I can do anything with my AV data (but I won't do that): Public attitudes towards data recorders in self-driving cars

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Abstract

This article reports results from a public survey designed to evaluate public attitudes and perceptions towards data recorders in Autonomous Vehicles (AVs). Our study indicated that road users are willing to make compromises about their privacy in and around AVs, as long as the data recorded is used to improve vehicle safety. Our study also indicated that more vulnerable road-users such as pedestrians, cyclists and horse-riders are willing to be recorded by on-board devices, however this willingness is linked to the data from these devices being accessible to determine liability and the cause of an accident or near-miss. However, the type of data recording currently mandated by international legal frameworks does not accord with these public expectations. While the results of our survey highlights a gap between the international legal obligations of manufacturers and the expectations of the public, it is also relevant to inform policy makers at the national level on the public's view about the importance of data recorders in the development of trustworthy autonomous vehicles. The failure of AVs to meet societal expectations on transparent data recording frameworks, and the use of that data to improve safety, may impact the uptake and acceptance of AVs.

CCS Concepts

• **Human-Computer Interaction; Security and Privacy; Computing/technology policy**;

Keywords

Responsible innovation, data, autonomous vehicles, data recorders

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1 Introduction

Self-driving, or driverless, cars are one of the 'future' technologies that have been anticipated since the 1960s [19], and the technology required to make them a reality now appears close enough that such vehicles have become a topic of mainstream public discourse as well as testing on public roads. However, novel technologies such as this inevitably have societal impacts, both desired and undesired. In order to improve the 'fit' of such technologies with societal needs and to ensure that any undesired impacts are minimised as far as possible, a responsible innovation approach points to the importance of consulting with diverse groups of stakeholders, anticipating possible outcomes, and preparing for the societal impacts that might transpire - both positive and negative.

There is much to be discovered about how the public views the data collected, recorded, and stored by such vehicles. Surveys such as the Eurobarometer [5] provide insights, such as identifying that some respondents were uncomfortable sharing data with; public authorities, other road users and private companies, yet also revealing that some respondents are willing to share their data. A survey on the use of "black boxes" to reduce insurance premiums in conventional vehicles [16] also returned a mixed result of respondents supporting the concept, and those indicating they would refuse such a scheme.

When it comes to safety however, there is more consensus. The survey reported by Tennant et al [16], indicated that respondents were generally in favour of camera data being i) anonymised, ii) capable of being shared, and iii) used to prosecute rule breakers. Where data collection is linked with improving the safety of a vehicle investigating an accident [26] the public expect the AV will record relevant data, and to share that data. It is this finding which stood out in our own public survey of 317 road users, which we will detail below in section 4.

Regulations on what data should be recorded and what it should be used for are being developed at an international level, and to a lesser extent, national level. Presently we know little about what type of data is stored by manufacturers and developers, or how

that data is processed. These issues are likely to be considered proprietary and/or commercially sensitive information by manufacturers. There are clear ethical, legal and social questions around the amount and type of data that is gathered and stored by such devices, the purpose and use of such data, its storage, who is responsible for it, and who can access it.

These considerations motivated the present study, which was carried out as part of the Trustworthy Autonomous Systems Hub pump-priming project RoAD (Responsible AV Data). The RoAD project was grounded in a responsible innovation mindset that requires anticipation of possible impacts and consultation with potentially-affected stakeholders [23] [25]. A public survey was carried out to evaluate public attitudes towards data recording by AVs. This paper describes the frameworks relevant to data-recording and governance (section 2), before outlining our study and methodology (section 3), discussing our findings (section 4), and concluding with recommendations for policy makers. (section 5).

2 Background

2.1 Legal frameworks on data recorders

For the purposes of this study, the most relevant work on regulating AV data recorders is that carried out by the United Nations Economic Commission for Europe (UNECE) World Forum for Harmonization of Vehicle Regulations [20]. The World Forum is a permanent part of the UN and has the specific goal of globally harmonising technical regulations on motor vehicles in order to improve safety, environmental protection, and trade [20].

The World Forum, also known as Working Party (WP) 29, has recently drafted and approved two regulations for data recorders in use in AVs (as addenda to the 1958 Agreement).[1] The first is 'UN Regulation 160', which contains provisions concerning the approval of motor vehicles with regard to the Event Data Recorder [19]. The second is 'UN Regulation 157 - Automated Lane Keeping Systems (ALKS)' [17], which contains regulatory provisions for a second type of recording device, called the Data Storage System for Automated Driving (DSSAD), specifically designed for vehicles fitted with advanced driver assistance systems, and autonomous vehicles. The following sets out details on the aspects of these regulations which are relevant to data recorders, and our public survey.

2.1.1: Data recorders. An Event Data Recorder (EDR) records the vehicle's dynamic, time-series data during the time period just prior to an event or during a crash event, intended for retrieval after the crash event [19]. The UNECE WP29 regulation provides specifications on the type and format of the data an EDR should collect, store and maintain prior to or during a crash event. The overall goal of EDRs is to improve car safety by facilitating data for crash investigations and improving the performance of safety equipment. The EDR does not record data continuously, it is only activated when a limited specified event happens. Among the triggering events listed in the UNECE regulation are:

- a change in longitudinal or lateral vehicle velocity more than 8 km/h within a 150m or less interval;
- activation of non-reversible occupant restraint system (e.g. airbag); and
- activation of vulnerable road user secondary safety system.[2]

The DSSAD is the Data Storage System for Automated Driving [17] and is mandated in all vehicles fitted with an Automated Lane Keeping System (ALKS). An ALKS is a driver activated assistance system which maintains the vehicle's trajectory within the lane by controlling lateral and longitudinal movements, without driver input [18]. ALKS corresponds with SAE level 3 of automation [11], as it is designed to perform the dynamic driving task instead of the driver in limited situations such as slow-moving traffic on motorways, and is limited to use in driving at no more than 37mph. Unlike the EDR, the DSSAD continuously records data.

Both the DSSAD and EDR are applicable to autonomous vehicles. The data parameters which must be recorded by AVs under the current international framework include the following:

Neither the EDR nor the DSSR record personal or sensitive data, namely VIN, associated vehicle details, location/positioning data, information on the driver, date and time of an event, audio or video feed. [16]. Manufacturers *may* equip vehicles with devices which record other data parameters including audio and video data, but currently there are no regulations which *oblige* manufacturers to store collect or store such data for the purposes of accident investigation.

2.1.1 International regulations on data sharing. In the event of an accident, there may be a need for data to be shared between involved parties or to authorities for the purpose of accident investigation or safety regulation. Relevant international provisions for data sharing in AVs are the General Data Protection Regulation [4] which concerns personal information, and the proposed EU Data Act, which would mainly relate to non-personal data. [3] The purpose of the GDPR is to create an international standard for the protection of personal data, which may be recorded and processed under certain conditions. Users must be provided with information about the purposes for which their data will be processed, and provided with the opportunity to refuse their data being used. Similarly, one of the objectives of the proposed EU Data Act is purported to allow users to take control of non-personal data which they generate via a product or a service. While both the GDPR and the proposed Data Act purport to give control to consumers, these regimes rely on users being cognisant of their rights, and being able to engage with the task of weighing complex consequences and benefits offered in contractual terms offered by manufacturers and developers [8]. This is relevant because as will be discussed below, it may be that some consumers are sceptical of any arrangement whereby a manufacturer is requesting use of their data for a commercial purpose, and would prefer that it was not an option at all.

