will need to pass for them to be assured the technology is safe and secure.



Participants appreciated the opportunity to talk about a big social change and influence decision-making. When talking about CAVs, terms like 'driverless vehicle' or 'self-driving vehicle' rather than 'autonomous' or 'automated' would make discussions more accessible. Similarly, making comparisons to other transitions in technology that people may be familiar with could help them connect with the topic more easily.

**In summary**, participants were cautiously optimistic about CAV technology. They felt it has the potential to achieve real benefits for individuals and society, but were concerned this opportunity could be missed if development were driven by market forces alone. Consequently, they saw a significant role for government in ensuring these benefits would be achieved for all.

**TRAVERSE**

