Driverless Futures?

A survey of expert attitudes

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Executive Summary

1. Introduction

In December 2021 and January 2022 we invited a range of stakeholders in the development of self-driving vehicles to respond online to a shortened version of public surveys we fielded in the UK (October-November 2021) and US (February-March 2022). We report here on results from 80 of these stakeholder respondents: 74% of these have various roles in the development of self-driving cars, while the remainder described themselves as interested observers We refer, loosely, to the respondents as 'experts' in this report, given their professional profiles and the low self-reported levels of knowledge and engagement reported by most of our public survey respondents. Full details of the participants and approach to sampling are provided in the main report.

The purpose of the survey was to draw comparisons between views of the public and those involved or professionally interested in the development of self-driving cars. With a convenience[1] sample of 80 we must caution against over-interpretation, but the commentary below is informed by a set of 50 qualitative interviews with a range of experts (conducted from 2019 to 2021, see Tennant & Stilgoe, 2021 for details) that preceded and informed the design of the survey. We suggest that the contrasts between public and 'expert' views revealed can helpfully inform efforts towards responsible innovation for SDVs. The reports on the public surveys provide greater detail on the survey questions and the methodology[2].

2. General enthusiasm for self-driving vehicle technology

As would be expected, our expert respondents tend to express high levels of enthusiasm for self-driving vehicle technology, across a range of measures, as well as high levels of enthusiasm for technology in general (a concept we call 'technological optimism'). Almost 90% of our expert respondents are male, and the average levels of enthusiasm in the whole sample are similar to those of the 10% most technologically optimistic US and UK male public survey respondents.

3. Confidence in the technology

Where there are differences between expert and public views, these often suggest greater confidence from experts in the technology. There is a greater readiness among expert respondents to cede control of driving to a self-driving vehicle and to enjoy the benefits of not having to concentrate on driving. But this also means that the experts tend to have greater concern over the potential problems associated with transferring control from the self-driving vehicle to a human driver while travelling.

While majorities of the UK and US public respondents agree that not having human common sense will prove a handicap to self-driving vehicles, only 31% of the experts think this. 66% of both the UK and US respondents reject the proposal that *"If SDVs are able to react more quickly than human drivers, they should be allowed to drive much closer to other vehicles"* but only 37% of the experts do.

[1] The convenience sample comprised stakeholders known to us and some respondents sourced through specialist online forums; we would not claim that it is fully representative of all professionals involved in the development of self-driving vehicles. Full details are given in Section 1 of the report.
[2] These reports can be accessed at driverless-futures.com

A large majority (74%) of our expert respondents reject the idea that *"Human-driven vehicles and SDVs should not share the same stretch of road"*, whereas only 30% of UK and 36% of US public respondents do. Only a minority of experts (36%) think *"SDVs should stick to the formal rules of the road in all situations"*, while 80% of the UK and 67% of the US publics do, and 57% of experts think *"SDVs should be allowed to break the formal rules of the road in some situations"*, but minorities (UK 17%; US 28%) of public respondents agree. When asked about required safety standards for self-driving vehicles, whereas public respondents are most likely to say that they must be safer than the safest human driver, experts tend to choose a lower safety threshold.

4. Views on labelling

One possible constraint on self-driving vehicles would be clear identification. Large majorities of public respondents (UK 86%; US 78%) agree that *"It must be clear to other road users if a vehicle is driving itself"* but only 46% of experts agree with this. Another form of identification would be if self-driving vehicles behave differently: although experts tend to agree that self-driving vehicles should drive more cautiously that human drivers, their rate of agreement here is lower than the public's, perhaps because experts are more worried that pedestrians will take advantage of cautious self-driving vehicles.

5. Who has a say over the introduction of self-driving vehicles?

The experts appear averse to requiring anything from the public to facilitate the technology. Expert opinion is more strongly against the idea that pedestrians should have to adapt to self-driving vehicles (76% against) than the public (UK 56%, US 43%). In the UK (76%) and US (70%) public surveys there is majority agreement that *"SDVs should only be introduced if they have support from a clear majority of the public"*. For the technological experts, 69% disagree with this suggestion, with only 12% agreeing. But the experts are more committed to external regulation, most obviously with 77% rejecting the idea that *"SDVs should be regulated by the technology companies that understand them"* compared to 30% of UK public and 25% of US public respondents.

6. Diversity in expert views

It is noticeable that on some detailed issues there is considerable variation in the expert views. Although it might be expected that the diverse roles our individual experts play would provide divergent perspectives, there are only occasional substantial differences between the views of those involved directly in technology development and the rest (these are noted where relevant in the main report). Instead, the diversity in views seems more likely to reflect the early stage status of the technology - there is much still to be worked out. For example, on the following five issues, we found between 35% and 45% of experts on each side of the argument:

- Agreement or disagreement with the statement *"If SDVs are able to react more quickly than human drivers, they should be allowed to drive much closer to other vehicles"*
- Agreement or disagreement with the statement *"We should standardise the driving environment internationally, to make it easier for SDVs to work everywhere"*
- Agreement or disagreement with the statement *"SDVs should stick to the formal rules of the road in all situations"*

- Preference for one of two statements: *"SDVs would be able to cope well with the variety of behaviour from pedestrians crossing the road"* versus *"SDVs would struggle to cope with the variety of behaviour from pedestrians crossing the road"*
- Preference for one of two statements: *"Pedestrians would want to communicate with the SDV just as they communicate with human drivers"* versus *"Pedestrians would get used to SDVs and not mind if they could not communicate with them"*

These issues are not straightforward. The proposals in the first three statements entail both risks and benefits; the two pairs of statements ask for predictions about pedestrian-SDV interactions, which are difficult to make, even in the context of research in controlled settings and simulations.

7. Priorities for transport policy

Experts' views on the road of today and their priorities for transport policy are consistent with believing in self-driving vehicles as a key component in solving current problems. Asked to name their top two policy priorities out of six options, 61% named *"Reducing the number of people killed and seriously injured on the roads"* (compared to 33% of the UK public respondents, US 40%) and 57% chose *"Reducing the pollution and environmental cost of transportation"* (UK public 47%, US 26%). These preferences mirror the self-driving vehicle developers' focus on improved safety and reduced pollution as two of their key objectives. Whereas 77% of UK and 69% of US public respondents agree that *"We have to accept that there will always be some road casualties"* only 46% of our experts share this view.

Public priorities for transport policy vary between the US and UK. The top priority in the US is reducing congestion (4th in UK), but in the UK it is reducing environmental costs (5th in US). But affordability and accessibility both feature more prominently in the US and UK public priorities than for the experts.

8. Conclusion

We repeat the caveat on our findings by noting that these results come from a relatively small convenience sample. The comments below draw together insights from the expert interviews we have carried out, this survey, and the surveys of UK and US public respondents.

Most of our expert survey respondents report high levels of enthusiasm for the technology, as we would expect, and most of our expert interviewees see the technology as intrinsically desirable. In interviews, many experts argue for light touch regulation, and some also express impatience with the pace of regulatory developments. Both in interviews and in the survey, experts tend to downplay concerns about humans and self-driving vehicles mixing in shared space and about the importance of transparency and explainability. This creates a potential conflict with members of the public for whom these concerns are central, and for whom knowing what they are dealing with when interacting with self-driving vehicles on the road is essential. The concerns, uncertainties and diversity of opinions revealed in our public surveys reflect some of the uncertainties around the technology that the experts themselves are currently grappling with, some of which will not be resolved easily in the short term. Indeed, on a number of detailed issues the expert survey respondents showed a wide variety of responses, with similar numbers both for and against various approaches. Companies developing the technology often suggest that public discomfort with self-driving vehicles and problems of public trust will be resolved simply with greater awareness or information about them. Our surveys suggest this won't be the case, and that the issues are more complicated.

In comparison with our public survey respondents, the experts express greater rates of confidence that self-driving vehicles can blend in and share the road with human road users without requiring substantial changes to the latter's behaviours. Public respondents tend to ask for higher safety standards and clear identification of self-driving vehicles, and to anticipate that adjustments will need to be made for self-driving vehicles from other road users. Just as when two drivers negotiate who passes first through a narrow space, there needs to be negotiation between human road users, and those responsible for self-driving vehicles, on how the roads and the place of self-driving vehicles on them develops. The developers' tendency to sidestep the idea of public engagement beyond information and exposure exercises falls short of a responsible innovation trajectory.

1. Who completed our 'expert' survey?

Alongside our surveys of the publics in the UK and US on their views on self-driving vehicles (SDVs), we invited developers, other stakeholders and interested observers to complete a shortened version of the survey, also on the Qualtrics platform. Respondents were invited either by direct email contact or by an invitation posted on two different Reddit chat groups. In this report we refer to our respondents as 'experts', reflecting the fact that most have had much more involvement in the technology than our public respondents[3].

Although 113 people started the survey, a number exited the survey before completing it. The survey was explicitly divided into a short survey of core questions, followed by an invitation to continue to supplementary questions. As shown below, 80 people completed the short survey and 73 people responded to all questions on self-driving vehicles, although one of these failed to complete a few of the final questions on general social and political attitudes. In addition, since some questions were only shown to those with a driver's licence, one non-driving respondent did not see those questions, and this is reflected in some of the response numbers in this report.

	Started	Short Survey	All SDV questions	Complete survey
Direct invite	74	48	42	41
Reddit forums	39	32	31	31
Total	**113**	**80**	**73**	**72**

Figure 1.1. Overview of survey respondents

The 80 respondents who answered the short survey were asked to describe their role, and were offered six different descriptions from which they could choose any that applied:

Self-descriptions (n = 80)	Yes	No
Interested Observer	35	45
Tech commercial	29	51
Tech non-commercial	11	69
Social scientist	16	64
Regulation specialist	21	29
Other	13	67
Total	**125**	**325**

Figure 1.2. Occupational self-descriptions of survey respondents

Of the 80 respondents, 37 described themselves as involved in self-driving technology development[4]; we refer to these in the rest of the report as 'technical experts', and to others as 'non-technical experts'. We also asked where respondents had spent most of their life and where they were currently

[3] Our measure of technological engagement has 62% of UK respondents scoring <=2 (on a 0 (low engagement) to 7 (high engagement) scale): a typical respondent in this group would have said they know a little about SDVs and have talked to friends and family a few times about them or searched for information about them, but not both. 46% of our US respondents scored <=2 (68% <=3).

[4] These are the 'Tech commercial' and Tech non-commercial' - some respondents described themselves as both. We refer to these in the rest of the report as 'technical experts', and to others as 'non-technical experts'.

located. The table below records where respondents (recruited by direct invitation, or via a Reddit forum) had spent most of their life:

	North America	UK/Europe	Other	Total
Direct invite	17	27	4	48
Reddit forums	21	9	2	32
Total	**38**	**36**	**6**	**80**

Figure 1.3. Geographical areas where respondents have spent most of their life

Of the 38 from North America, 36 are currently located there, and of the 36 from UK/Europe 30 are currently located there with most of the others now in North America.

Figure 1.4 below shows that the vast majority of respondents are male, with of the respondents are middle aged men.

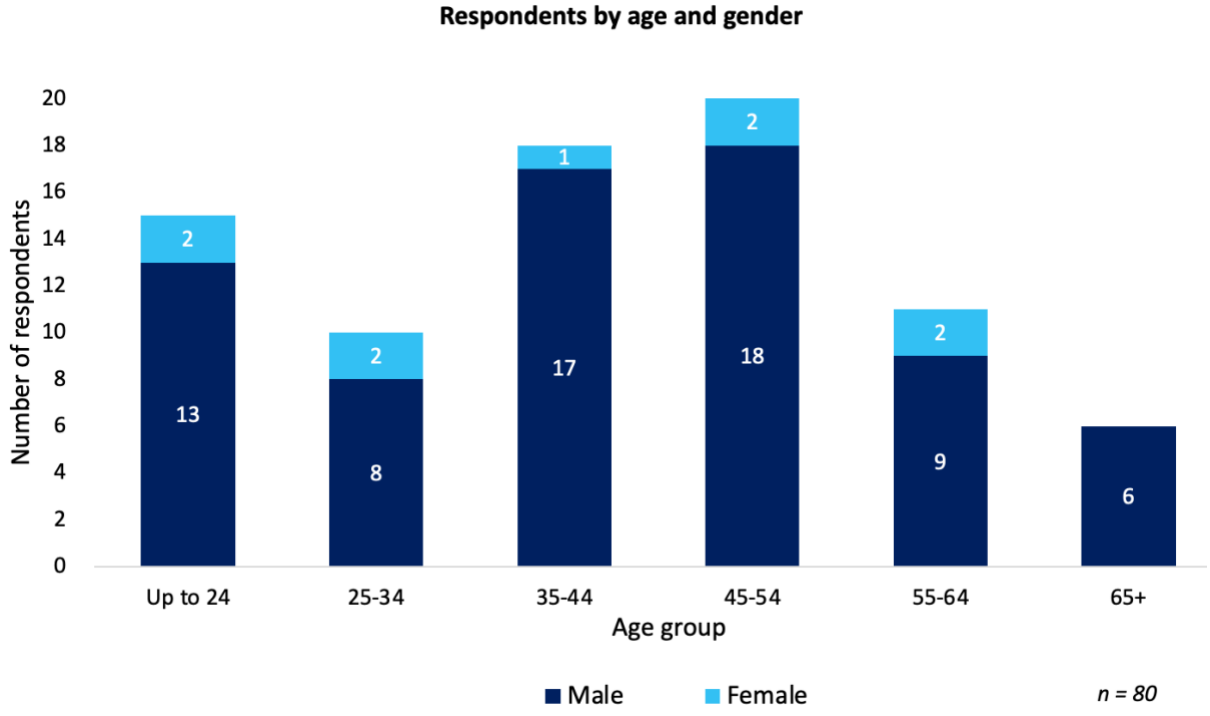

Figure 1.4. Respondent demographics: age and gender

2. Levels of technological optimism

We asked respondents five questions (reduced from the larger set of nine in our public survey) to gauge their level of overall enthusiasm about technology in general. We created an overall 'technological optimism' score by taking the mean of all five items, with scores between 1 and 5 (5 being most optimistic). The table below shows that the mean level of technological optimism from our expert sample is higher (as we would expect) than the corresponding average levels of technological optimism in our public surveys. The mean from the experts matches quite closely the mean from the 10% most technologically optimistic respondents who are also male, from the public samples:

	Technological optimism - 5 item scale		
Sample	All	Highest tech-opt (top 10%)	Highest tech-opt (top 10%) male only
Experts	3.66		
US public	2.85	3.51	3.81
UK public	2.34	3.53	3.68

Figure 2.1. Levels of technological optimism

Bearing in mind this baseline level of optimism from our largely male sample of experts, in order to facilitate informative comparisons between experts and public respondents, in some places in this report we compare the responses of experts to those highly technologically optimistic males, within those public samples.

3. Comparisons given in this report

For completeness we report all the questions we asked of the experts respondents concerning SDVs and issues about the road of today, together with the comparison figures for the public surveys in the UK and US. As noted above, because most of our sample of experts are male, and because of their generally high levels of technological optimism, for some questions we include also the comparator results from male public survey respondents with high levels of technological optimism. In addition, we provide for some questions a comparison between those experts who classed themselves as having technological or non-technological expertise in relation to SDVs, where there is a difference[5] between the 'non-technological experts' and the 'technological experts' (see above).

Taken as a whole, the spread of views of the US and UK public respondents is very similar: for any single question this might seem unremarkable, but the overall concurrence is noteworthy.

[5] We have checked mean scores wherever appropriate for 'non-tech' and 'tech' experts: where there is a difference ~>0.5 in the mean scores we have investigated these and usually reported both figures in the comparison tables.

4. Headline questions

In our main survey we have three broad questions on comfort and enthusiasm with the technology. Expert responses towards these questions are much more positive than those of our public samples towards the technology, but their attitudes are similar to those of men in the top decile of technological optimism. The table below shows the mean scores for these three questions:

SURVEY QUESTION	***Do you think this technology should be developed?***	***How would you feel about using the roads alongside self-driving vehicles?***	***How would you feel about riding in a self-driving vehicle instead of the existing ways you travel?***
RESPONSE SCALE	from *'definitely no'* (1) to *'definitely yes'* (4)	from *'totally uncomfortable'* (1) to *'totally comfortable'* (5)	from *'totally uncomfortable'* (1) to *'totally comfortable'* (5)
Ns[6]	*1,762*	*1,799*	*1,804*
US all public respondents	2.74	2.72	2.53
Ns	*4,421*	*4,642*	*4,632*
UK all public respondents	2.61	2.51	2.37
Ns	*80*	*77*	*77*
All experts	3.59	3.79	3.84

Figure 4.1. Mean scores of responses to headline questions

Asked whether the technology should be developed, 57 of our 80 experts (71%) answer definitely yes, compared to 23% of our UK respondents and 29% of our US respondents.

65% of experts are comfortable with the prospect of using the roads alongside SDVs (UK public 25%, US 29%) and 68% are comfortable with riding in an SDV (UK public 24%, US 28%).

The question of how safe SDVs need to be is more complex: it appears that, amongst our public respondents, technological optimism may be encouraging confidence in the SDV technology as capable of achieving a very high safety bar, while the public themselves demand a high safety bar.

Experts, by contrast, on average set a lower bar for safety than the mean scores from the US and UK general surveys. It may be that experts are concerned that a very high safety bar could delay deployment. Some of our expert interviewees strongly believed that even marginal safety performance gains would justify using SDV technology.

[6] N numbers vary since the *'don't know'* responses are excluded when calculating the mean score.