[1] Also known as 'Agreement concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations (Revision 3) (https://unece.org/trans/main/wp29/wp29regs)..At the global level (including the USA and Canada), WP 29 has drafted an EDR Guidance document: - 'Guidance on Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreement Resolutions or Regulations' ("EDR Draft Guidance"), submitted by the Working Party on General Safety (GRSG).

[2] 'Vulnerable road user secondary safety system means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision' (UN Regulation No. 160)

Table 1: EDR: Annex 4 Table 1 Reg 160 and DSSAD Regulations 157

EDR (UN Regulation 160)	DSSAD (UN Regulation 157)[3]
Speed	Activation and deactivation of the system
Engine Throttle	Transmission demand
Air Bag Warning Lamp	Reduction or suppression of driver input
ABS Activity	Start and end of driver input
Steering Input	EDR trigger
	Detectable collision
	Minimum risk manoeuvre by system
	Severe AKLS failure
	System override by braking or steering input

2.2 Responsible Innovation

Legal frameworks and regulations provide one source of governance within research and innovation, but more flexible and granular forms of governance are also available to developers of novel technologies. Responsible Innovation (RI) is a form of anticipatory governance, which is an approach to developing new technologies that seeks to strengthen the relationship between innovators and the societies in which they are embedded. Commentators [7] [15] [22] have argued for many years that it is vital for the science and innovation establishment to recognise and engage with its societal context, pointing out that an absence of engagement (and responsiveness) can lead to both a lack of trust on the part of society and a lack of understanding in the innovation ecosystem of society's needs and desires. The net effect of these gaps in understanding may result in societal rejection of potentially useful technologies and a widening breach between 'science' on one side and 'society' on the other. Research on public trust in science in the UK [2] finds that citizens are often predisposed to trust science and innovation, but in order for innovations to be accepted it is seen as vital to retain that trust.

Part of that societal trust will depend on innovations being well-aligned with societal requirements in both a product and a process sense – this may mean not just creating innovations that society needs, but carrying out innovation out in a way that enables publics to have confidence in the methods used [1].

Responsible Innovation (or Responsible Research and Innovation, RRI) can be defined in a number of ways. A frequently cited framing is from von Schomberg:

> "Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)" [13].

This shows a focus on the relationship of trust between innovators and the society within which they operate. Within the UK context, another framing comes from Stilgoe et al, [15] who focus more on the relationship between the present and the future:

> "Responsible Innovation means taking care of the future through collective stewardship of science and innovation in the present." [15]

Both these definitions emphasise that an RI approach is about process, but that the point of improving the process is to obtain a better outcome for the future. RI is not about "rule-based" tick-boxes but rather is flexible, iterative, and reflexive [15]. It may include midstream modulation, adapting to changing circumstances and new information.

The RoAD project [10], funded as part of the Trustworthy Autonomous Systems Hub in 2021, was grounded in an RI mindset that anticipates potential outcomes. In this case the focus was on the investigation of accidents involving self-driving cars at various levels of autonomy. For such accidents to be investigated, data that is useable, sufficient, and accessible, must be available to parties including insurers, victims, police, and the legal system.

The project interrogates what this data might need to be, how it might be made available, whether additional data needs to be gathered in order to satisfy societal requirements (in addition to those of manufacturers, who may only be interested in a specialised stream of data), and what the ethical, legal and social implications of such data gathering might be. To do this, RoAD operationalised an RI approach that engaged with stakeholders - civil society groups, insurers, professionals - and drew these together to generate safety-critical scenarios. Reflecting on these, and further engaging with society through a public survey, the project aimed to make policy, governance, and safety recommendations as part of its outputs.

3 Survey methodology

The public survey was prepared at the beginning of 2022 and sought to canvass respondents' views about recording devices in autonomous vehicles. The focus of the survey was on the public's expectations about what data should be recorded by AVs, what that data could and should be used for, and who could and should have access to it. The survey respondents were recruited by Prolific, a company specialising in recruiting paid respondents for academic surveys [9]. The survey had a total of 317 respondents and a copy of the survey questions is contained in Appendix A.

3.1 Survey demographics

Prolific was instructed to distribute the survey to a wide variety of respondents covering different ages and socio-demographic characteristics. Consequently, the sample received was a proportional representation of the population of the UK in terms of professions, gender-balance, socio-economic indicators and ethnicity. The gender distribution of respondents was 52% female, and 47.3% male, with 0.3% non binary and the rest preferring not to say. The majority of the respondents (73%) described their ethnic background as white from the UK, with other groups represented including African, Indian, Chinese, Bangladeshi, Caribbean and Arab.

The analysis was derived from simple univariate statistics displayed in column graphs, indicating the numbers of respondents who gave what type of answer to each question. Respondents had been given either a proposed concept which they were then asked to rate on a Likert scale of scaled responses, including Strongly Agree, Agree, Neither Agree nor Disagree, Disagree and Strongly Disagree.

We have highlighted where answers were popular and showed support for a particular proposition, where opinions were more mixed, and where there was strong opposition to a concept. We set out below the initial analysis of the survey results.

3.2 Limitations

The public survey was a small study, limited by the size of the project. Further work with a larger and more robustly representative sample would be necessary to confirm our findings. However, the views about data recording in AVs which were expressed by our sample give a good indication of general public sentiment at this point in time and can serve as a useful benchmark for later studies on these questions.

4 Findings

Overall, our survey demonstrates many gaps in the general public's knowledge about the types of data which may be recorded by AVs, who has access to it, and how that data may be used. While respondents generally seemed aware that AVs had data-recording capabilities, far fewer people were aware that audio could be recorded inside a vehicle, and that some vehicles may also record data such as which seats were used, and which doors opened and closed, with associated timestamps. (These are current capabilities in some vehicles, not restricted to AVs).

While respondents indicated concerns about data privacy, particularly when it came to audio and video being recorded inside the vehicle, they were strongly supportive of video being recorded outside of the vehicle, especially where it was used to verify liability or investigate an accident. There was clear support from the respondents for AV data to be used to make vehicles safer. Respondents approved of organisations such as the police, independent safety bodies, and insurance companies having access to AV data for the purpose of accident investigation. Respondents supported the concept of an independent commission or body being formed to investigate AV accidents, and to regulate AV data. However, they did not support third parties having access to personal data for commercial purposes, even where consent was given. Some support was shown for anonymised and aggregated data to be given to third parties for the purpose of marketing or other commercial interests, where drivers and operators have provided consent. Respondents indicated that near-miss data was important to be recorded, and should be shared periodically with safety organisations, the manufacturer and the driver. Respondents were also supportive of driver and safety organisations having more detailed data about near-miss events, but not supportive of all road users having access to all data related to a near-miss event involving them. The data supporting the findings below can be found at Appendix B.

4.1 Current awareness of how AVs operate

The widest awareness of the data-recording capabilities of vehicles was around location data. Drivers are very familiar with satellite navigation devices, whether or not they use them, and are also familiar with location-tracking on phones.

- Most people (75%) are aware that AV's may record internal system data, for example; braking and acceleration
- A slightly higher proportion of respondents indicated they knew AV's could record location data (80%)
- Most respondents did not know that AV's could record audio and video inside the vehicle (62%)
- Most people did know that AV's could record audio and video outside of the vehicle (62%)
- Most people did not know that vehicles can record other data such as which doors had been opened, and which seats had been (67%)

4.2 Attitudes towards recording devices and their capabilities

Respondents consistently and in large numbers supported data-recording, storage and use for public-safety-related reasons, ie to improve accident investigations or aid in criminal investigation (for example where police are able to access video data of an incident that occurred near the vehicle). However, they were not supportive of data being made available to commercial organisations for purposes such as advertising.

- A majority of respondents (95%) indicated that AV's should be able to record data that could be used in accident investigations by insurers.
- The majority of respondents agreed that AV data should be available to an independent body such as a safety assurance body (87%)
- Most respondents (94%) agreed that AV data should be used by the police in relation to a vehicle incident
- Most respondents (75%) agreed that AV data should be used in relation to other crimes that were not related to the vehicle, however this is notably less than above
- Most respondents (74%) disagreed with AV data being used for commercial purposes (such as advertising)

4.3 What data should the AV record

Respondents had distinct views on the type of data they believed should be recorded. This included factors such as the use of the self driving system, the physical state of the vehicle's occupants, and the activities of other road users such as cyclists, children and

pedestrians. It should be noted that some of the stipulations around the driver's physical state are already being incorporated into legislative frameworks - in the US, for example, the Infrastructure

Investment and Jobs Act included a requirement for all vehicles sold in the US from 2024 to incorporate intoxication-detection technology as well as other monitoring systems [6].

However, while respondents were in favour of data which revealed the physical state of the occupants of the vehicle, they were generally not in favour of video being recorded inside the vehicle, or audio recording of conversations within the vehicle.

- Most respondents agreed that the AV should record;
  - When and where the system was activated (89%)
  - The physical state of the occupants, including whether awake, whether affected by drugs/alcohol (72%)
  - The use of vehicle entertainment systems (66%)
  - Other car and road users behaviour (such as cyclists, scooters and horse-riders) (83%)
  - Pedestrians and others using the pavement (63%)
- However most respondents disagreed with AVs recording;
  - Conversations in the car (79%)
  - Interior video (56%)
- When asked if they would be happy to travel in a car that could record conversations at any time, respondents strongly disagreed (80%)
- When asked if they would be happy to travel in a car that could record conversations 'only at my request', respondents were more amenable to this, with 64% agreeing they would be happy with this

4.4 When asked about how comfortable they would be being nearby or in a vehicle with a video recording device, AV respondents agreed they would be comfortable as:

- A cyclist (66%)
- A motorcyclist (62%)
- A traveller in a conventional vehicle (66%)
- A horse-rider (53%)

However, less than half of our respondents (48%) indicated the would be comfortable as a passenger in an AV (48%) that had a recording device, potentially indicating that citizens think of the interior of the car as a different type of space than the exterior, with some expectation of privacy.

4.5 When asked to think about the concept of "trust" in AVs, respondents said that trust depends upon:

- Being able to determine the cause of the incident (86%)
- Being able to find a responsible party when there is an incident (81%)
- Ensuring the right punishment for wrongdoing (63%)
- Ensuring mistakes did not happen again (85%)

Overall, respondents indicated they did not feel trust was affected by how the car looked, with only 12% agreeing this was a factor. This may prove to be a factor, however, in tests that have included 'eyes' on the front of vehicles to improve engagement between the AV and pedestrians.

4.6 Access to data

When asked about who should have access to AV data, respondents indicated they were strongly in favour of certain organisations or persons having access to all of an autonomous vehicle's data. The police were considered to be the most important body to have such access, with 87% agreeing with this. Lawyers representing people involved in the accident were also considered to be important (82%), and insurers were also high on the list (73%).

There was less, but still significant, support for allowing additional groups to have access to data, including anyone involved in the accident (63%); an independent accident-investigation body (71%), and the manufacturer (58%) The last point is particularly interesting, given that accident-data would be critical in evaluating safety-features of vehicles and informing future design, yet 42% of our respondents thought that manufacturers should not have access to data from the vehicle. This may be linked to the mistrust (discussed below) of data being put to commercial use.

Respondents indicated a mixed response about whether Government authorities such as the Department for Transport or the local transport authority having access to AV data

- Local authority (41% Agree, 27% neither Agree nor Disagree, 32% Disagree)
- DfT (40% Agree, 27% Agree, 33% Disagree)

4.7 Personal data

When asked about personal data, respondents indicated:

- Manufacturers and developers should only have access to anonymised personal data for the purpose of making improvements to their vehicles (85%)
- Manufacturers and developers should have access to all data (including personal data) for the purpose of making improvements to their vehicles (34%)

Respondents were less likely to agree that companies and third parties should have access to personal data for the purposes of advertising. Respondents indicated they were against personal data being provided to third party companies, even where the driver agreed. However more respondents were happy for anonymized data to be provided, if the driver/operator agreed.

- AV data should not be provided to third parties for advertising purposes (82%)
- AV data can be provided if the driver/operator agrees (27%)
- Aggregated and anonymized data can be provided to third parties if the driver agrees (66%)

Similarly, respondents did not agree that the Government or insurance companies should have access to personal data, even where the driver has agreed, but respondents agreed that the Government and insurance companies could have access to anonymized personal data, if the driver/operator agreed.

- Anonymized personal data can be provided to the Government if the driver operator agrees(79%)
- Anonymized data can be provided to insurance companies if the driver operator agrees (69%)

The exception to the above trend by the respondents against access to personal data, was in relation to the police having access to this data for the purpose of investigating criminal activity involving the vehicle, a person driving the vehicle, or a passenger in the vehicle. Here 77% of respondents agreed that the police should have access to all personal data.

4.8 In relation to near miss events

A 'near miss' event was defined as where there has been an incident involving an AV which did not cause harm, but had the potential to cause harm to human life or damage to another vehicle or property [12].

Respondents indicated that where the AV had been involved in a near miss event, that drivers/operators should be provided with all information relating to that incident, and that they should receive a periodic report summarizing near miss events. In addition, an independent body tasked with AV safety should be provided with such periodic reports, with support also shown for such a body to be given all data relating to such incidents. Respondents were less supportive of other road users or pedestrians involved in a near miss event being provided with data.

- The driver/operator should be provided with all data related to near misses (84%)
- The driver/operator should be provided with a periodic, aggregated report (88.9%)
- Anyone involved in a near miss event should be provided with all data related to the event (50%)
- An independent commission or body formed to investigate AV safety should be provided with all data related to near miss events (69%)
- An independent commission or body formed to investigate AV safety should be provided with a periodic aggregated report related to near miss events (78%)

4.9 Safety expectations and policy implications

Respondents also indicated that they considered recording devices in AVs would increase vehicle safety (75%), make roads and cities safer (60%), and help to verify liability in the case of an accident (84%).