5. Detailed Questions

5.1. Views on how self-driving vehicles might share the road with other road users

In the core survey, we asked three questions on this topic, by asking respondents to what extent they disagreed or agreed with a statement. The statements are given in the titles of the bar charts below:

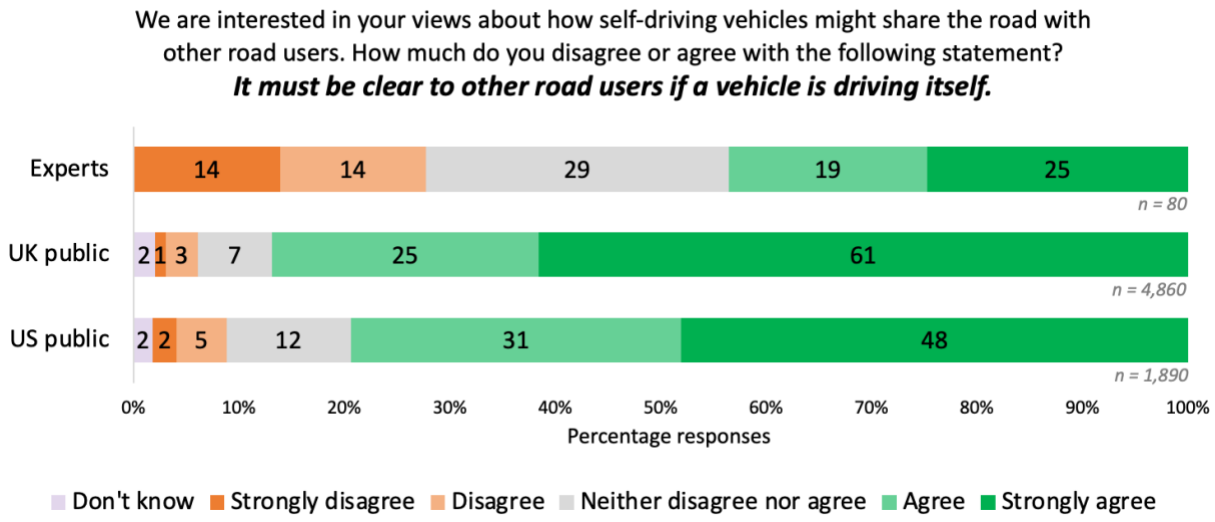

Figure 5.1. How self-driving vehicles might share the road with other road users - Question 1

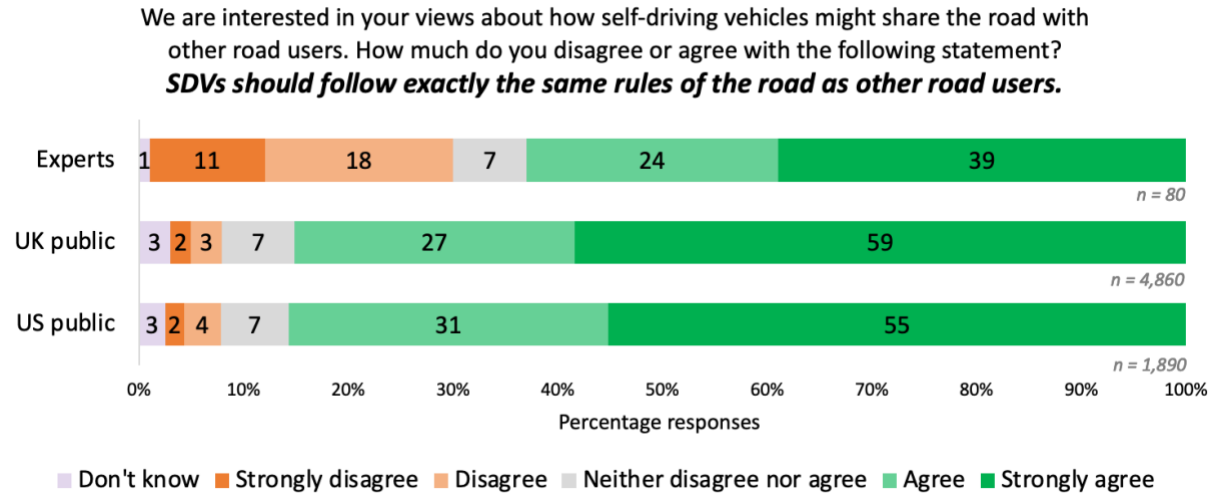

Figure 5.2.How self-driving vehicles might share the road with other road users - Question 2

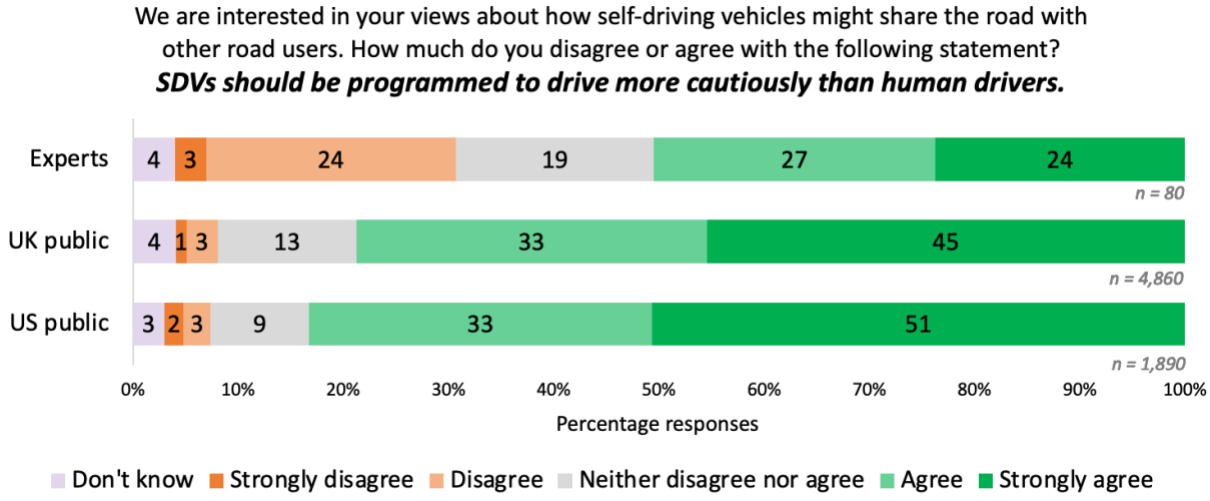

Figure 5.3. How self-driving vehicles might share the road with other road users - Question 3

The public respondents show strong majority preferences on all three of these, but expert views are much more varied. Public respondents in both the UK and US are clearly in favour of SDVs being identifiable (over 80% agreeing), but amongst the experts only 46% take that view. In Questions 2 and 3 again large majorities of the public agree with the propositions that SDVs must follow the same rules as human drivers (i.e., SDVs should behave in the same way, 86% in both UK and US) and that SDVs should be programmed to drive more cautiously (78% UK, 84% US). Though a majority of experts also agree with these propositions, they are smaller majorities (63% Question 2 and 51% Question 3). The wider variety of judgements from experts echo the diversity of thinking conveyed in our expert interviews about the ways in which SDVs deployment might or might not work.

5.2. Views on human intervention to control an SDV

The second part of the survey opened with four questions on this topic, again by asking respondents to what extent they disagreed or agreed with a statement. The statements are given in the titles of the bar charts below:

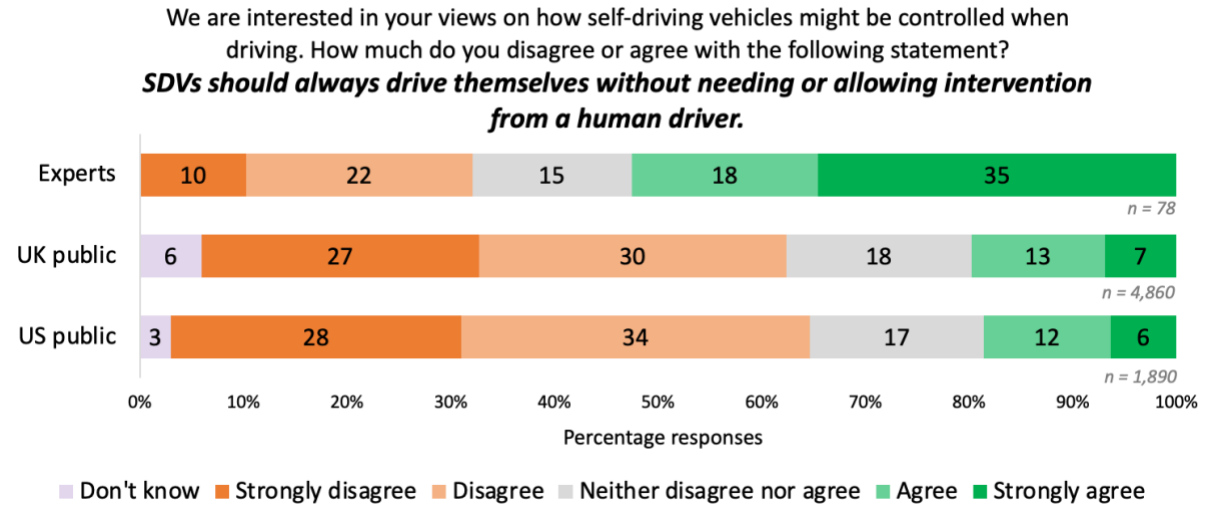

Figure 5.4. Human intervention to control SDV - Question 1

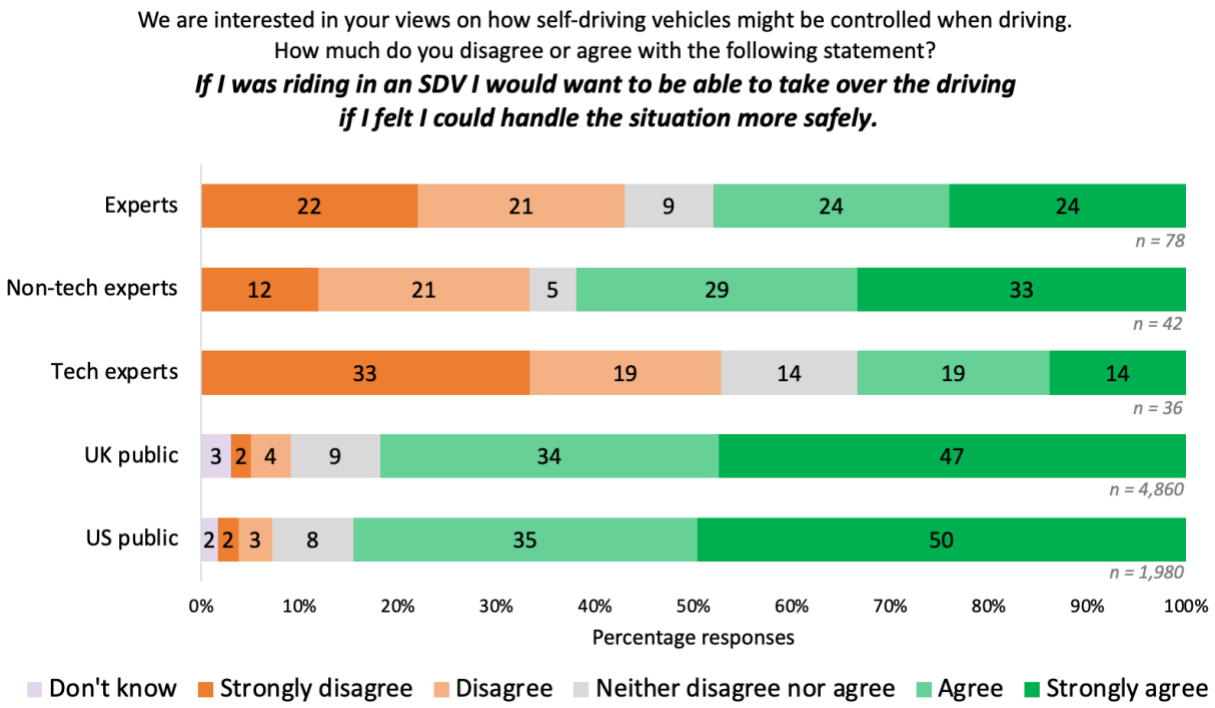

Figure 5.5. Human intervention to control SDV - Question 2

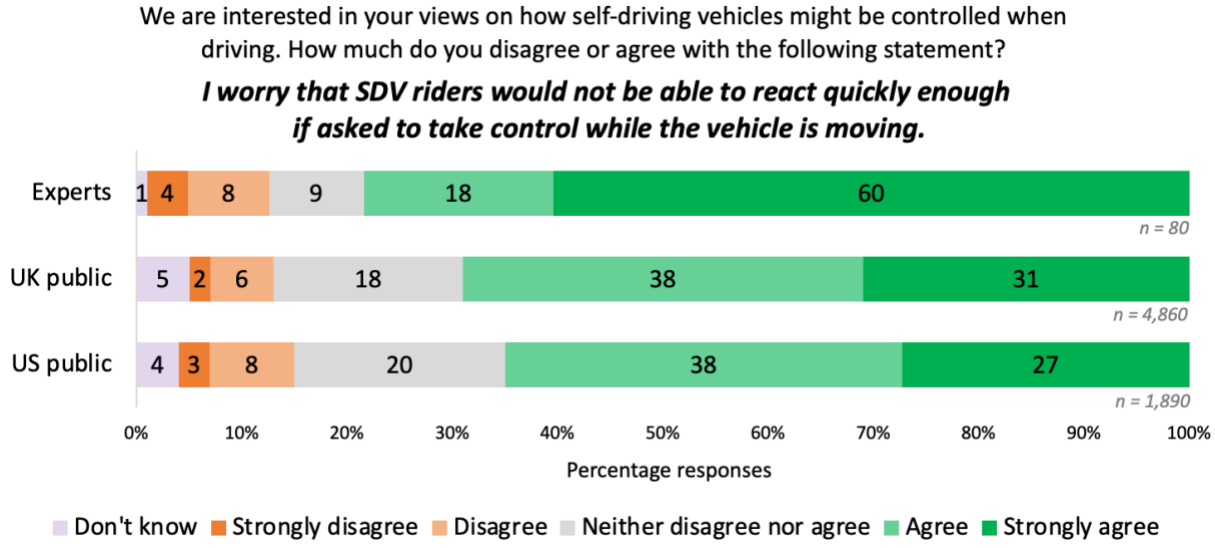

Figure 5.6. Human intervention to control SDV - Question 3

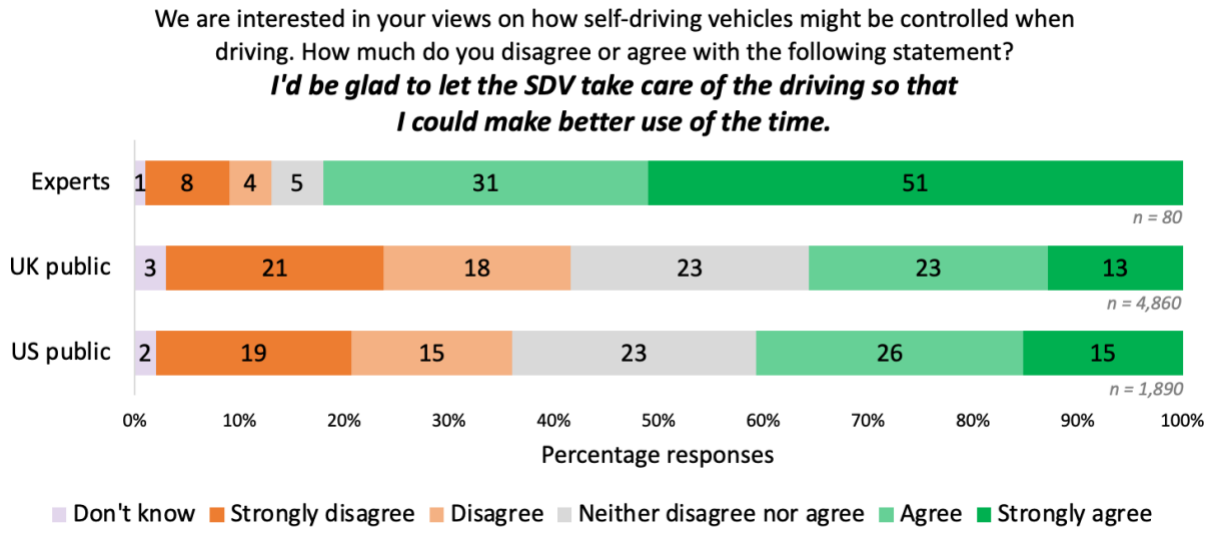

Figure 5.7. Human intervention to control SDV - Question 4

Questions 1 and 2 both address the question of human intervention in the driving of a self-driving vehicle. Our public respondents largely want humans to be able to retain some control over the vehicle[7]. In Question 2, asking particularly about human intervention for safety purposes, the majority of technological experts are sceptical (perhaps reflecting existing research on the dangers of 'Level 3' automation), while the spread of responses from non-technological experts is closer to those of the publics. By contrast, Question 4 expresses one of the foundational arguments for self-driving technology, so it would be surprising if the experts did not endorse it: but the contrast with responses from public respondents, who are by no means unanimous on taking the opportunity to do other things in the vehicle while the systems, is striking.

The well-documented dangers of human intervention while the SDV is moving (Question 3) are reflected in public responses, but there is less agreement here, and more 'neither agree nor disagree' responses, compared to the position mostly taken by the experts.

[7] This table combines the responses for drivers and non-drivers: see Section 6.2 in the UK and US reports.