The response was less strong when asked if they agreed whether recording devices would:

- increase trust in AVs (50%)
- make vehicles more comfortable (38%)
- decrease insurance costs (42%)
- provide benefits such as a personalized experience (33%)

Respondents also indicated that they considered recording devices to be a potential threat to privacy (70%), be a new target for cyber attacks (81%) and provide an indirect method of surveillance (70%). The high awareness of the potential misuses of such data may indicate that manufacturers and bodies concerned with governance should consider having robust protocols in place for the management and safeguarding of the data in order to maintain public trust.

4.10 Who should investigate AV accidents and who should regulate the data

Respondents indicated they were in favour of an independent body or commission being established to investigate accidents (80%) and also that an independent body should regulate AV data (80%).

5 Conclusions

Our public survey provided granular insights into attitudes towards what types of data parameters should be recorded by AVs, the circumstances in which the public would be willing to share this data, and what organisations this data should be shared with. The study showed support for AVs recording data parameters that could be used to determine the cause of an accident, and this included exterior video of other road users and pedestrians, information about the state of the driver at the time of the accident (intoxication, sleep), where the vehicle was located when the system was activated, and whether entertainment systems were in use. The survey indicated the public's willingness to share AV data with authorities such as the police. There was a clear demarcation in the public mind between the use of AV data to improve safety, and the use of data for commercial purposes. Even when the data might be used for other economic-related purposes, for example to provide a discount on a product, or where permission was expressly sought for the use of data for commercial purposes, there was a strong disinclination towards using data for these purposes. This stands in contrast to the types of data which must be recorded by AV under developing international instruments, and also international instruments which would permit the use of both personal and anonymised, aggregate AV data for commercial purposes.

Further, the survey responses did not support the recording of video and audio inside the vehicle, with respondents demonstrating unease around such a suggestion, and highlighted potential public concern regarding recording devices being used as an indirect method of surveillance, and a threat to privacy.

Crucially, these findings also indicate that the public expect AVs to record more extensive data parameters than are currently mandatory. The priority for the public is that data recorders are available and used to record information useful to improve the safety of vehicles, and to investigate accidents – they remain sceptical of data recorders which are used for any other purpose, even if it is done with permission.

As national governments develop frameworks which govern the development and use of AVs, and the use of AV data to improve public safety, the results of our survey provide indications of public priorities for this technology. Should AVs commence widespread operation without the ability to provide enough accurate data to determine accidents and improve safety, this may impact public confidence and uptake of AVs. Further, the public are wary of AV data being used by manufacturers and developers for commercial purposes, and do not necessarily feel protected via instruments such as GDPR or a contract seeking permission.

5.1 Recommendations to policy makers on public trust and safety

- Further research into public attitudes to data recorders is required, in particular exploring the use of external/internal

video data and location data for accident investigation by authorities and insurers.
- Engage with manufacturers about the technical and practical consequences of increasing the number of data recorder parameters required to be stored and shared for the purposes of accident investigation, including; location and external/internal video data.
- Engage with insurers about requirements for accident investigation for AVs, in particular how additional parameters such as internal/external video could be utilised, and how these could be securely processed and accessed.

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Appendix

A. Survey Questions

Section 1: Previous knowledge or experience of recording devices

These questions are about your current knowledge of recording devices in autonomous vehicles.

AVs record data as they operate. Please indicate yes or no to each of the following statements.

- I am aware that AVs may record internal system data - for example to do with braking and acceleration
- I am aware that AVs may record location data
- I am aware that AVs may record video and audio inside the vehicle
- I am aware that AVs may record other data - for example doors opening and closing, which seats are being used
- I am aware that AVs may record video outside the vehicle

Today's vehicles already have recording devices. These are usually referred to as Event Data Recorders (EDRs). The next set of questions examines attitudes towards such recording devices.

Section 2: Attitudes towards recording devices and their capabilities

These questions are about your views on the data recorded by autonomous vehicles.

Please indicate to what extent you agree with each of the following statements.

(eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree).

What type of data should autonomous vehicles record?

- AVs should record data that can be used in accident investigations by insurers
- AVs should record data that can be used in accident investigations by independent third parties (such as a safety assurance body)
- AVs should record data that can be used in investigations by the police related to a vehicle incident
- AVs should record data that can be used in investigations by the police related to other crimes or incidents
- AVs should record data that can be used for other purposes, such as commercial purposes (eg advertising)

Specifically, the AV should record

- When and where the self-driving system was activated
- The physical state of the car's occupants (awake or asleep; under the effect of drugs/alcohol)
- If the occupant(s) are using entertainment systems
- Other cars' and road users' behaviour (such as cyclists, scooters, horse-riders)
- Conversations inside the car
- Video inside the car
- Pedestrians and others on the pavement (eg children)

Please think about how comfortable you would be in the presence of an AV with a video-recorder on board and indicate to what extent you agree with each of the following statements:

- I would be comfortable as a pedestrian
- I would be comfortable as a cyclist,
- I would be comfortable as a motorcyclist;
- I would be comfortable as a traveller in a conventional vehicle,
- I would be comfortable as a passenger in an AV

[Free text] 4a Do your answers to question 4 depend on what data is being recorded by the vehicle?

The next questions are about what might lead people to trust that AVs are safe.

5. Please indicate to what extent you agree with each of the following statements. (eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree)

- Trust in AVs depends on being able to investigate the causes of an incident.
- Trust in AVs depends on being able to find someone responsible (eg user, manufacturer) in case of an accident
- Trust in AVs depends on what the cars look like
- Trust in AVs depends on ensuring the right punishment for wrongdoing
- Trust in AVs depends on ensuring mistakes do not happen again

[Free text] 5a Are there any other factors that might lead people to trust that AVs are safe?

The next questions are about how important privacy is to people in vehicles.

Please indicate to what extent you agree with each of the following statements. (eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree)

- I would be happy to travel in a car that could record what I am saying at any time
- I would be happy to travel in a car that could record me only at my request
- I would be happy to travel in a car that could record video of the inside of the vehicle
- I would be happy to travel in a car that could record video of the outside of the vehicle
- I would be happy to travel in a car where a third-party operator could monitor the vehicle and take control of it in an emergency

Section 3: Attitudes towards the collection, access, processing and use of data retrieved from data recorders

The next questions are about what data should be recorded and available in the event of a) incidents/ crashes, b) near misses and c) other circumstances.

7. Please indicate to what extent you agree that each of the organisations identified should have access to all data recorded by an automated vehicle in the event of an incident (such as a crash) (eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree)

- Insurers of vehicle/s involved should have access to all data
- The police should have access to all data
- Legal professionals representing those involved in the incident should have access to all data
- Anyone involved in the AV incident (including the driver/operator, passengers, pedestrians, those in another vehicle) should have access to all data
- Non-governmental organisations related to vehicle safety should have access to all data
- Central Government Departments such as The Department for Transport should have access to all data
- The Local Government authority (eg the council in charge of roads) where the incident occurred should have access to all data
- An independent commission or body formed to investigate AV accidents and safety should have access to all data
- The manufacturer of the AV should have access to all data

8. For this question a 'near miss event' is defined as where there has been an incident involving an AV which did not cause harm, but had the potential to cause harm to human life or damage to another vehicle or property (Sanders 2015)

We would like to know your views on:

- whether data related to a near miss event should be reported,
- to what organisation it should be reported, and
- whether the report should be an an aggregated summary format (which does not disclose personal data), or whether access to all the relevant data is necessary

Please indicate the extent to which you agree or disagree with the following statements:

- Insurers of vehicles should be provided with a periodic aggregated report summarising near miss events
- Insurers of vehicles should be provided with all data related to near miss events

- The driver/operator should be provided with a periodic aggregated report summarising near miss events
- The driver/operator should be provided with all data related to near miss events
- Anyone involved in the near miss event (including the driver/operator, passengers, pedestrians, those in another vehicle) should be allowed to access all data related to the near miss event
- An independent commission or body formed to investigate automated vehicle accidents and safety should be provided with a periodic aggregated report summarising near miss events
- An independent commission or body formed to investigate automated vehicle accidents and safety should have access to all data related to near miss events

9. Please indicate the extent to which you agree or disagree with the following statements related to the data recorded by an autonomous vehicle in circumstances not related to incidents or near miss events

- Manufacturers and developers should have access to all AV data for the purpose of making improvements to their vehicles
- Manufacturers and developers should only have access to aggregated data and anonymised/pseudonymised personal data for the purpose of making improvements to their vehicles
- AV data should not be provided to any third party for the purpose of marketing and advertising products or to provide drivers/operators with discounts
- All AV data can be provided to a third party for the purpose of marketing and advertising, if the AV driver/operator is aware and explicitly agrees
- Only aggregated and anonymised/pseudonymised personal data an be provided to a third party for the purpose of marketing and advertising, if the AV driver/operator is aware and explicitly agrees
- Insurance companies should have access to aggregated data and anonymised/pseudonymised personal data for the purpose of designing better insurance products and premiums
- Government departments such as the Department for Transport should have access to all AV data for the purpose of verifying safety of AVs
- Government departments should only have access to aggregated data and anonymised/pseudonymised personal data related to AVs or the purpose of verifying safety of AVs
- Police should have access to all AV data for the purpose of investigating criminal activity involving the vehicle, a person driving the vehicle, or a passenger in the vehicle
- Police should have access to all AV data for the purpose of investigating criminal activity taking place outside the vehicle which may have been recorded by devices in the vehicle

Section 4: Expectations, concerns and policy implications

The next questions are about what data recorders might provide in terms of benefits and downsides, and who you think should be in charge of making decisions about data recorders

10. Please indicate to what extent you agree with each of the following statements. (eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree) Recording devices. In autonomous vehicles will:

- Increase safety in self-driving cars
- Verify liability in case of accidents
- Increase trust in AVs
- Make autonomous driving more comfortable
- Decrease insurance costs
- Be a new business opportunity for big-data companies
- Be a way to make roads and cities safer
- Be an opportunity to enjoy a personalised experience in an AV
- Be an opportunity to enjoy benefits derived from sharing data to companies (such as insurance discounts)
- Be a threat to privacy
- Be a new target for cyber attacks
- Reduce our freedom
- An indirect way of surveilling (monitoring) citizens

11. We would like to know your views as to what type of body or authority should control autonomous vehicle data and recording devices, and what type of bodies should investigate AV accidents. Please indicate to what extent you agree with each of the following statements. (eg Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree)

An independent body or commission should be established to investigate accidents involving automated vehicles,

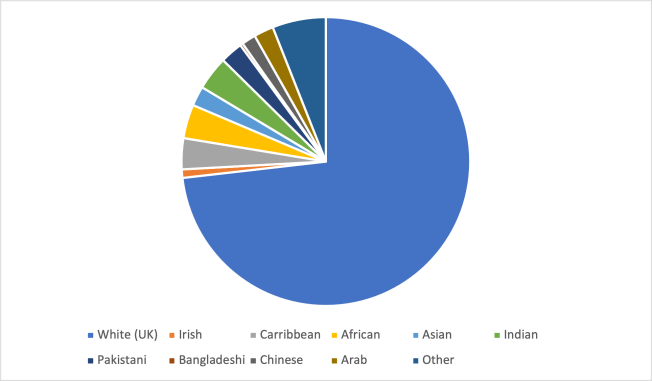
An independent body or commission should be established to regulate data from automated vehicles and recording devices

Police already investigate vehicle accidents and a new type of body is not necessary

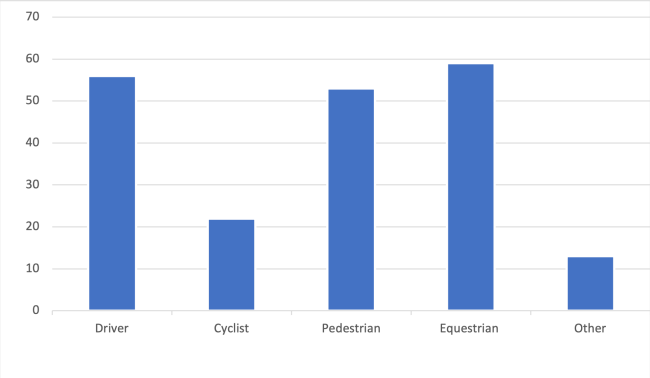
Personal data recorded by automated vehicles is already regulated by the Information Commissioners Office, a new independent body is not necessary.

B. Survey results

DEMOGRAPHIC DATA



Ethnic background of respondents

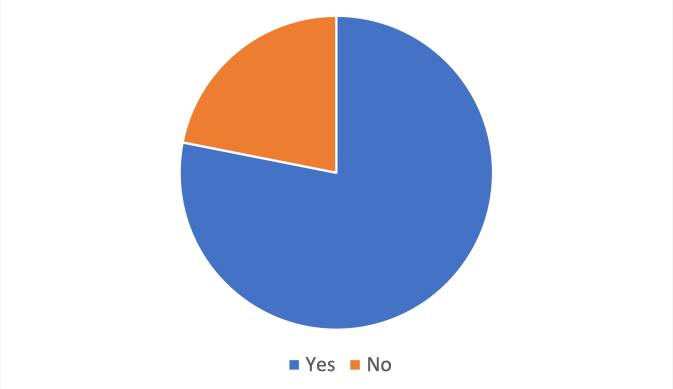


Type of Road User

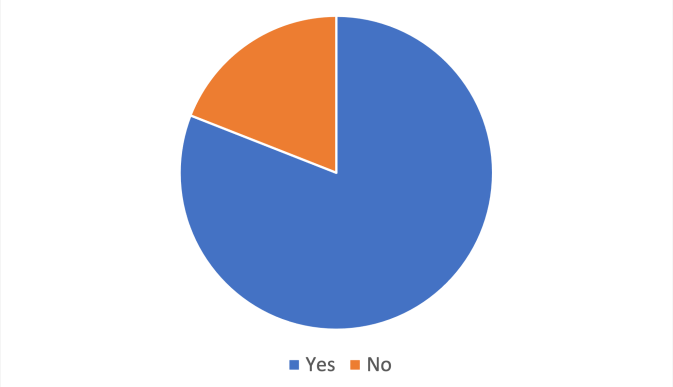
Section 1: Previous knowledge or experience of recording devices