5.3. View on how SDVs and other road users might interact

We posed three questions on this topic, again by asking respondents to what extent they disagreed or agreed with a statement. The statements are given in the titles of the bar charts below:

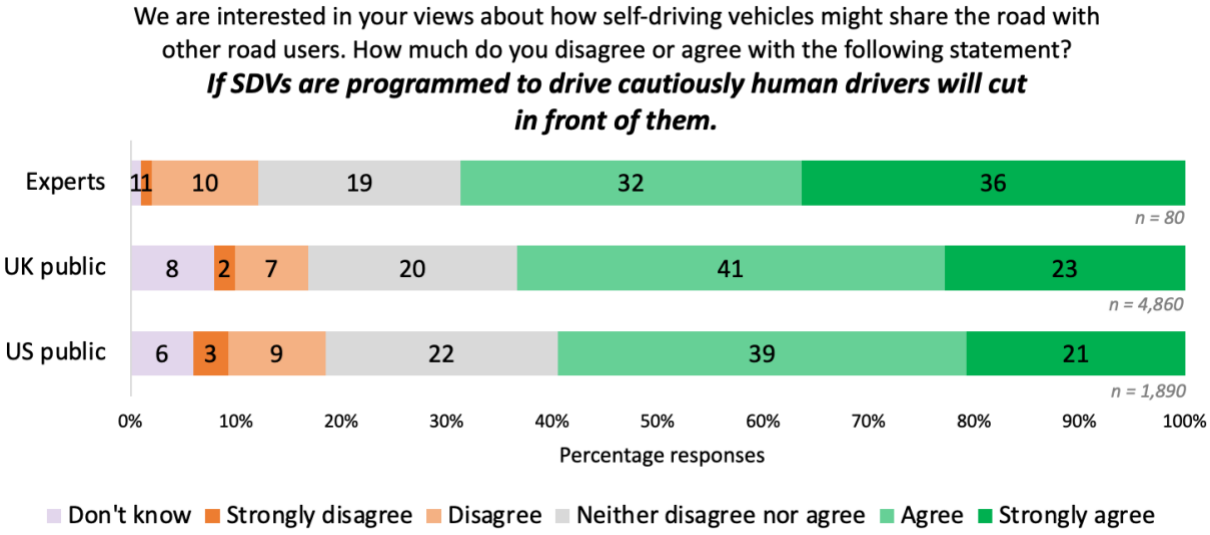

Figure 5.8. How will SDVs and other road users interact? - Question 1

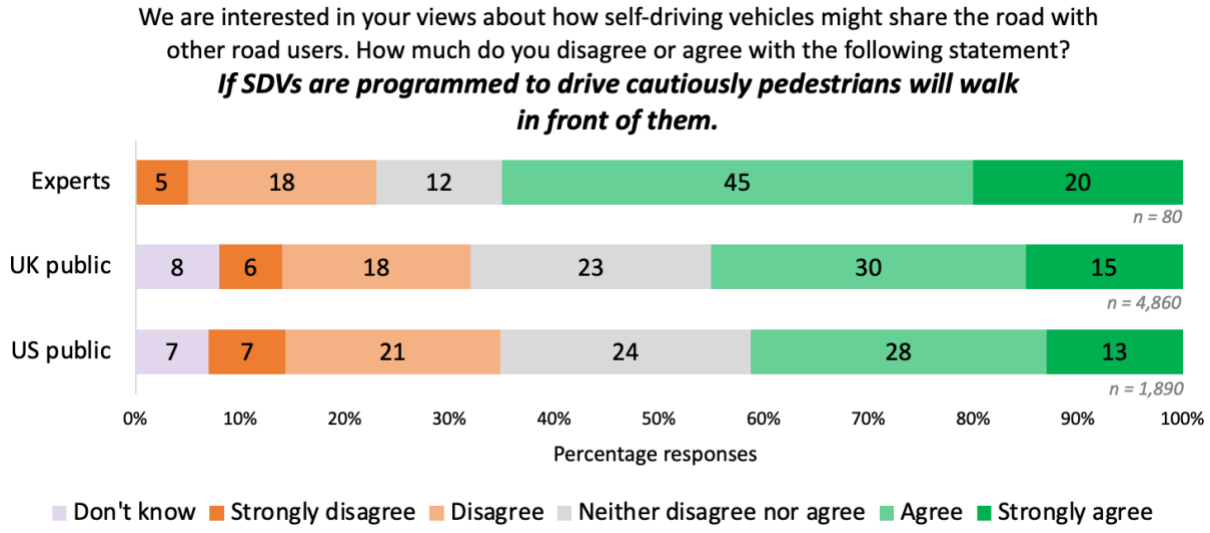

Figure 5.9. How will SDVs and other road users interact? - Question 2

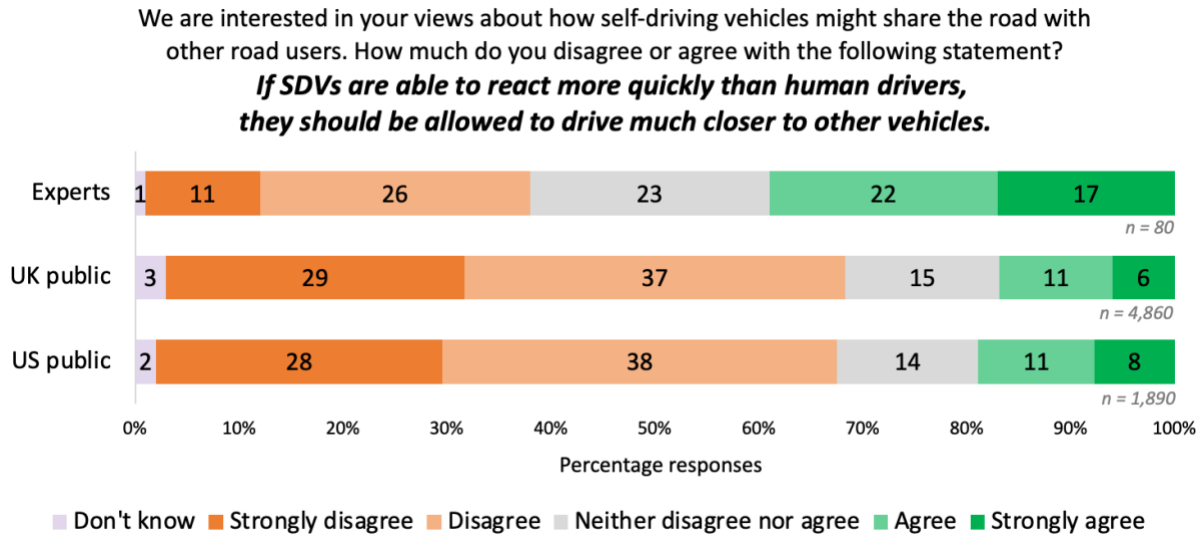

Figure 5.10. How will SDVs and other road users interact? - Question 3

Clear majorities of the experts expect other road users to cause problems for SDVs if the latter are programmed to drive cautiously (Questions 1 & 2). It is important to note that this does not necessarily translate to an argument for programming SDVs not to drive cautiously. The public respondents find it harder to predict what might happen, e.g. with notably more neither agreeing nor disagreeing, or saying they don't know, than the experts on Question 2. Responses to Question 3 repeat features seen in other questions: wide variance in the expert responses, and the public responses suggesting a greater reluctance for SDVs to behave differently from human drivers. But the greater number of experts agreeing that SDVs should be allowed to drive closer suggests greater confidence in the technology.

5.4. Views on a selection of issues regarding how should SDVs be introduced

This section comprised four questions, again posed as statements (given at the top of each bar chart below), with agree-disagree response options:

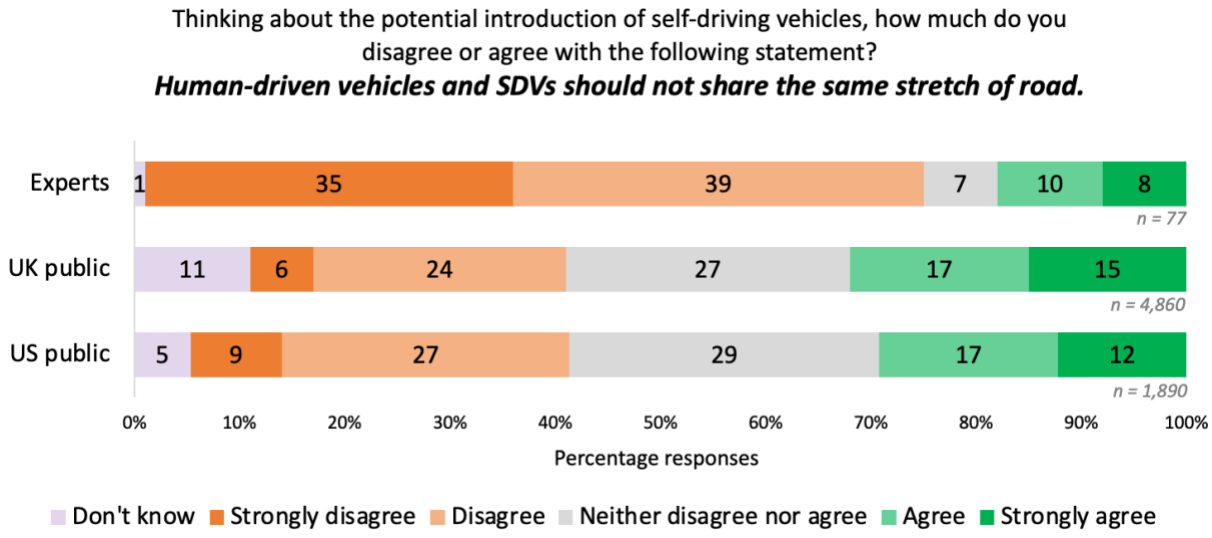

Figure 5.11. How should SDVs be introduced? - Question 1

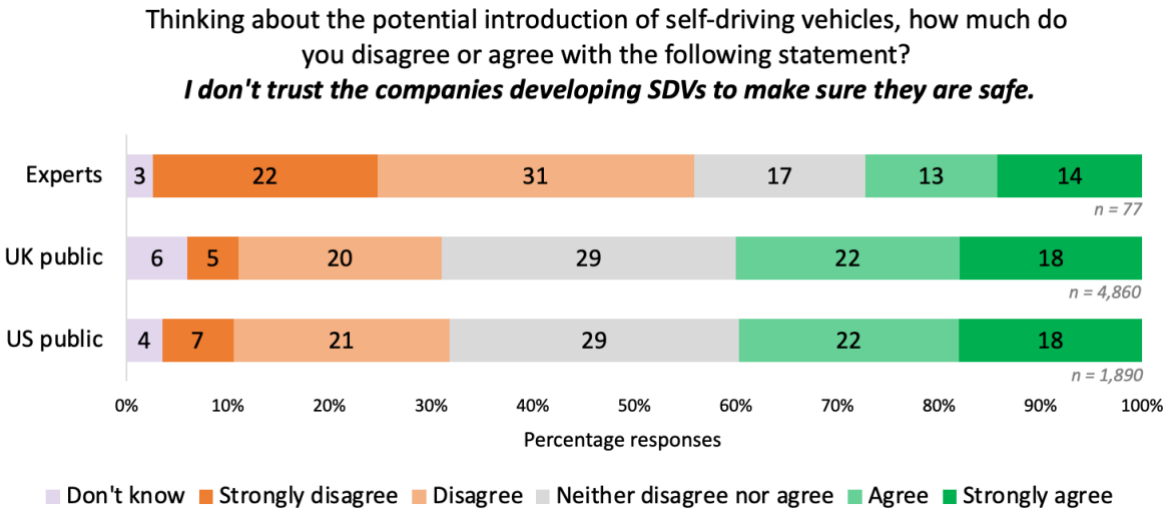

Figure 5.12. How should SDVs be introduced? - Question 2

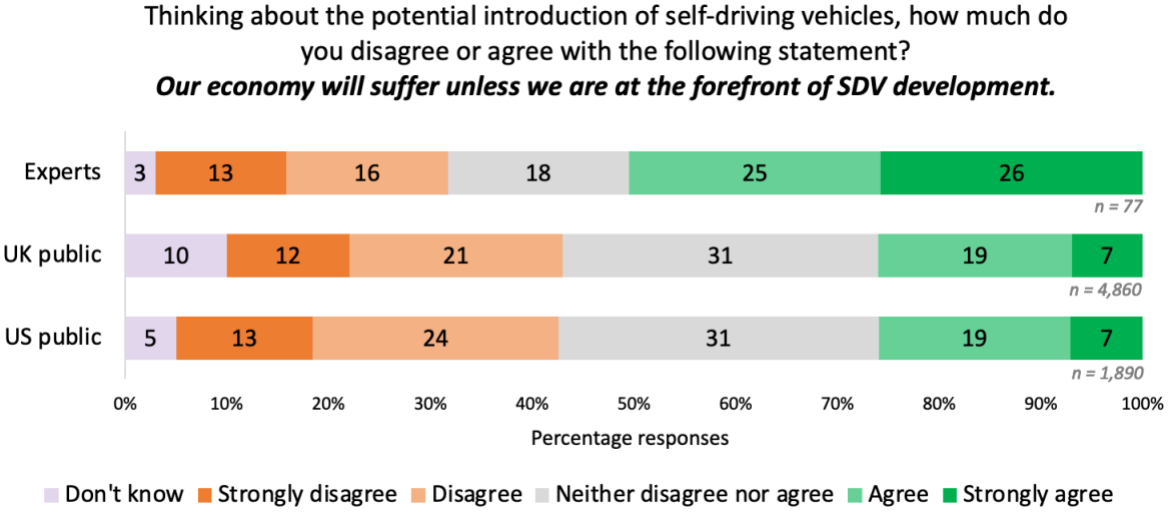

Figure 5.13. How should SDVs be introduced? - Question 3

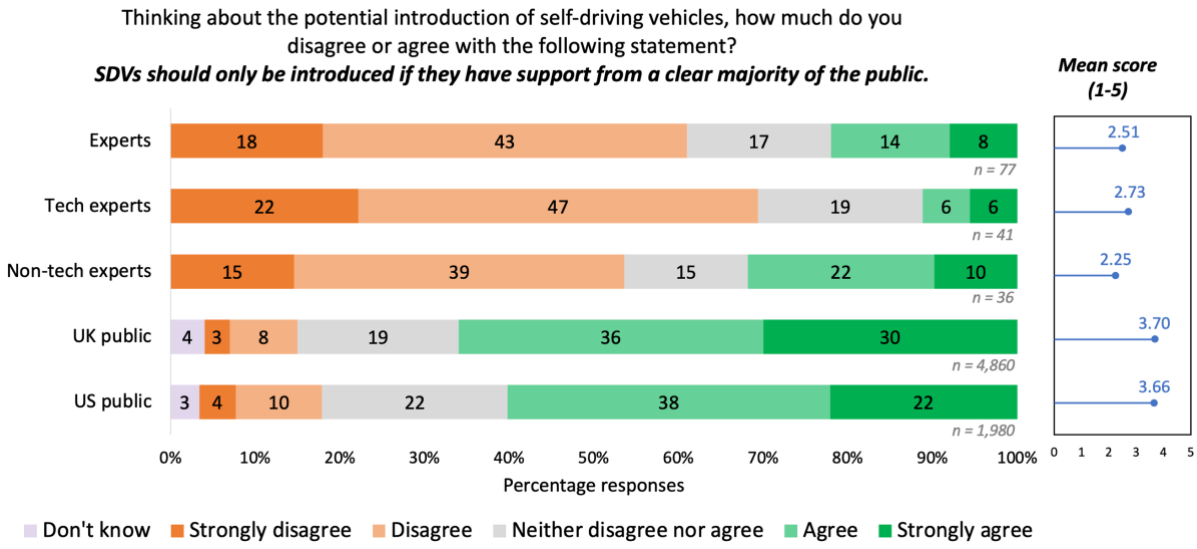

Figure 5.14. How should SDVs be introduced? - Question 4

The large majority disagreement from experts that SDVs and humans should not share the same road space (Question 1) stands in contrast to the mixture of views from the public. The bare 53% majority from experts agreeing that they trust technology companies to make sure SDVs are safe might (Question 2) seem rather lukewarm though it represents greater confidence overall compared to, again, the spread of responses from public respondents. Likewise, only 51% of experts agree with the idea of an economic imperative in developing SDV technology (Question 3) – far fewer public respondents are convinced of this argument. For all three questions, responses from the publics are more diverse, and include over a third of 'neither disagree nor agree' or ' don't know' responses.

Responses to Question 4 (*"SDVs should only be introduced if they have support from a clear majority of the public"*) are striking. In the UK (76%) and US (70%) there is majority agreement for this in the public surveys. For the technological experts 69% disagree with the suggestion with only 12% agreeing.

5.5. Views on the regulation of SDVs

For this topic, we asked respondents to indicate the extent to which they disagreed or agreed with four statements (again given in the titles to the charts below):