Awareness of data recorders and their capabilities

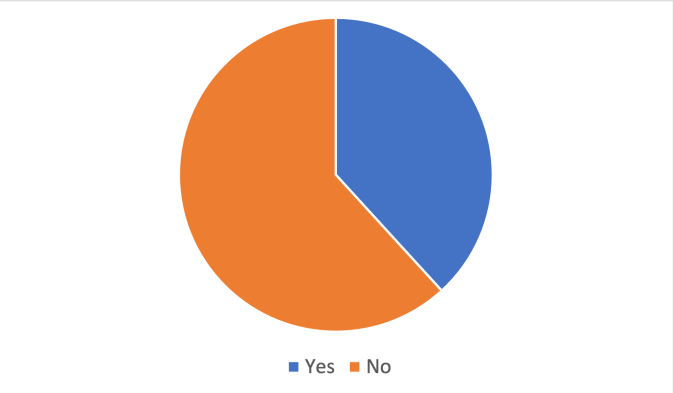
I am aware that AVs may record internal system data- for example braking and acceleration (Yes: 78.1%)



I am aware that AVs may record location data (Yes 81%)



I am aware that AVs can record audio inside the vehicle (Yes: 38.2%)

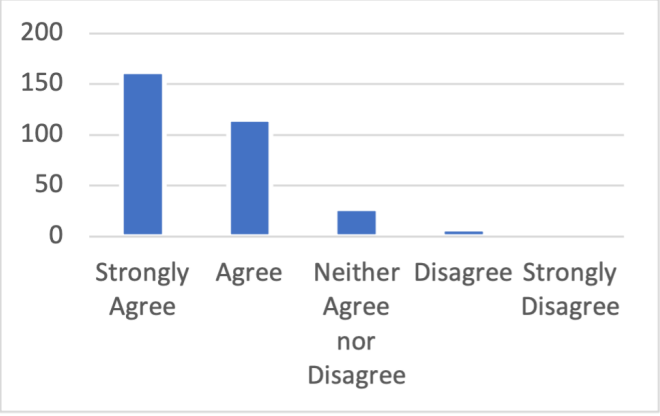


I am aware that AVs can record other data, such as opening of doors, which seats are being used (Yes 49.5%)

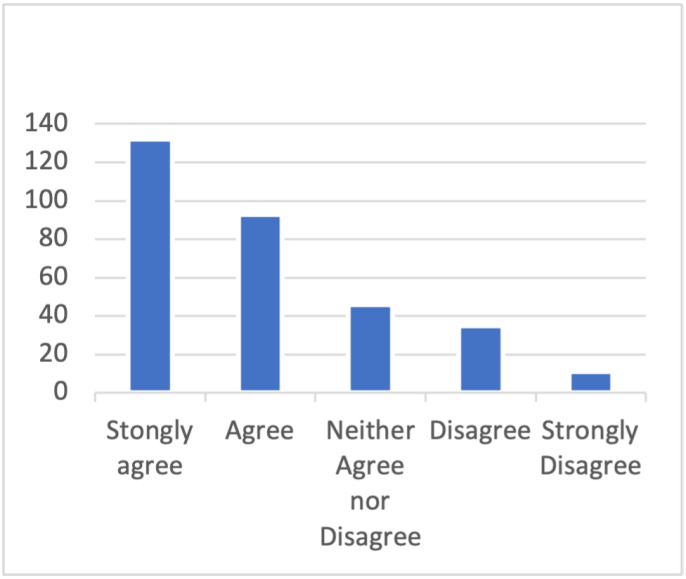
I am aware that AVs may record video outside of the vehicle (Yes: 68.9%)

Section 2: Attitudes towards recording devices and their capabilities

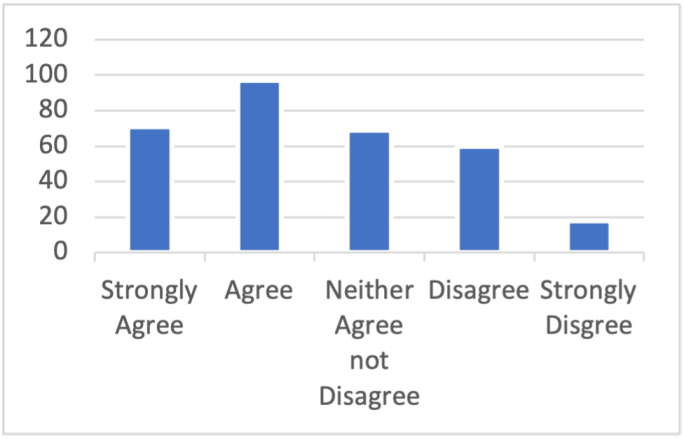
The AV should record when and where the system was activated



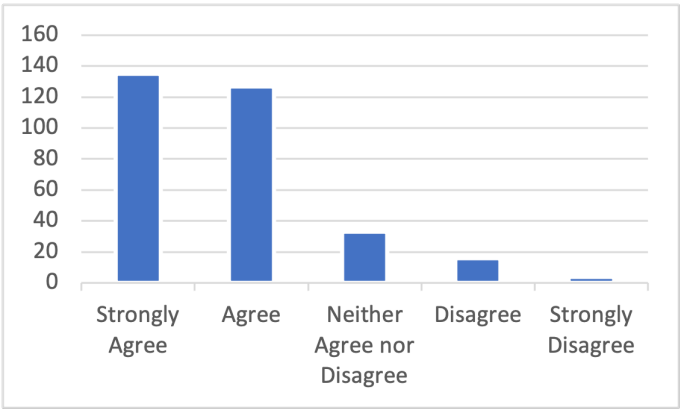
AVs should record the physical state of the vehicle's occupants, including whether awake or asleep, under the effects of drugs/alcohol



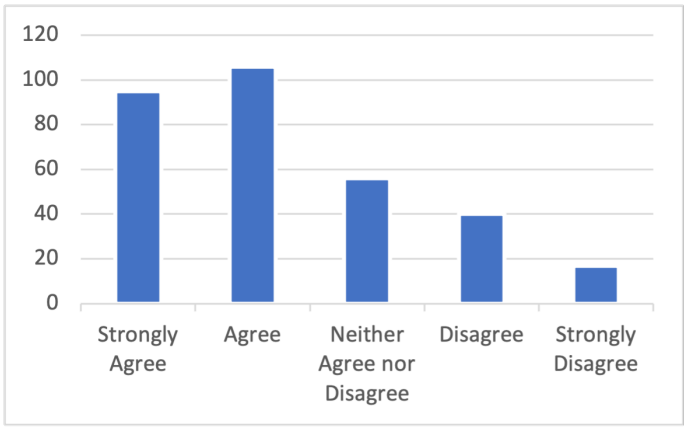
AVs should record If the occupants are using the entertainment system