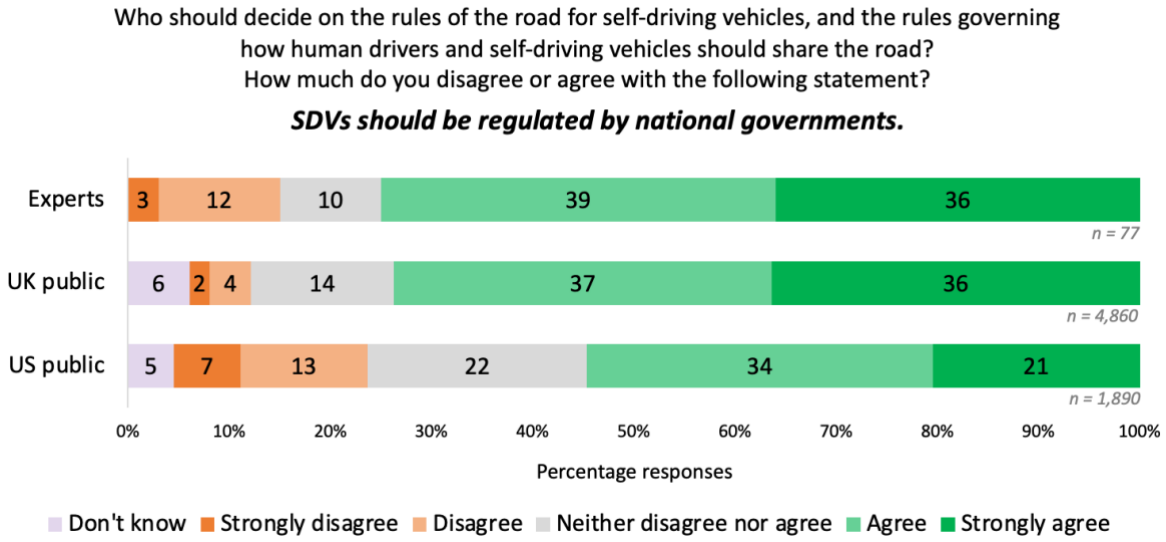

Figure 5.15. Views on regulation of SDVs - Question 1

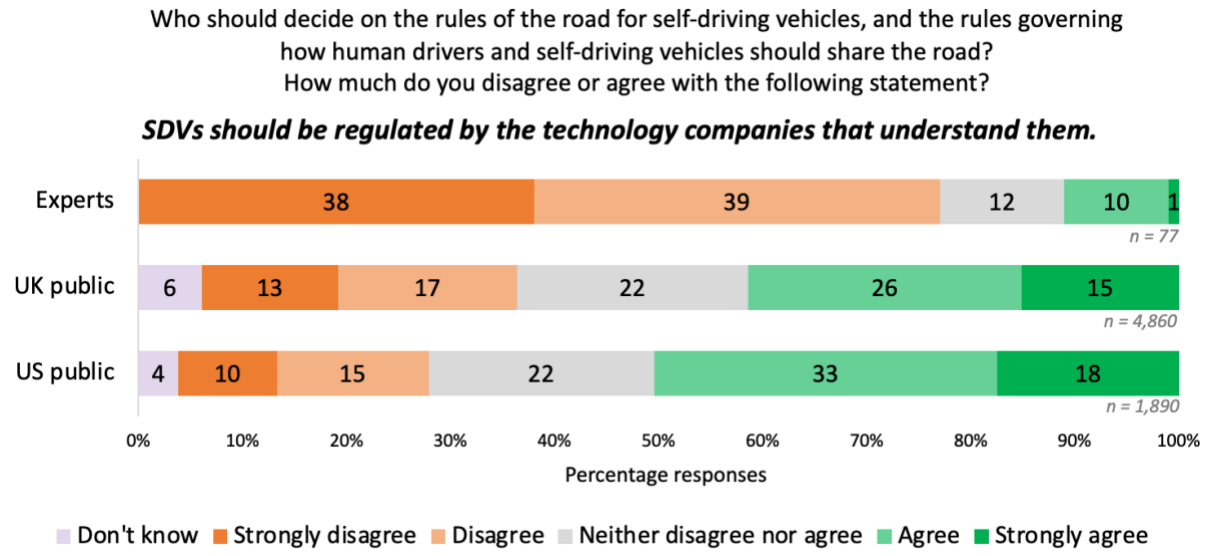

Figure 5.16. Views on regulation of SDVs - Question 2

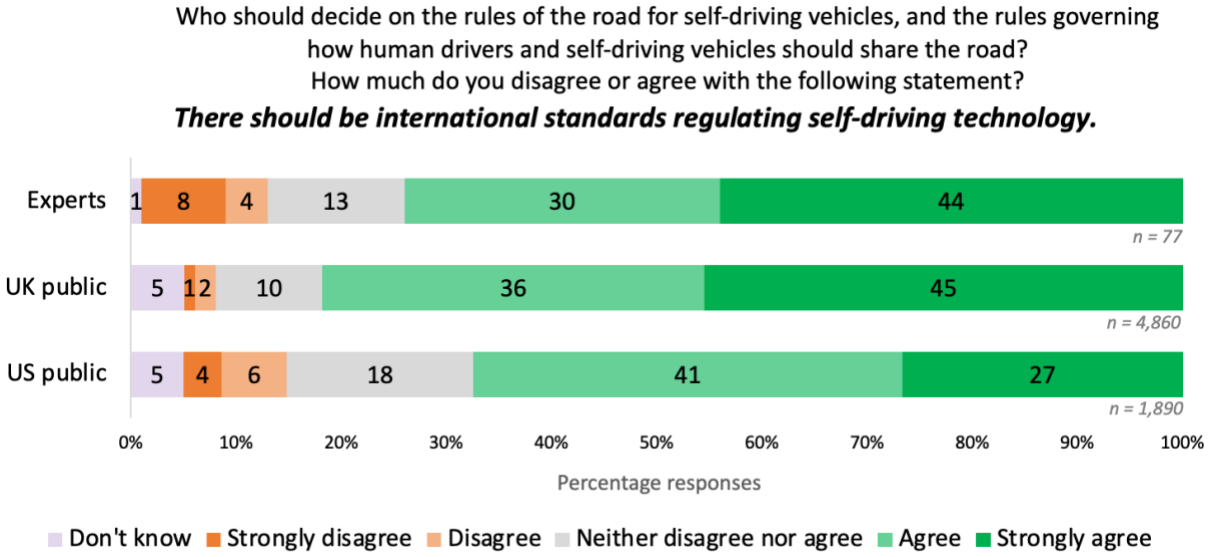

Figure 5.17. Views on regulation of SDVs - Question 3

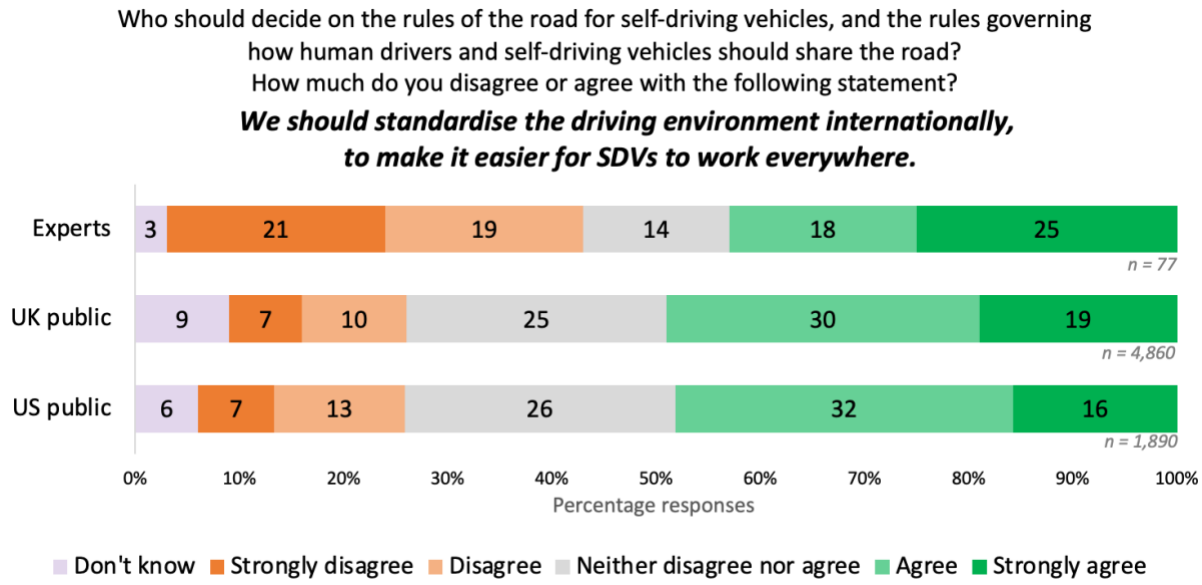

Figure 5.18. Views on regulation of SDVs - Question 4

There is general support for both national government involvement in regulation and for international standards, although this is one of the few themes on which there is a noticeable difference between the UK and US publics, with less enthusiasm for both in the US.

The expert positions on Questions 2 and 4 are worth highlighting: very few (11%) of our experts think SDV companies can be self-regulating, while 51% of the US respondents think they can be. Regarding the possibility of standardising the driving environment, there is both strong disagreement (21%) and strong agreement (25%) amongst the experts. Some of our expert interviewees were emphatic that the road environment should not be changed to assist SDVs and that the AI within SDVs should be smart enough to cope with different jurisdictions, infrastructures and driving cultures. On the other hand, to others international harmonisation may be seen as a form of modernisation. More research would be needed to understand what motivates agreement from nearly 50% of public respondents in both the UK and US on this point.

5.6. Rules of the road

Next, we asked six questions about compliance with the rules of the road (again in the format of statements, asking respondents the extent to which they disagreed or agreed with them). The equivalent questions in the public surveys were asked in the modules allocated to sub-sections of the main samples, which is the reason for the lower response numbers in the charts below:

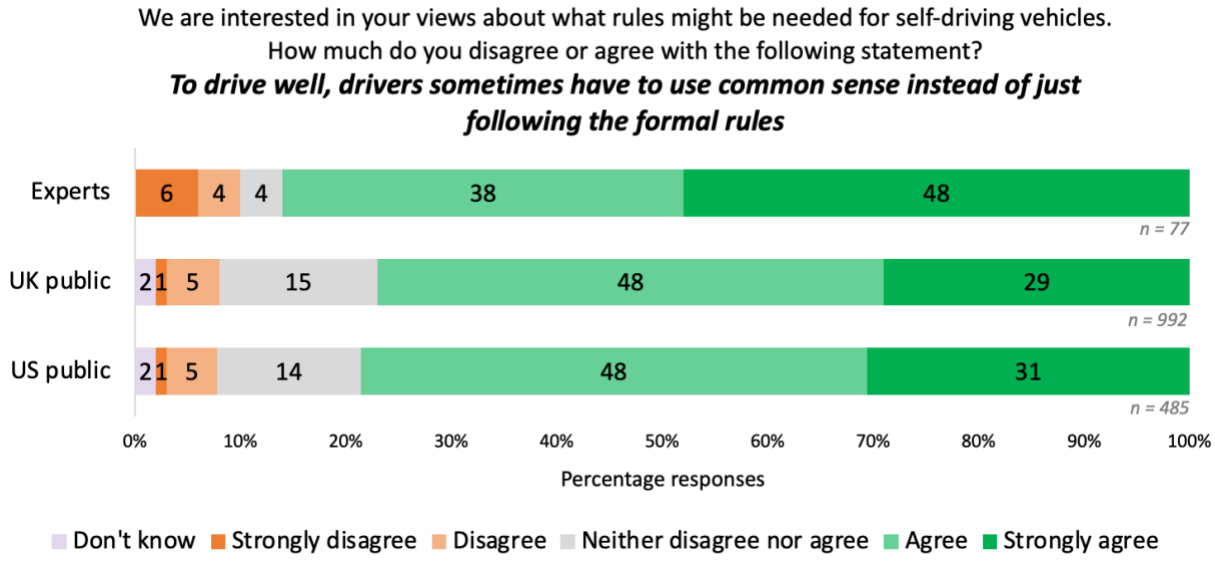

Figure 5.19. Rules of the road - Question 1

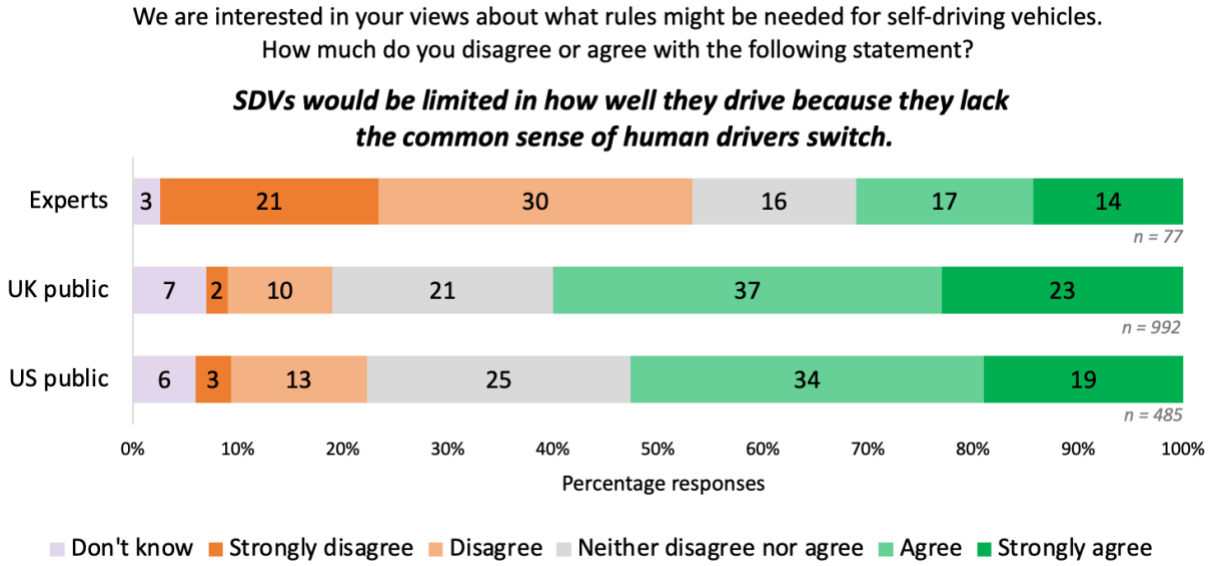

Figure 5.20. Rules of the road - Question 2

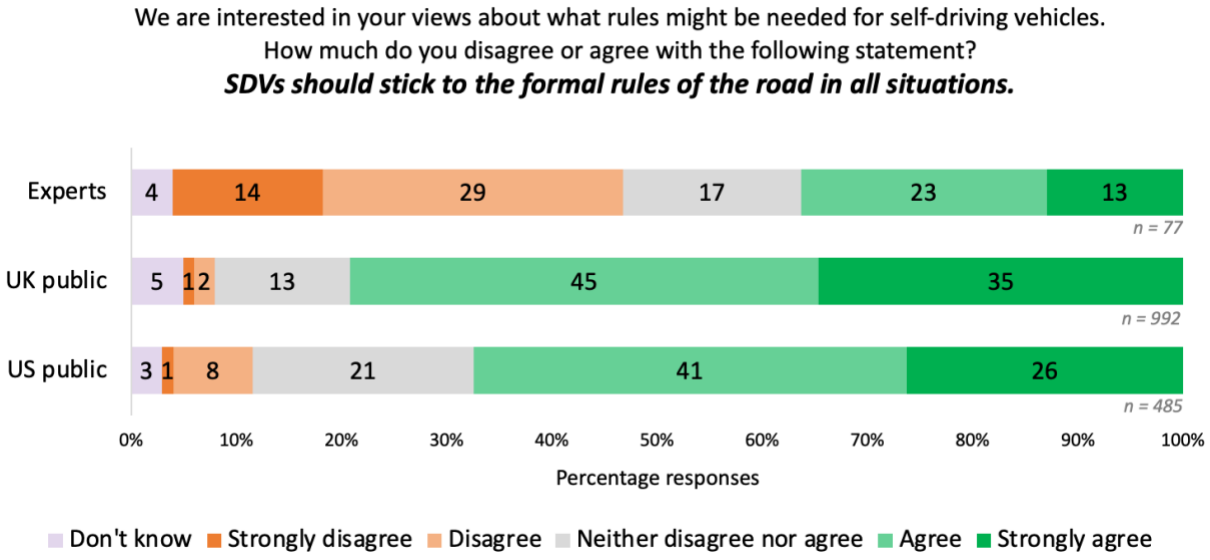

Figure 5.21. Rules of the road - Question 3

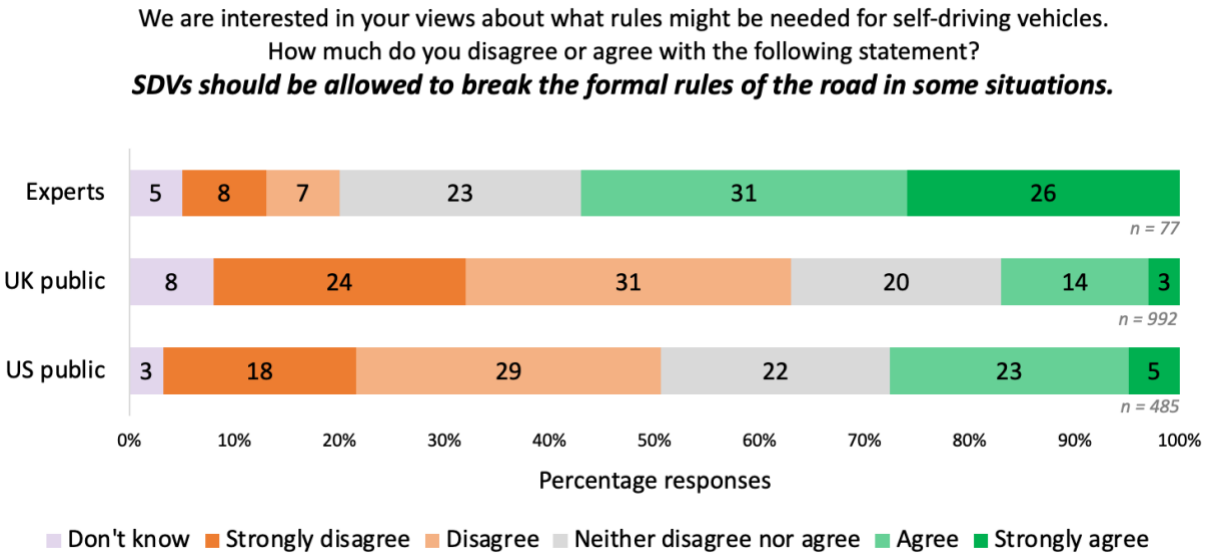

Figure 5.22. Rules of the road - Question 4

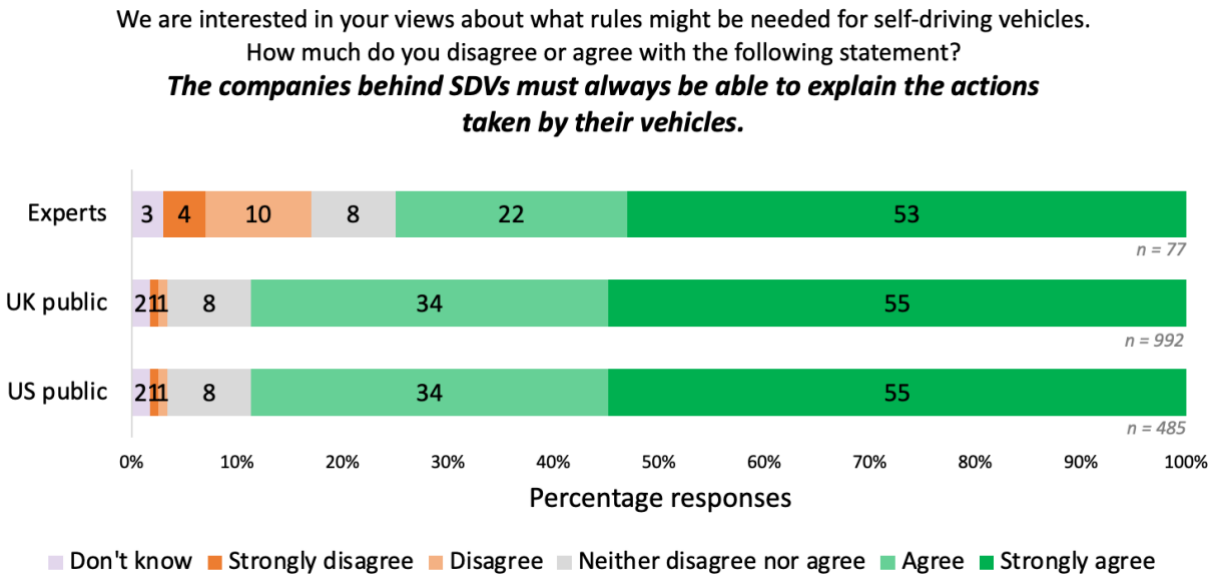

Figure 5.23. Rules of the road - Question 5

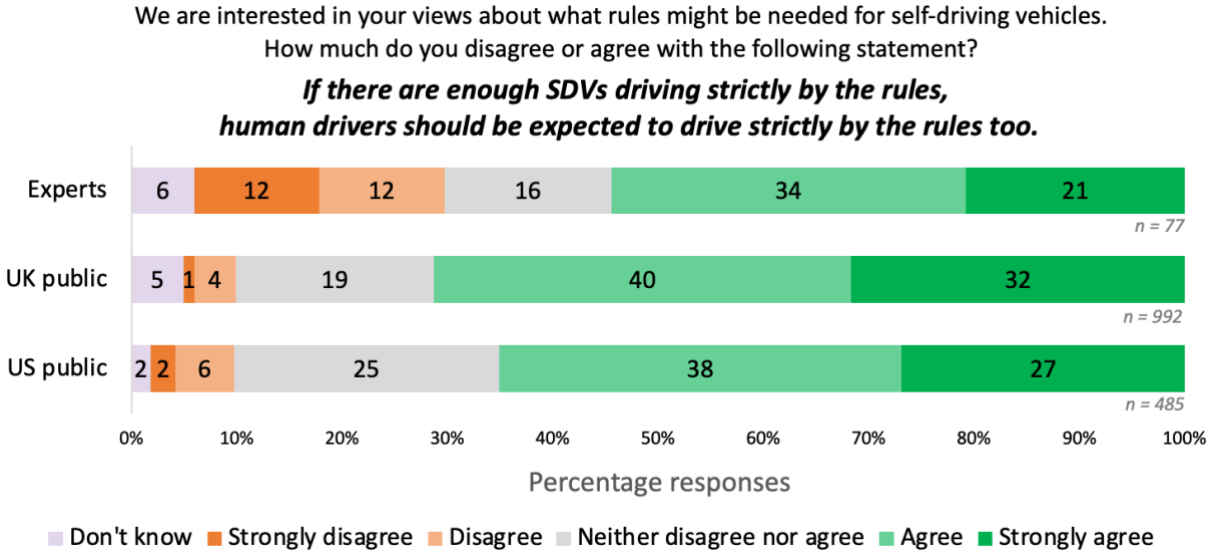

Figure 5.24. Rules of the road - Question 6

There is little disagreement that drivers need to use common sense as well as the formal rules of the road when driving (Question 1), with upwards of 77% of each sample group agreeing with the statement. Public survey respondents tend to conclude that SDVs will be limited by lacking human common sense (Question 2: 53% of US and 60% of UK respondents agreeing), but this conclusion is not so readily shared by the expert respondents(31% agreeing, 51% disagreeing).

The public respondents tend to want SDVs to abide rigorously by the rules of the road (Question 3, UK 70%, US 67%), but only 36% of experts want this: more research would be needed to establish whether this is motivated by concerns that such compliance would be too constraining, or by a commitment to have SDVs driving like human drivers and applying contextual judgement to rule compliance. The same contrast is seen with the suggestion that SDVs should be allowed to break the rules sometimes (Question 4). Unusually, here there is also a modest difference between the spread of UK and US views, with the US respondents a little less likely to demand strict rule compliance of SDVs. For Question 6 too, the majority public agreement that if there are enough SDVs complying rigorously

with the rules human drivers should adjust their behaviour to match (72% UK, 65% US) is not repeated amongst the experts (55% agreement), where 24% disagree with this (compared with 5% of UK and 8% of US respondents). Some of our expert interviewees argued forcefully that SDVs should not impose changes on other road users, and this may be reflected in the responses of those 24% of survey expert respondents.

Question 5 sees broad agreement between experts and public on the need for full explainability (with agreement from 75% of the expert sample, 91% UK respondents and 89% US respondents). Some technologists in our expert interviews argued that good enough safety performance should invalidate the need for full explainability, and this would be one potential explanation for the 14% of expert respondents who disagreed with the item.

5.7. Views on how SDVs could and should behave at pedestrian crossings

Next, we asked five questions in the form of pairs of opposing statements, asking respondents to indicate which of each pair best represented their views (these are known as 'semantic differentials'; see UK report, section 9.3 for more details). The statements related to how SDVs might deal with pedestrian crossings, especially in situations where the pedestrian behaviour might not be easily predicted. In the UK these questions referred to Zebra crossings, but in the US, they referred to unsignalled crosswalks. The expert survey used the US framing. In the UK the survey began this section with a number of questions regarding specific situations encountered at zebra crossings, and this may have raised an expectation with respondents that issues might arise at crossings: the results do suggest some greater concern amongst the UK respondents.

In the charts below, the pairs of statements are given in the heading. Percentages of respondents selecting the first statement of each pair are represented on the left-hand side of the chart, and percentages of respondents selecting the second statement are represented on the right hand side. The bars are centred around the percentage of respondents selecting a neutral response, i.e. not favouring either statement.

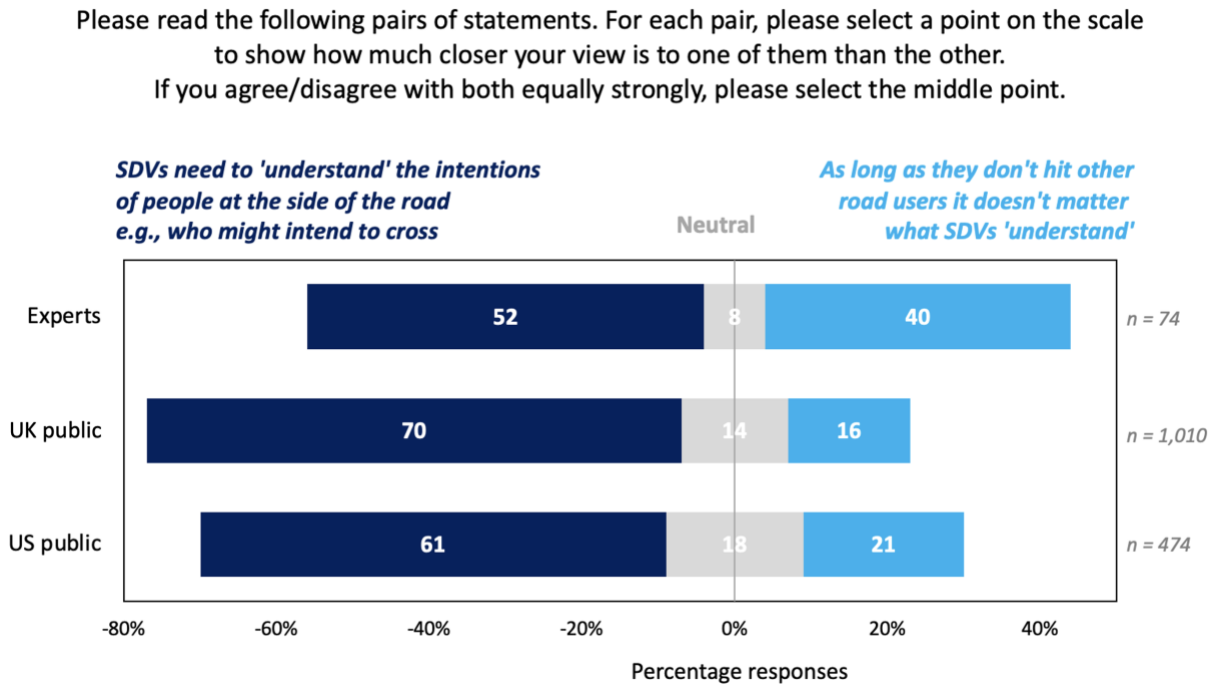

Figure 5.25. SDVs and pedestrian crossings – Question 1

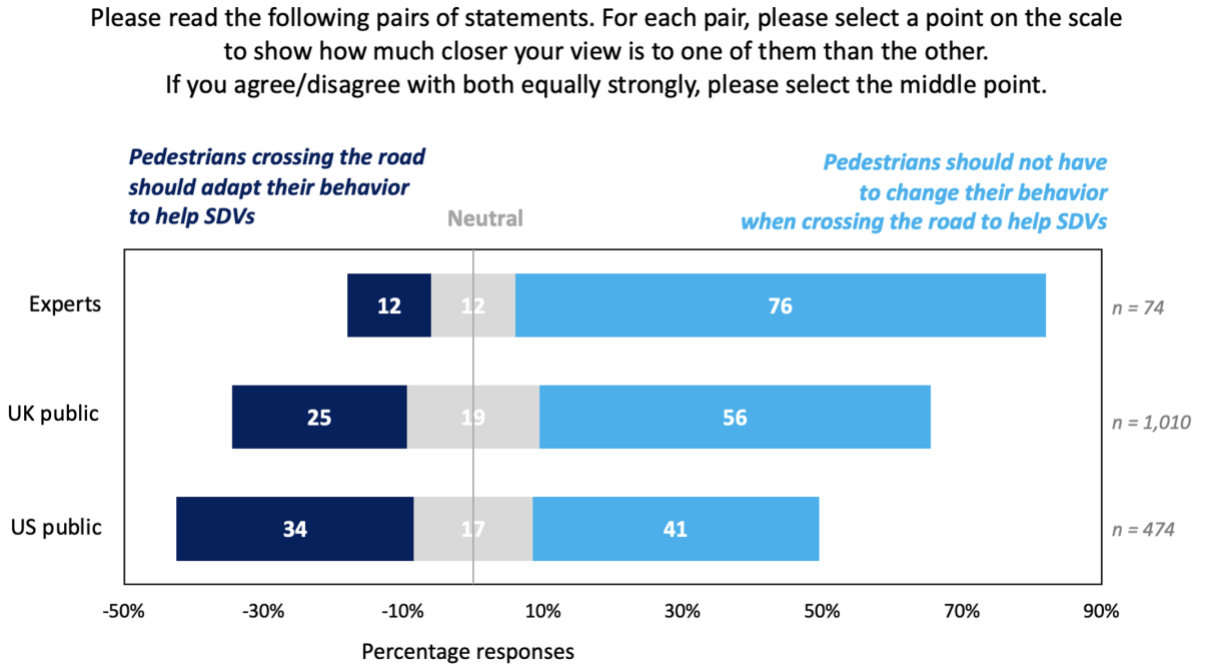

Figure 5.26. SDVs and pedestrian crossings – Question 2

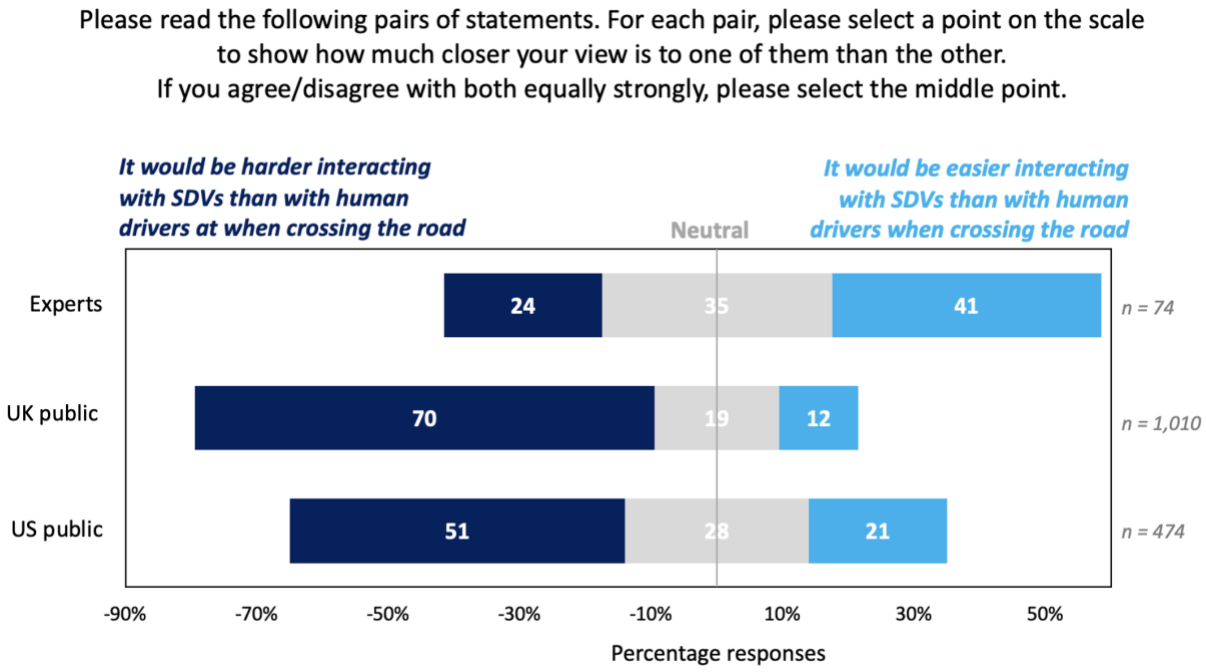

Figure 5.27. SDVs and pedestrian crossings – Question 3

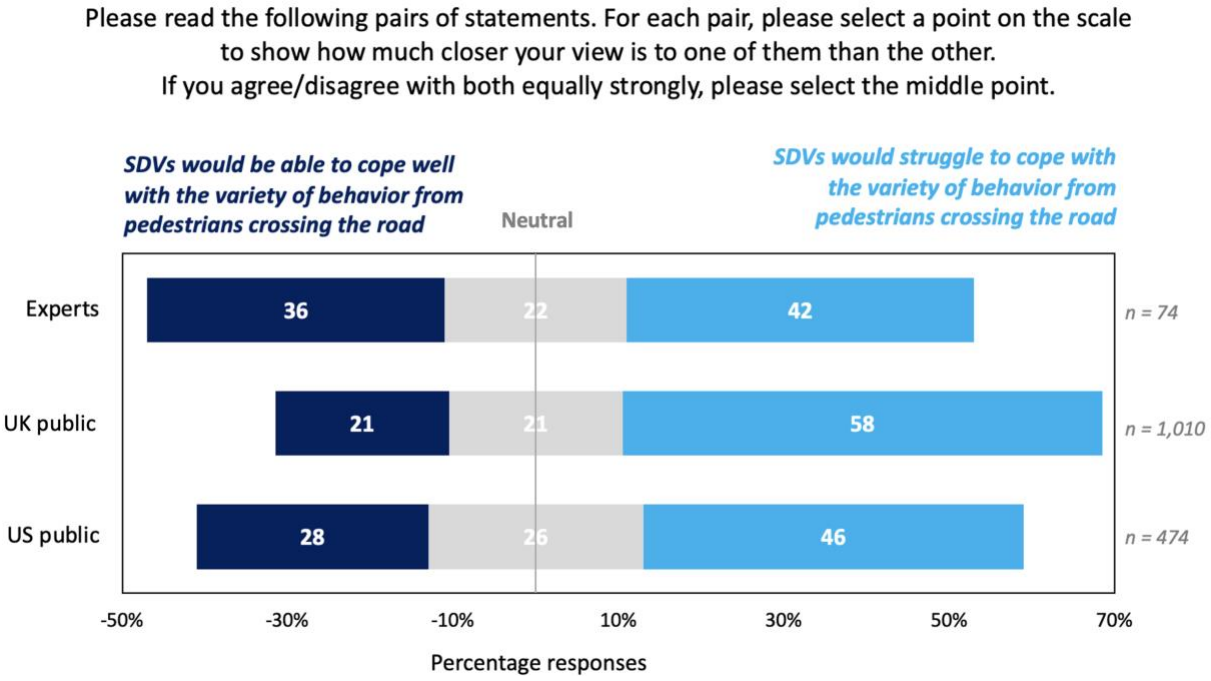

Figure 5.28. SDVs and pedestrian crossings – Question 4

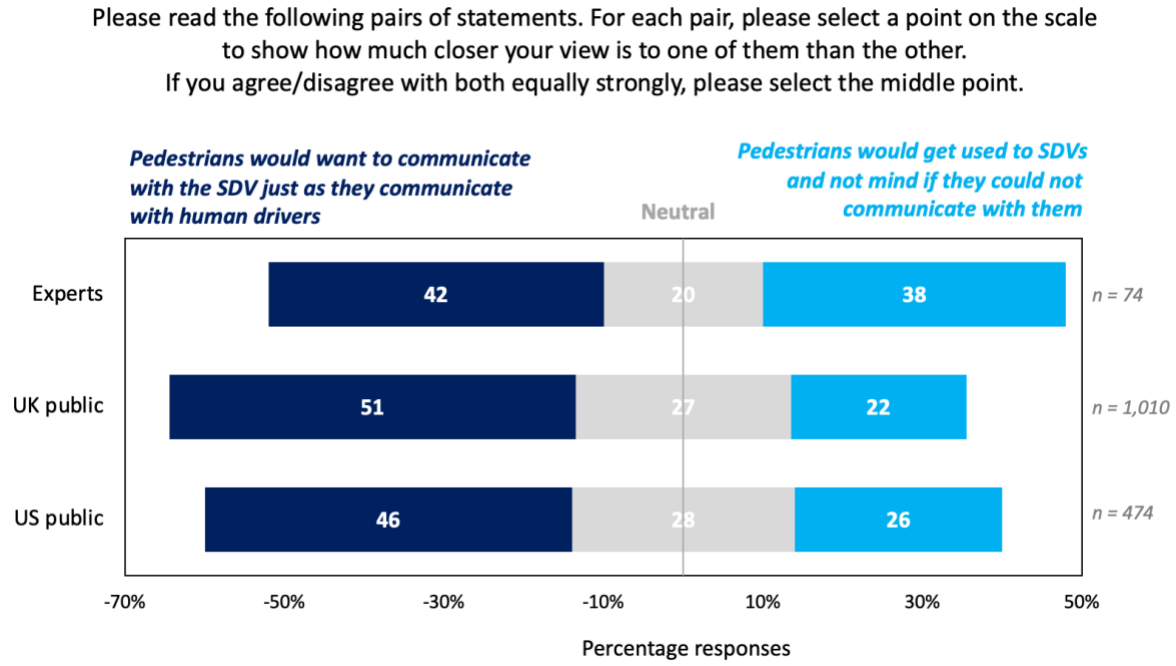

Figure 5.29. SDVs and pedestrian crossings – Question 5

A slim majority of experts say that SDVs need to understand people (Question 1, 52%, in contrast with 40% taking the view that they do not need to, as long as they are safe); public respondents (UK 70%, US 61%) are much more likely to state a desire that SDVs understand people in these scenarios. By contrast, expert respondents are much more likely than public respondents to say that pedestrians should *not* have to adapt their behaviour for SDVs (Question 2: 70% among experts, 65% of UK and 41% of US respondents). They are also – perhaps therefore – more optimistic that humans should find it easier to interact with SDVs than with human drivers (Question 3: expert respondents 41%, UK public 12%, US public 21%). Despite this, we find that for each respondent group, people are more likely to

predict that SDVs will struggle (rather than cope well) with pedestrian crossings (Question 4): 42% of experts, 58% of UK public and 46% of the US public respondents take this view. However, it is notable that among expert respondents, as many as 36% predict that SDVs would cope well – opinion among experts is more evenly divided on the issue than for public respondents. A similar pattern is found for Question 5 relating to human communication with SDVs, with experts almost evenly split on whether pedestrians will want to communicate with SDVs (42%) or get used to SDVs and not mind a lack of communication (38%); for public respondents, the balance of answers is a little more clearly away from the idea that people won't mind not communicating with SDVs (22% UK and 26% US respondents taking this position).