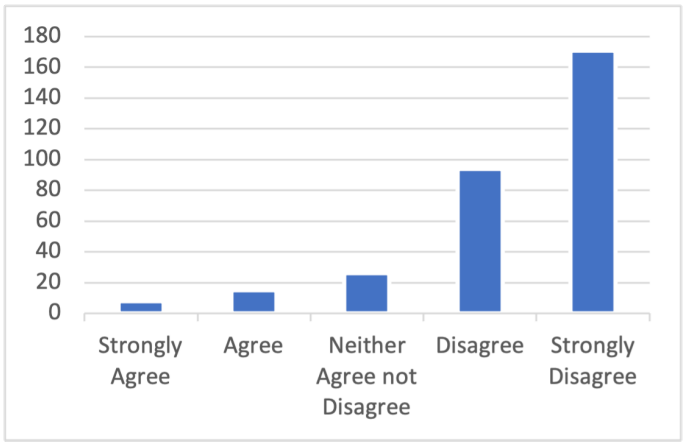
AVs should record other road user's behaviour such as cyclists, scooters and horse-riders



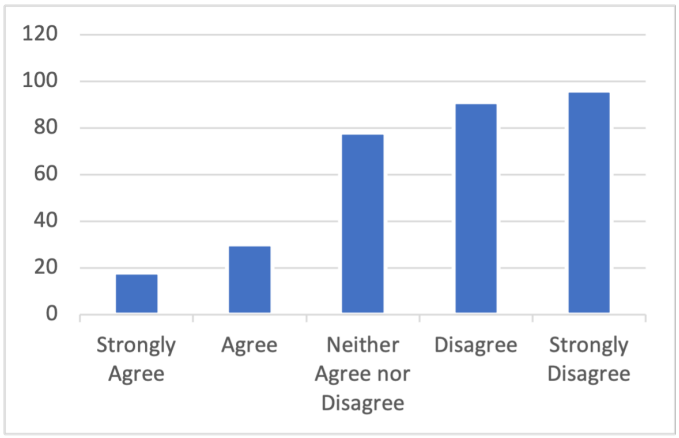
AVs should record pedestrians and others on the pavement (including children)



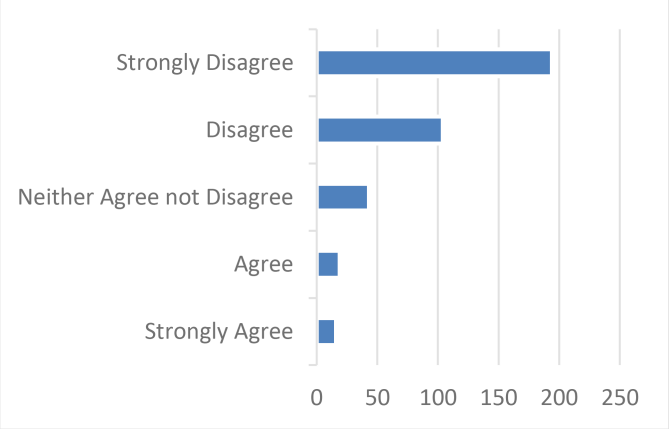
AVs should record Conversations in the car



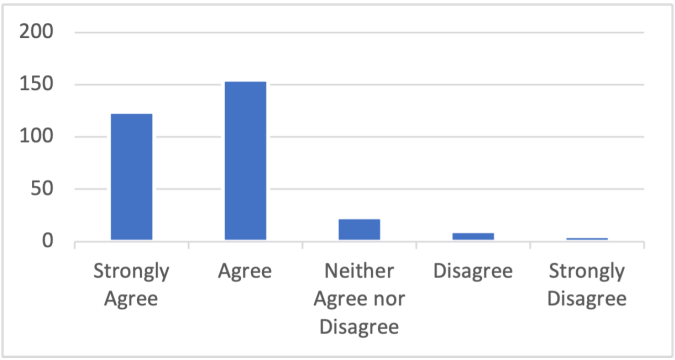
AVs should record Video inside the car



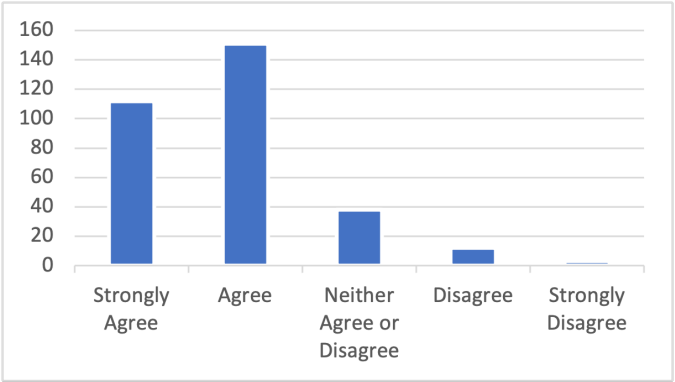
AVs should record Conversations in the car



Trust depends on being able to investigate the cause of the accident



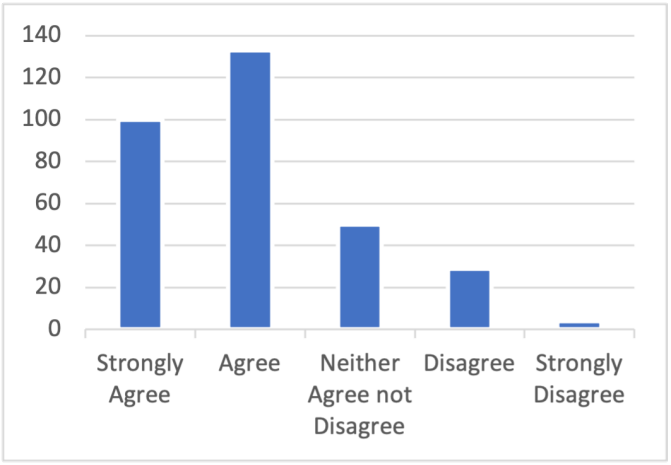
Trust depends on being able to find someone responsible (eg manufacturer) in the case of an accident



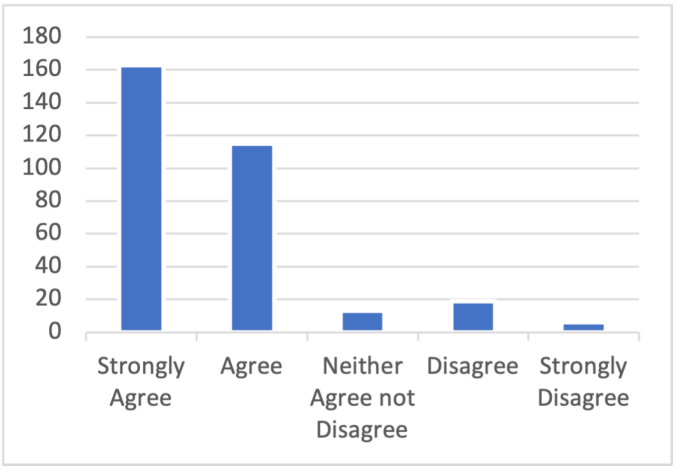
Trust depends on ensuring mistakes do not happen again

Section 3: Attitudes towards the collection, access, processing and use of data retrieved from data recorders