5.8. If a self-driving vehicle is involved in a collision, what should happen next?

In this section we asked respondents to react to a set of five statements, indicating the extent to which they disagreed or agreed with each one. Again, the statements are included as headings in the charts below:

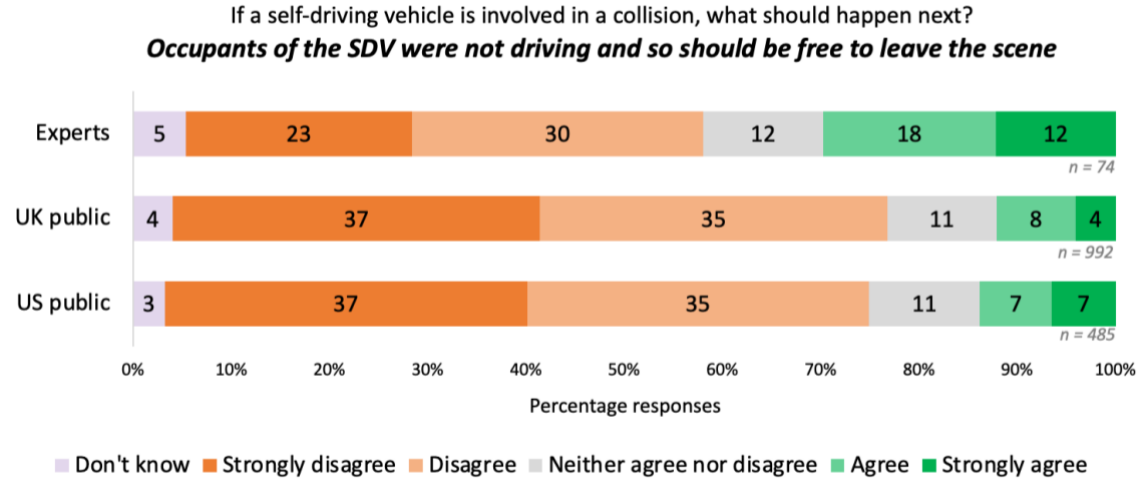

Figure 5.30. If a self-driving vehicle is involved in a collision, what should happen next? - Question 1

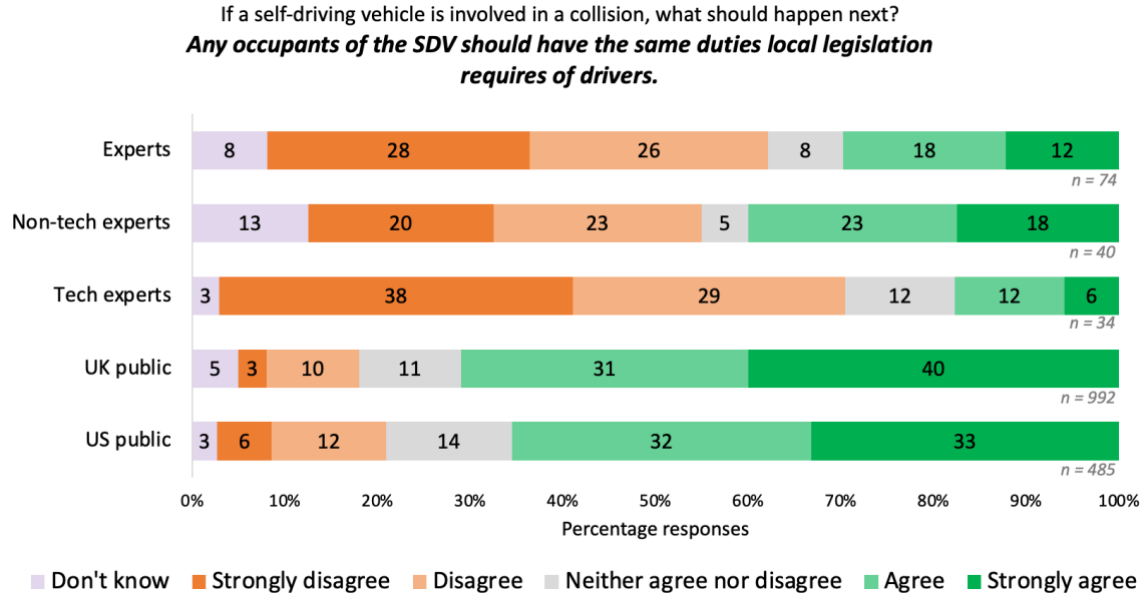

Figure 5.31. If a self-driving vehicle is involved in a collision, what should happen next? - Question 2

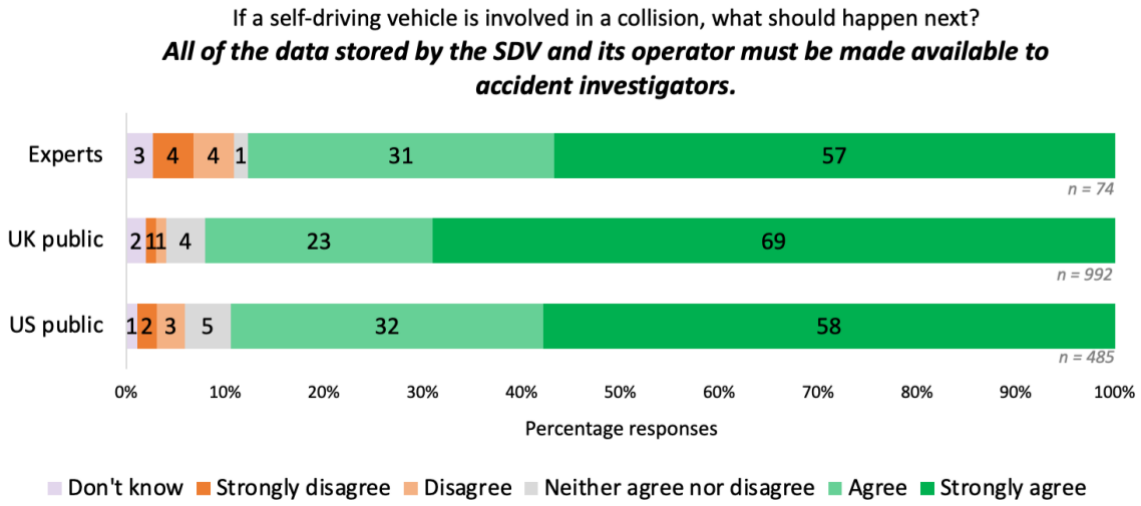

Figure 5.32. If a self-driving vehicle is involved in a collision, what should happen next? - Question 3

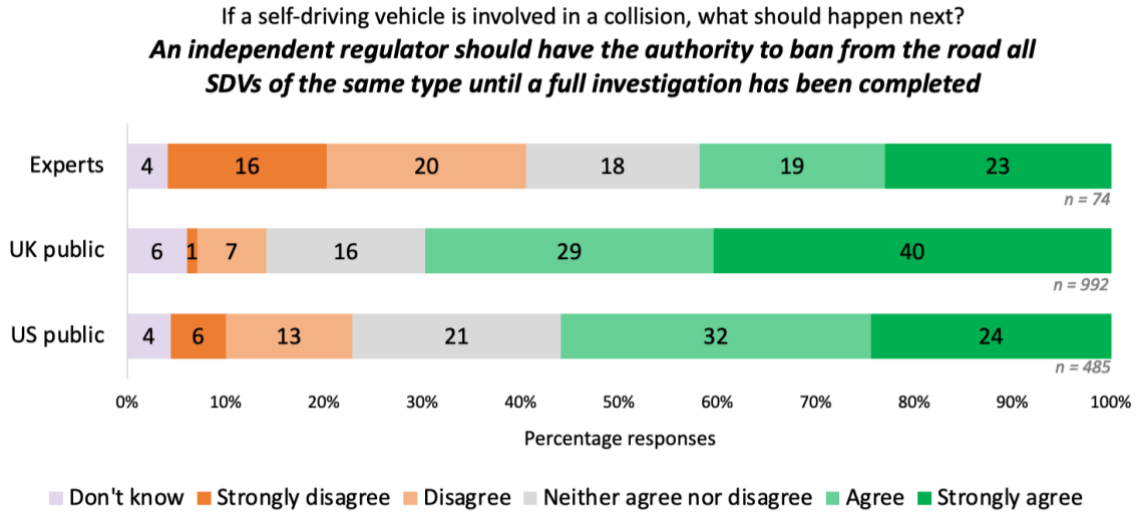

Figure 5.33. If a self-driving vehicle is involved in a collision, what should happen next? - Question 4

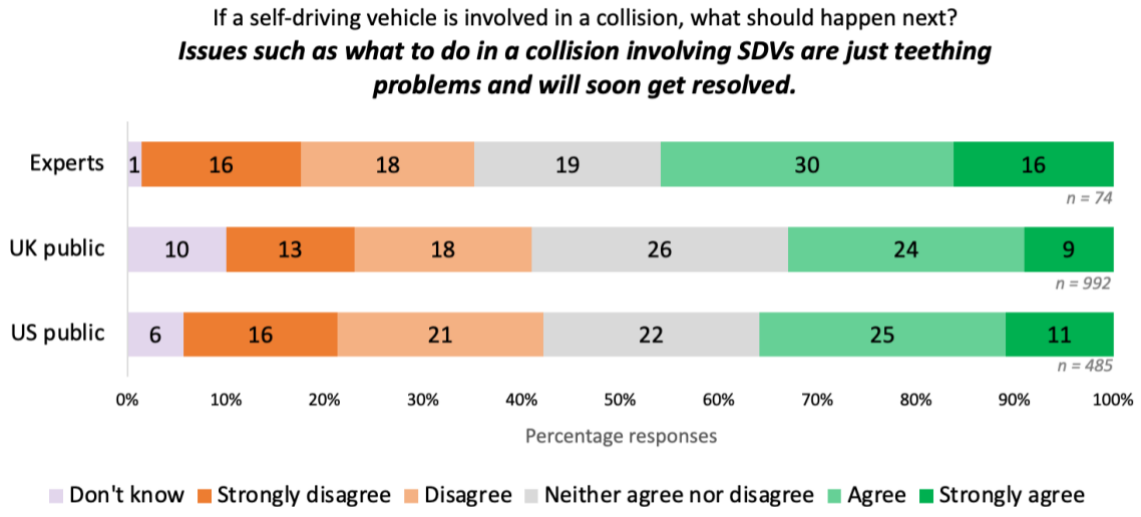

Figure 5.34. If a self-driving vehicle is involved in a collision, what should happen next? - Question 5

Our expert respondents are more likely than the public respondents to say that SDV occupants should be free to leave in the event of an incident (Question 1: 30% experts, 12% UK and 14% US public respondents). Correspondingly, they are much less likely to agree that SDV occupants should have the same responsibility status as those in a conventional vehicle (Question 2); 30% of experts take this view, and only 18% of the 'tech experts' do so, in contrast with 71% of UK and 65% of US respondents. The rates of public agreement with the statement are close to the rate of the technological experts' *dis*agreement (at 67%). We see large majorities of all our respondent groups favouring the idea that SDV data must be available to help investigators (Question 3: 88% experts, 92% UK and 90% US public). On the subject of regulation, our expert respondents (as might be expected) are relatively less likely to agree that regulators should have the authority to ban similar SDVs in the event of a collision (Question 4: 42% expert agreement), while UK respondents are the most likely to support this idea (69%), in contrast to US respondents (56%)..

As in the set of items on SDVs interacting on pedestrian crossings, it is noticeable that confidence is not widespread amongst our expert respondents. On the statement *"Issues such as what to do in a collision involving SDVs are just teething problems and will soon get resolved"* (Question 5) 34% of expert respondents disagree and 46% agree – a spread of responses that is similar to those of our public respondents

5.9. Who will benefit from the introduction of SDVs?

Our next questions asked respondents to reflect on the broader societal implications of the technology, and we asked the extent to which people disagreed or agreed with five statements that framed this in terms of who might benefit or lose out – again, the statements are given as the headings to the charts below:

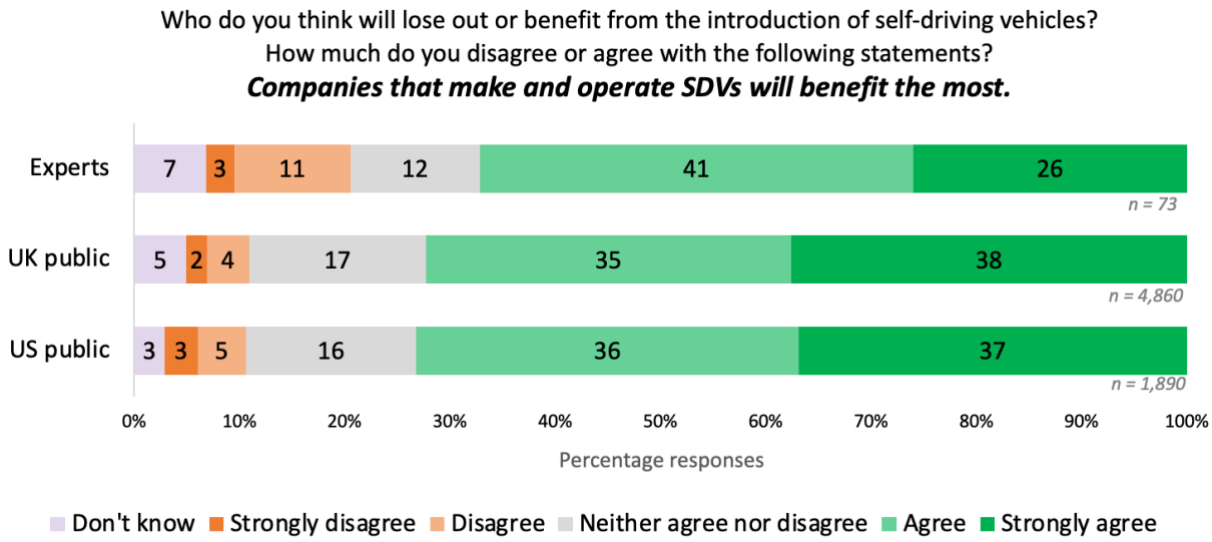

Figure 5.35. Who will benefit from the introduction of SDVs? - Question 1

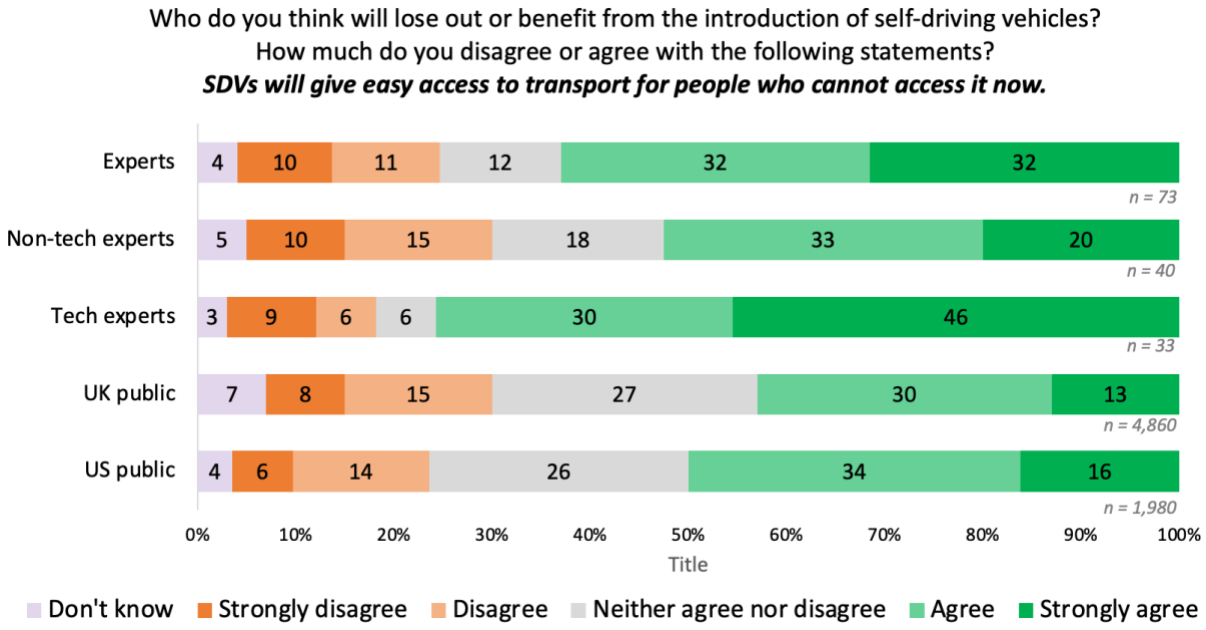

Figure 5.36. Who will benefit from the introduction of SDVs? - Question 2

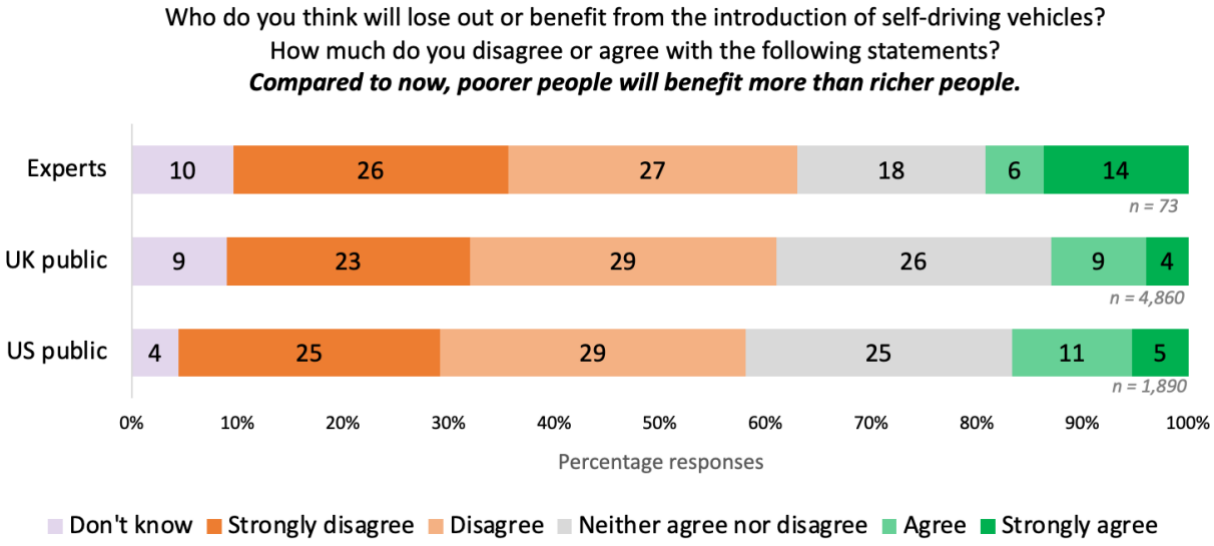

Figure 5.37. Who will benefit from the introduction of SDVs? - Question 3

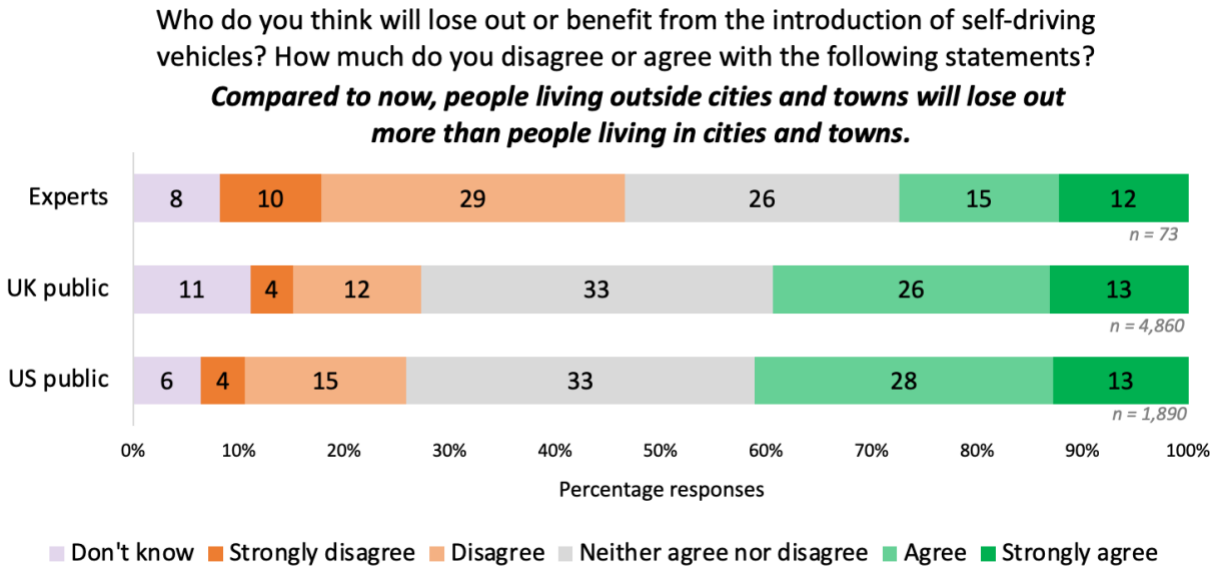

Figure 5.38. Who will benefit from the introduction of SDVs? - Question 4

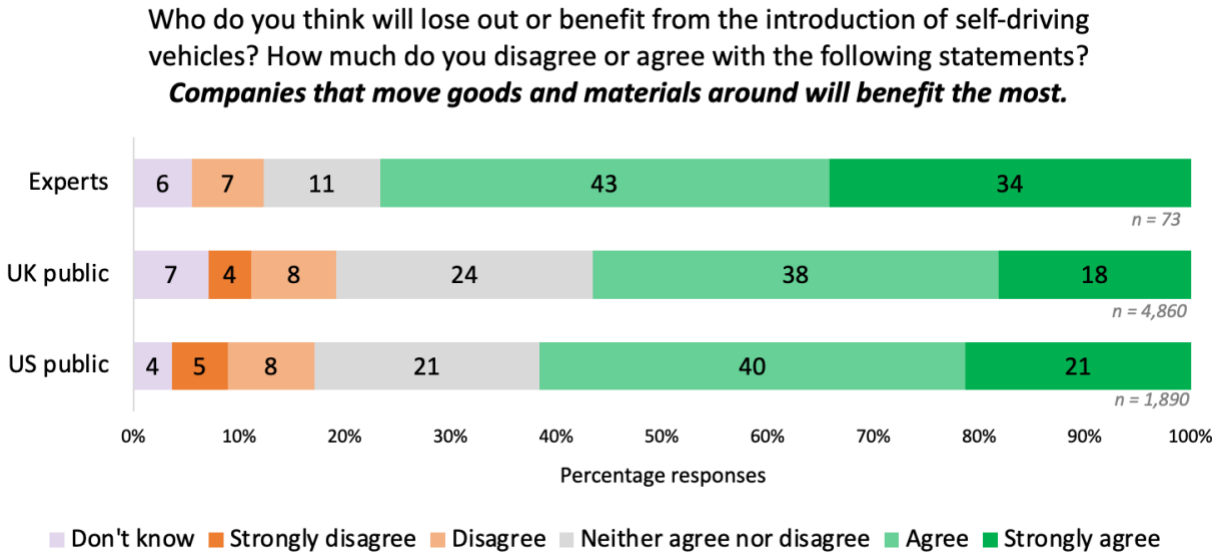

Figure 5.39. Who will benefit from the introduction of SDVs? - Question 5

On Questions 1 and 3, expert views show modestly greater expectation that the introduction of SDVs will have social benefits rather than just be for the good of the technology companies – though for all groups, majorities agree that SDV companies will benefit the most (Question 1), and disagree that poorer people will benefit more than richer (Question 3). By contrast, expert respondents are markedly *more* likely than public respondents to agree that logistics companies will benefit the most (Question 5: 77% experts, 56% UK and 61% US respondents). Alongside these responses which perhaps cast doubt on the idea of SDVs alleviating economic inequalities in society, Questions 2 and 4 demonstrate the relatively greater confidence among expert respondents in the potential for SDVs to widen access to mobility. 39% experts disagree with the assertion that people outside urban districts will lose out more, compared to 16% UK and 19% US respondents (Question 4). In Question 2, the technological experts in particular show a much greater level of agreement (77%) with the idea that SDVs will widen travel access, compared to non-technological experts (53%), UK public (43%) and US public (50%) respondents.

6. Views on the roads of today

We asked our respondents a set of questions to gauge their feelings about the ways in which the current road systems work. In our public surveys these were asked at the start of the questionnaire, to set the scene for the following questions. Because but came at the end of the expert survey.

6.1. General questions on the road of today

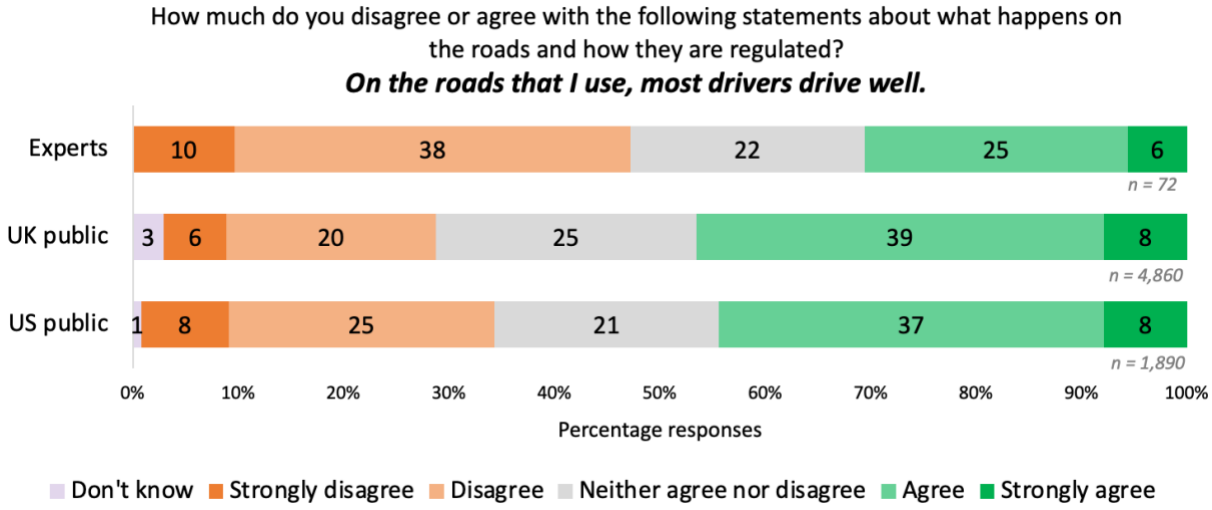

Figure 6.1. General questions on the road of today - Question 1

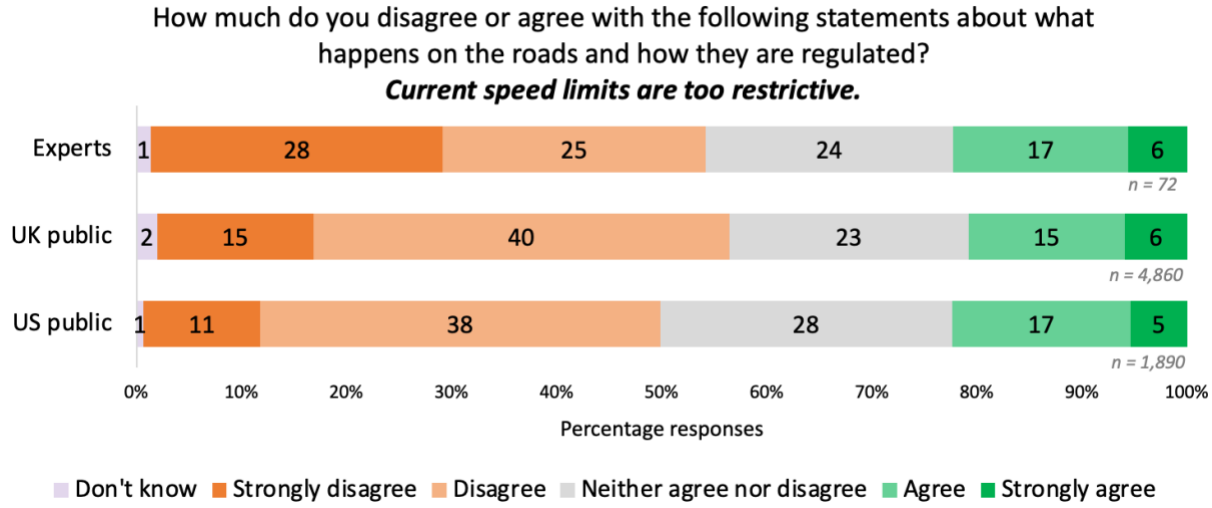

Figure 6.2. General questions on the road of today - Question 2

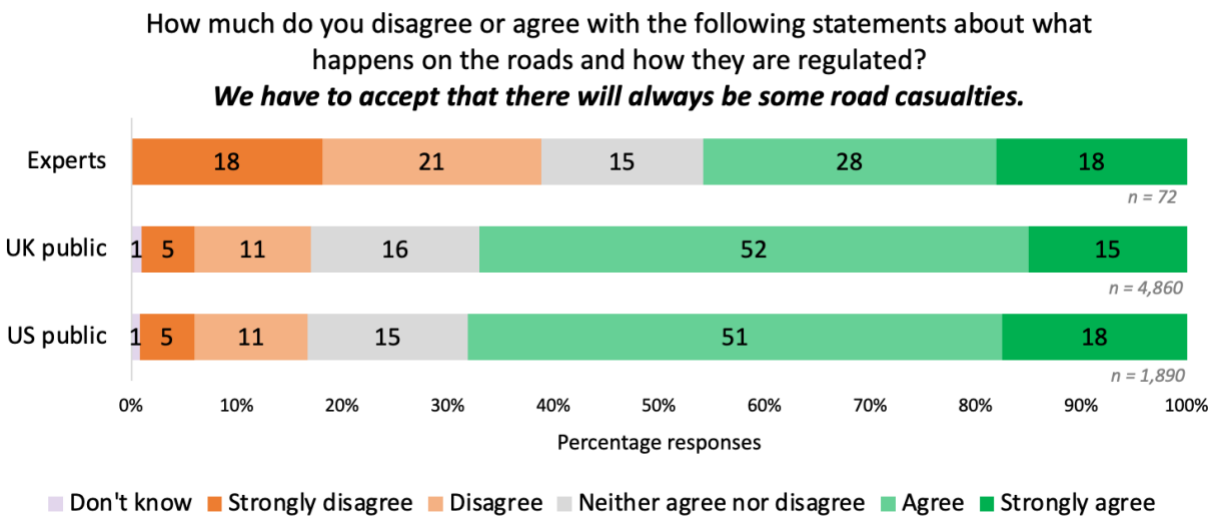

Figure 6.3. General questions on the road of today - Question 3

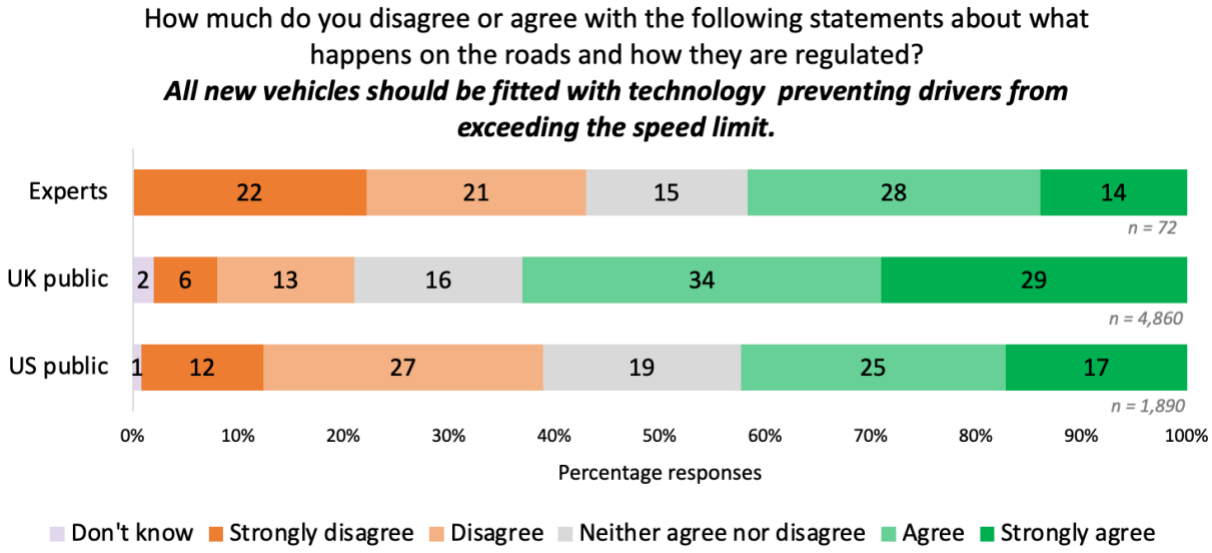

Figure 6.4. General questions on the road of today - Question 4

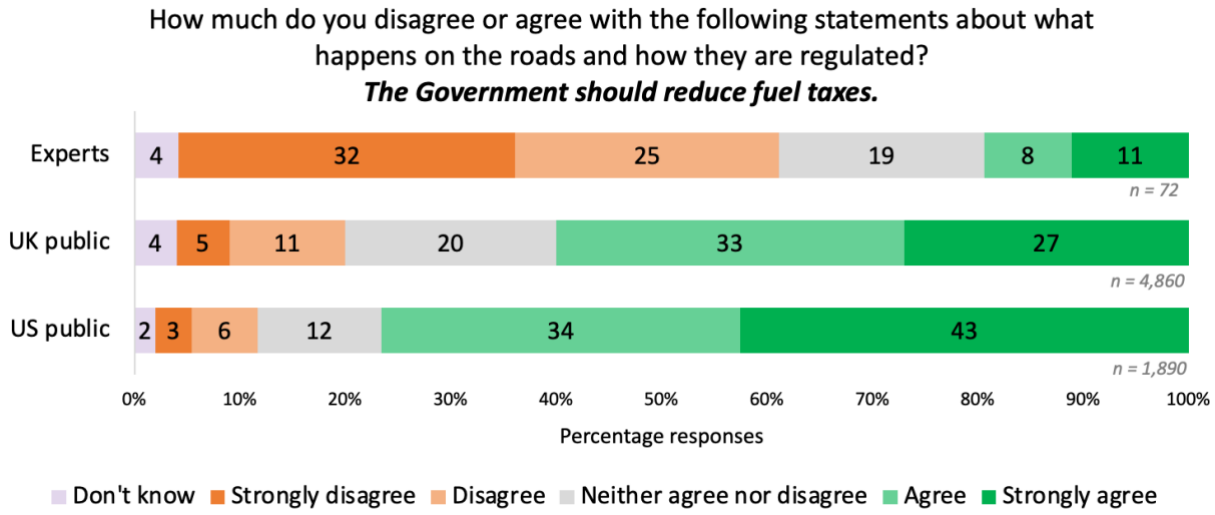

Figure 6.5. General questions on the road of today - Question 5

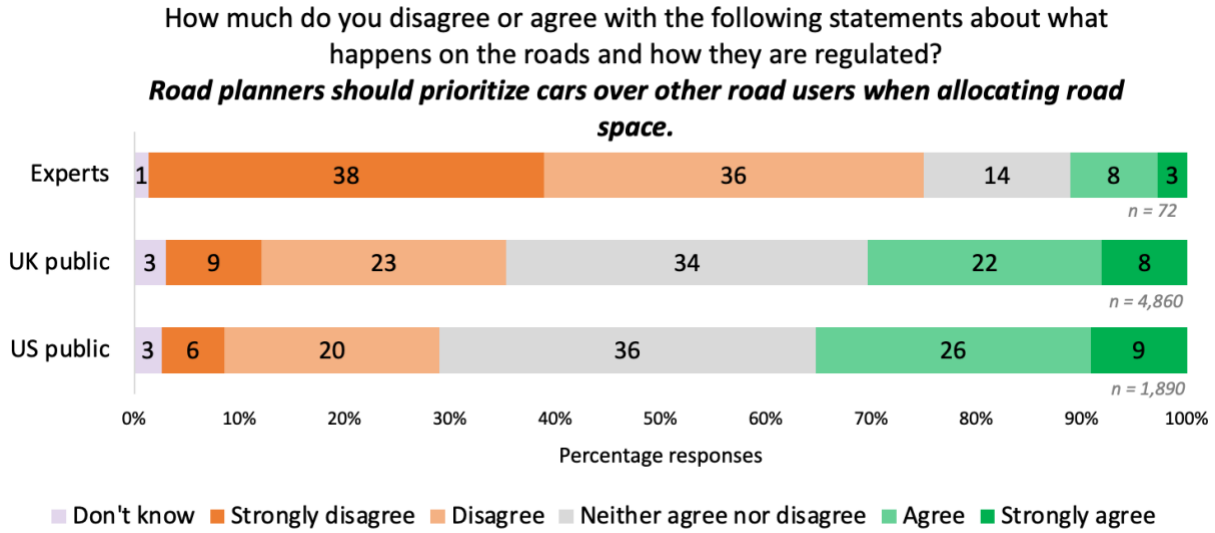

Figure 6.6. General questions on the road of today - Question 6

Where we see notable differences between the spread of responses from experts in comparison to those of the public, it tends to be that the experts agree more strongly (or disagree less) with arguments that might be made in favour of SDVs. Thus, more experts have a lower opinion of today's drivers (Question 1: 48% of expert respondents disagree that most drivers drive well, compared with 28% of UK and 32% of US public respondents), and fewer are willing to accept that there will always be road casualties (Question 2: 46% agreeing versus 67% of UK public and 69% of US public respondents).

Our expert respondents are also more likely to be in favour of policies that might be seen as restrictive of today's private motor transport. They tend to disagree that fuel taxes should be reduced (Question 5: 57% of experts take this view, , whereas 60% of UK public and 77% of US public respondents *agree* that they should be reduced). They tend to disagree that local government should prioritise cars over others road users (Question 6: 74% disagreeing versus 32% of UK public and 26% of US public respondents). This makes it slightly surprising that the experts do not show more support for speed limiters (Question 4: 42% in favour versus 63% of UK public but 42% of US public respondents). On

Questions 4 (speed limiters) and 5 (fuel taxes) the US public attitudes are noticeably more hostile to restrictions on private motoring than in the UK, but on Questions 2 (speed limits) and 6 (allocation of road space), US public attitudes are only slightly more favourable to the private motorist than those in the UK.

6.2. Transport priorities

We asked what respondents wished to see prioritised in transport policy, requiring a choice of two from a list of six options, which are listed in the chart below from the most to the least popular (left to right) among expert respondents:

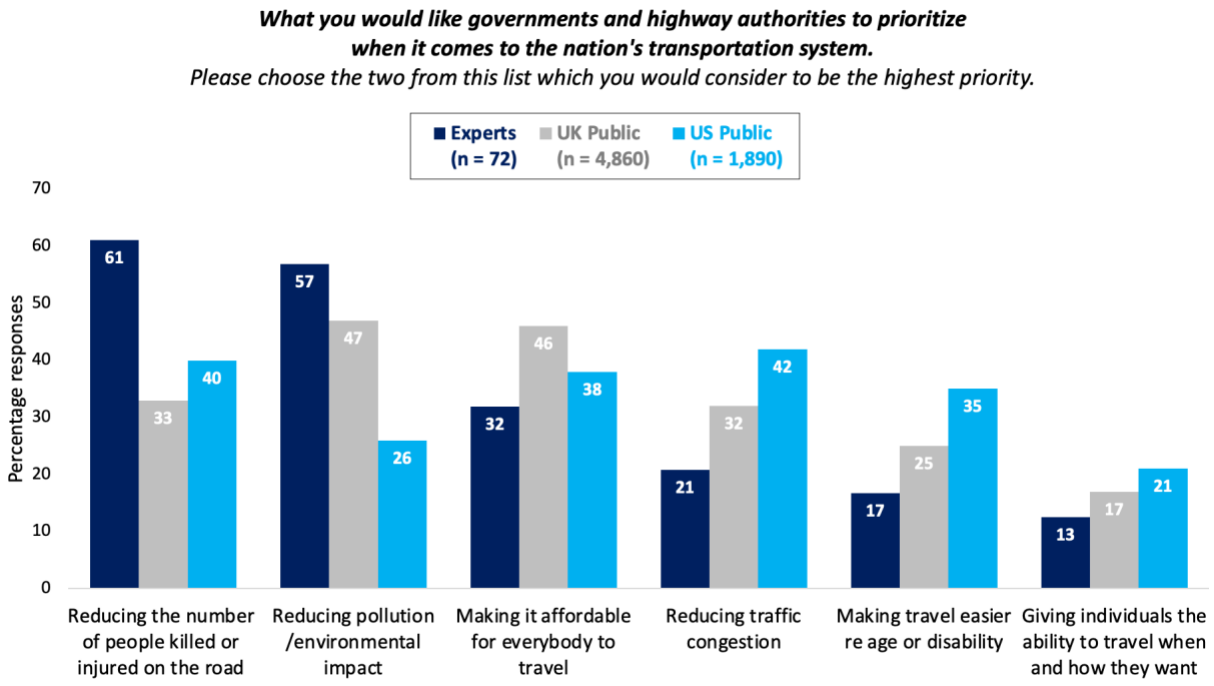

Figure 6.7. Transport priorities

As seen in Section 6.1, the priorities chosen by our expert respondents are consistent with common arguments by developers for SDVs, namely safety (61% expert respondents select this, compared with 33% UK and 40% US public respondents) and environmental concerns (57% expert respondents select this, compared with 47% UK and 26% US public respondents). Although we saw in Section 5.9 a notable confidence among the experts in the potential for SDVs to widen access to mobility, those policy priorities are less often selected (17% of experts select "making travel easier re age or disability" and 13% select "giving individuals the ability to travel when and how they want"). It is notable that of the two items related to emissions (reducing pollution, and reducing congestion), expert respondents (57%) and UK public respondents (47%) are relatively more likely to select the more general environment item, whereas US public respondents (42%) are more likely to select the item relating to convenience or travel experience.

7. Other Questions

Our survey finished with a small number of general questions about social and political attitudes. We used five of the technological optimism questions from our main survey (see Appendix 8 of the UK report): see Section 2 for results.

We also used four of the questions addressing attitudes to cars and to driving (again see UK Appendix 8). The experts show slightly less enthusiasm for cars and driving than the public, but the differences are modest[8].

[8] For example, the experts mean score on a semantic differential scale between *"I only drive because I have to"* and *"I enjoy driving"* was only 0.21 x Standard deviation below that of the UK public, and 0.27 x Std Dev below that for the US public.

Bibliography

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Appendices

Appendix 1 – Survey Questionnaire

Start of Block: Introduction

Q1.1 We would like to invite you to participate in this survey on attitudes towards the future of road transport and self-driving vehicles in particular. It is for a study conducted by a team of British researchers at University College London and the University of the West of England.

You have been invited to participate because we understand that you are interested or involved in the development of new vehicle technologies such as self-driving vehicles. This questionnaire has been adapted from a survey used to study attitudes of members of the public. A number of the questions are designed for a non-expert audience.

In participating you agree that you understand that you are free to withdraw from the survey at any point if you so wish, and the responses you give will be used for the purposes of this study only. We're seeking your own personal views, which will be kept anonymous, rather than your expectations of public opinion or the official position of any organization. Where questions ask for you to answer in your own words we may use quotations (still anonymous) from those responses in our reports.

In order to participate, you must be over 18. Your data will be handled in accordance with the Data Protection Act 2018. University College London will be the data controller. To find out more about our research, and how we protect your data. To find out more about our research, and how we protect your data, you can access the Participant information sheet. Do you agree to participate in this survey?

- ○ Yes (1)
- ○ No (2)

Q1.2 How would you describe your involvement or interest in self-driving and other new vehicle technologies (tick all that apply)?

- ☐ An interested observer (1)
- ☐ Directly involved in the development of the technology in a commercial enterprise (4)
- ☐ A researcher involved in the development of the technology in a non-commercial setting (5)
- ☐ A researcher focused on the social side of new vehicle technologies (6)
- ☐ A specialist involved in the development of regulation, standards and/or policy for new vehicle technologies (7)
- ☐ Other - please describe (8) _____

Q1.3 You said that you were directly involved in a commercial enterprise: which of the following best describes that enterprise (you can tick more than one, but if appropriate just tick the main one)?

- ☐ An automotive manufacturer or major supplier (1)
- ☐ A self-driving vehicle company (5)
- ☐ A digital technology company (2)
- ☐ A consultancy (3)
- ☐ Other - please describe (4) _____

Q1.4 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)

Q1.5 Where are you currently based, and where have you spent most of your life (you can tick more than one for each if appropriate)?

	Please tick at least one in the left-hand column	
	Currently based (1)	Spent most of my life, if different (2)
UK (1)	☐	☐
Continental Europe (3)	☐	☐
North America (2)	☐	☐
Asia (4)	☐	☐
Australasia (5)	☐	☐
Middle East (7)	☐	☐
Africa (6)	☐	☐
Central and South America (8)	☐	☐

Start of Block: Short survey

Q2.1 Just a reminder: This survey has been adapted from a survey used to sample attitudes of members of the public: a number of the questions are framed for a non-expert audience to allow direct comparison with data from that survey.

At certain points we provide the option for you to comment on the questions: for example we are aware that as a specialist you may feel you want to say 'it depends' but we do not give this as an answer option! You can use the optional comment boxes to raise such issues if you wish.

In this survey, we refer to self-driving vehicles (sometimes known as driverless, automated or autonomous vehicles), often using the abbreviation "SDV". SDVs are being designed to drive themselves on some or all of the conventional road network without the need for a human operator. We're interested in a range of possible vehicles implementing self-driving technology.

Do you think this technology should be developed?

- ○ Definitely yes (1)
- ○ Maybe yes (2)
- ○ Maybe not (3)
- ○ Definitely not (4)
- ○ Not sure (5)

Q2.2 Why or why not? (Minimum 7 characters, maximum 250 characters.)

_____

_____

Q2.3 (Optional) If you wish to comment on the definition of the technology used above, feel free to do so here:

_____

Q2.4 How would you feel about using the roads alongside self-driving vehicles?

- ○ Totally comfortable (1)
- ○ Quite comfortable (3)
- ○ Neither comfortable nor uncomfortable (4)
- ○ Quite uncomfortable (5)
- ○ Totally uncomfortable (7)
- ○ Don't know (8)

Q2.5 How would you feel about riding in a self-driving vehicle instead of the existing ways you travel?

- ○ Totally comfortable (1)
- ○ Quite comfortable (3)
- ○ Neither comfortable nor uncomfortable (4)
- ○ Quite uncomfortable (5)
- ○ Totally uncomfortable (7)
- ○ Don't know (8)

Q2.6 How safe do you think self-driving vehicles should be?

- ○ Never causing a serious collision (1)
- ○ Much safer than the safest human driver (2)
- ○ A little safer than the safest human driver (3)
- ○ As safe as the safest human driver (4)
- ○ As safe as an average human driver (5)
- ○ It doesn't matter (7)

Q2.7 We are interested in your views about how self-driving vehicles might share the road with other road users. How much do you disagree or agree with the following statements?

- – It must be clear to other road users if a vehicle is driving itself (1)
- – SDVs should follow exactly the same rules of the road as other road users (2)
- – SDVs should be programmed to drive more cautiously than human drivers (7)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q2.8 (Optional) If you wish to comment on the previous questions - e.g. 'This is the wrong question!' or 'It depends!', you may do so here. _____

Start of Block: Option to continue

Q3.1 It would really help us if you would answer some further questions, including on specific topics like how SDVs interact with pedestrians crossing the road or what should happen after a collision: we estimate that the previous questions should have taken approximately 3 minutes: the additional questions should take approximately 6 minutes.
Are you happy to continue?

- ○ Yes (1)
- ○ No (2)

Start of Block: Aspects of SDVs

Q4.1 Do you have a current, valid driver's license?

- ○ Yes (1)
- ○ No (2)

Q4.2 We are interested in your views on how self-driving vehicles might be controlled when driving. How much do you disagree or agree with the following statements?

- SDVs should always drive themselves without needing or allowing intervention from a human driver (6)
- If I was riding in an SDV I would want to be able to take over the driving if I felt I could handle the situation more safely (9)
- I worry that SDV riders would not be able to react quickly enough if asked to take control while the vehicle was moving (8)
- I'd be glad to let the SDV take care of the driving so that I could make better use of the time (12)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q4.3 We are interested in your views on how self-driving vehicles might be controlled when driving. How much do you disagree or agree with the following statements?

- SDVs should always drive themselves without needing or allowing intervention from a human driver (5)
- If I was riding in an SDV I would want there to be a human driver capable of taking control if it was necessary (2)
- I worry that SDV riders would not be able to react quickly enough if asked to take control when moving (3)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q4.4 We are interested in your views about how self-driving vehicles might share the road with other road users. How much do you disagree or agree with the following statements?

- If SDVs are programmed to drive cautiously pedestrians will walk in front of them (3)
- If SDVs are programmed to drive cautiously human drivers will cut in front of them (9)
- If SDVs are able to react more quickly than human drivers, they should be allowed to drive much closer to other vehicles (6)
- SDVs should be more considerate than human drivers towards other road users (10)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q4.5 (Optional) If you wish to comment on the previous questions - e.g. 'This is the wrong question!' or 'It depends!', you may do so here. _____

Start of Block: Expectations and rules

Q5.1 Thinking about the potential introduction of self-driving vehicles, how much do you disagree or agree with the following statements?

- Human-driven vehicles and SDVs should not share the same stretch of road (11)
- I don't trust the companies developing SDVs to make sure they are safe (3)
- Our economy will suffer unless we are at the forefront of SDV development (10)
- SDVs should only be introduced if they have support from a clear majority of the public (12)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q5.2 Who should decide on the rules of the road for self-driving vehicles, and the rules governing how human drivers and self-driving vehicles should share the road? How much do you disagree or agree with the following statements?

- SDVs should be regulated by national governments (1)
- Self-driving technology is too complex for government agencies to understand and to regulate (2)
- SDVs should be regulated by the technology companies that understand them (3)
- There should be international standards regulating self-driving technology (5)
- We should standardize the driving environment internationally, to make it easier for SDVs to work everywhere (11)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q5.3 We are interested in your views about what rules might be needed for self-driving vehicles. How much do you disagree or agree with the following statements?

- To drive well, drivers sometimes have to use common sense instead of just following the formal rules (21)
- SDVs should stick to the formal rules of the road in all situations (3)
- SDVs would be limited in how well they drive because they lack the common sense of human drivers (6)
- SDVs should be allowed to break the formal rules of the road in some situations (4)
- The companies behind SDVs must always be able to explain the actions taken by their vehicles (14)
- If there are enough SDVs driving strictly by the rules, human drivers should be expected to drive strictly by the rules too (19)

Answers (one per each statement):
(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q5.4 (Optional) If you wish to comment on the previous questions - e.g. 'This is the wrong question!' or 'It depends!', you may do so here. _____

Q5.5 Continuing to think about how SDVs might interact with other road users, and taking the example of pedestrians crossing the road (whether in an inner city, residential or rural setting):

Please read the following pairs of statements. For each pair, please select a point on the scale to show how much closer your view is to one of them than the other. If you agree/disagree with both equally strongly, please select the middle point.

	1	2	3	4	5	
SDVs need to 'understand' the intentions of people at the side of the road e.g., who might intend to cross	o	o	o	o	o	As long as they don't hit other road users it doesn't matter what SDVs 'understand'
Pedestrians crossing the road should adapt their behavior to help SDVs	o	o	o	o	o	Pedestrians should not have to change their behavior when crossing the road to help SDVs
It would be harder interacting with SDVs than with human drivers at when crossing the road	o	o	o	o	o	It would be easier interacting with SDVs than with human drivers when crossing the road
SDVs would be able to cope well with the variety of behavior from pedestrians crossing the road	o	o	o	o	o	SDVs would struggle to cope with the variety of behavior from pedestrians crossing the road
Pedestrians would want to communicate with the SDV just as they communicate with human drivers	o	o	o	o	o	Pedestrians would get used to SDVs and not mind if they could not communicate with them

Q5.6 If a self-driving vehicle is involved in a collision, what should happen next?
- Occupants of the SDV were not driving and so should be free to leave the scene (10)
- Any occupants of the SDV should have the same duties local legislation requires of drivers (9)
- All of the data stored by the SDV and its operator must be made available to accident investigators (4)
- An independent regulator should have the authority to ban from the road all SDVs of the same type until a full investigation has been completed (3)
- Issues such as what to do in a collision involving SDVs are just teething problems and will soon get resolved (11)

Answers (one per each statement):
(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q5.7 (Optional) If you wish to comment on the previous questions - e.g. 'This is the wrong question!' or 'It depends!', you may do so here. _____

Start of Block: Modes and winners and losers

Q6.1 For society in general, which of the following developments do you think would be useful? Place the slider to indicate your view.

	Not useful / Neither / Useful / I'm not sure -4 -3 -2 -1 0 1 2 3 4
Low-speed self-driving shuttle buses ()	
Self-driving buses on regular routes ()	
Self-driving taxis ()	
Self-driving car clubs (cars for short-term hire) ()	
Privately owned self-driving cars ()	
Small self-driving delivery pods ()	
Self-driving trucks ()	

Q6.2 Who do you think will lose out or benefit from the introduction of self-driving vehicles? How much do you disagree or agree with the following statements?

- Companies that make and operate SDVs will benefit the most (1)
- SDVs will give easy access to transport for people who cannot access it now (2)
- Compared to now, poorer people will benefit more than richer people (5)
- Compared to now, people living outside cities and towns will lose out more than people living in cities and towns (6)
- Companies that move goods and materials around will benefit the most (3)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q6.3 (Optional) If you wish to comment on the previous questions - e.g. 'This is the wrong question!' or 'It depends!', you may do so here. _____

Start of Block: Final questions and road of today

Q7.1 Lastly we have a few questions on broader topics:

Q7.2 How old are you? _____

Q7.3 What you would like governments and highway authorities to prioritize when it comes to the nation's transportation system. Please choose the two from this list which you would consider to be the highest priority:

- ☐ Making it affordable for everybody, regardless of their financial means, to move around (1)
- ☐ Giving individuals the ability to travel when and how they want (4)
- ☐ Reducing the number of people killed and seriously injured on the roads (2)
- ☐ Reducing traffic congestion (3)
- ☐ Making travel easier for those currently unable to drive as a result of age or physical disability (5)
- ☐ Reducing the pollution and environmental cost of transportation (6)

Q7.4 How much do you disagree or agree with the following statements about what happens on the roads and how they are regulated?

- On the roads that I use, most drivers drive well (11)
- Current speed limits are too restrictive (2)
- We have to accept that there will always be some road casualties (1)
- All new vehicles should be fitted with technology preventing drivers from exceeding the speed limit (3)
- The Government should reduce fuel taxes (5)
- Road planners should prioritize cars over other road users when allocating road space (8)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q7.5 When the Government has to decide where to spend money, to improve private motor transportation or public transportation, how would you like them to allocate funds?

	More on private	More on public
()		

Q7.6 Next, we are asking for your opinions about technology in general. To what extent do you disagree or agree with the following statements about technology?

- Science and technology make our way of life change too fast (1)
- Overall, science and technology are making our lives healthier, easier and more comfortable (3)
- New technologies are all about making profits rather than making people's lives better (5)
- Machines are taking over some of the roles that humans should have (7)
- When my safety is involved I'm happy to rely on technology (10)

Answers (one per each statement):

(1) Strongly disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly agree
(6) Don't know

Q7.7 Now we'd like to ask about how you feel about driving and about your car. Please read the following pairs of statements. For each pair, please select a point on the scale to show how much closer your view is to one of them than the other. If you agree/disagree with both equally strongly, please select the middle point.

	1	2	3	4	5	
I only drive because I have to	o	o	o	o	o	I enjoy driving
I like to understand how my car's engine works	o	o	o	o	o	I don't care how my car's engine works as long as it gets me where I'm going
I find driving easy	o	o	o	o	o	I find driving difficult
I don't care what car I'm in, it's just a car	o	o	o	o	o	My car says something about me

Start of Block: Final questions

Q8.1 (Optional) If you wish to add any comments you may do so here.

_____