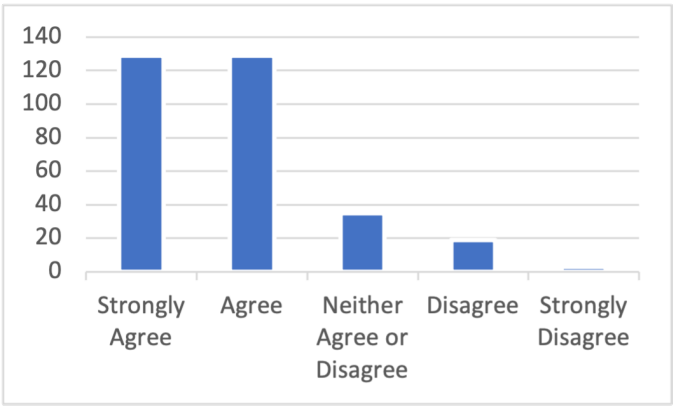
Insurers of vehicles should have access to all data



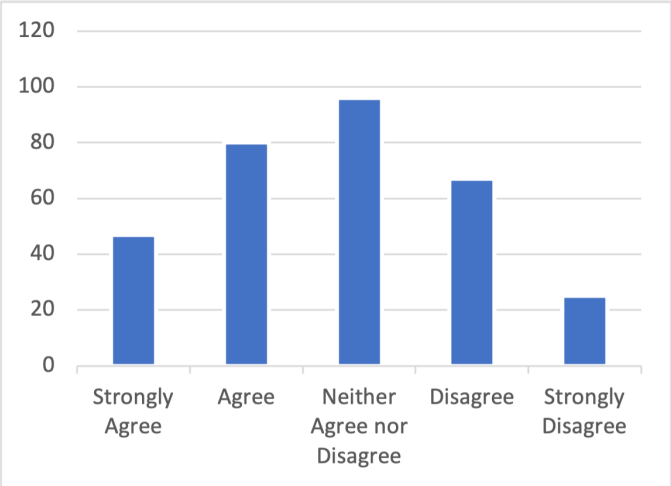
The police should have access to all data



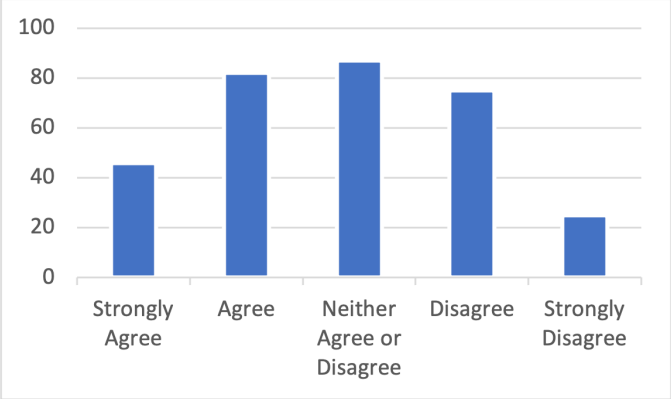
Legal professionals representing those involved in the incident should have access to all data



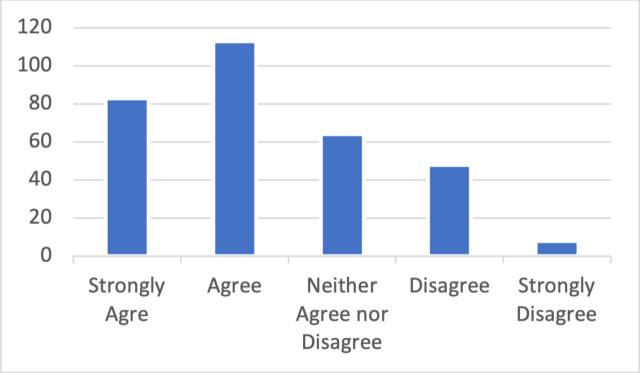
Non-governmental organisations related to vehicle safety should have access to all data



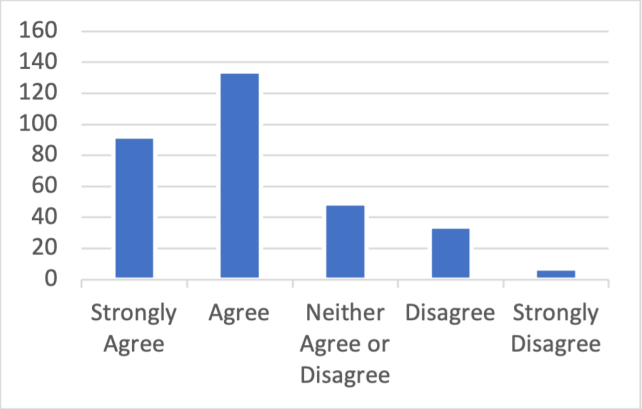
Central Government Departments such as the Department for Transport should have access to all data



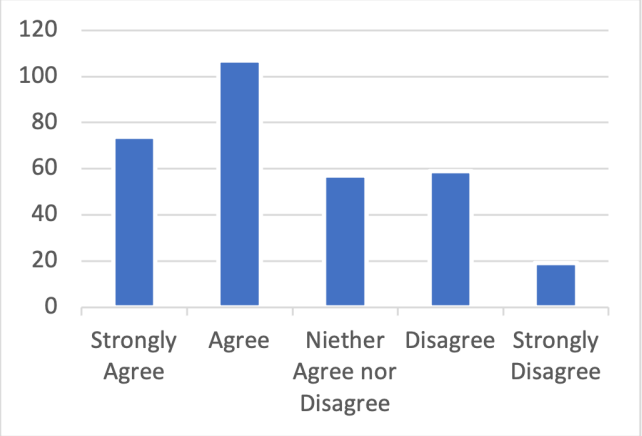
Anyone involved in the incident should have access to all data (ie driver/operator, passengers, pedestrians, those in another vehicle)



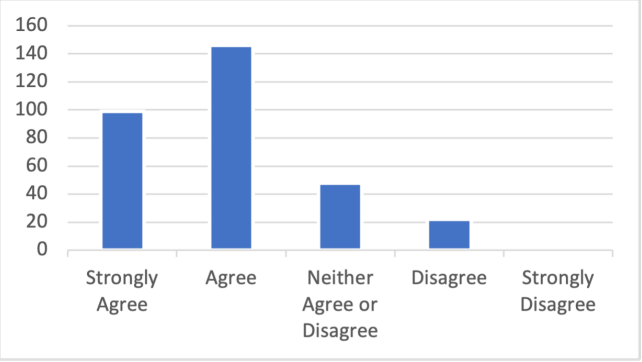
An independent commission or body formed to investigate AV accidents should have access to all of the data



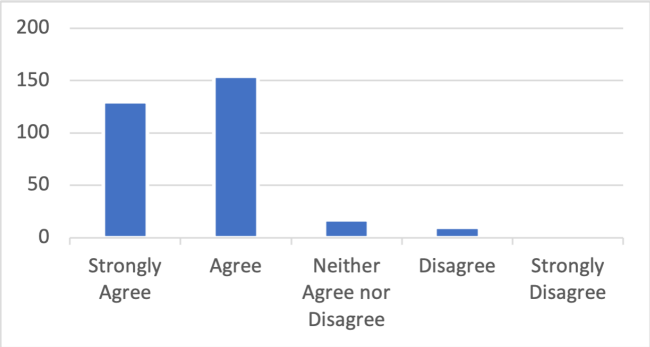
The manufacturer should have access to all of the data



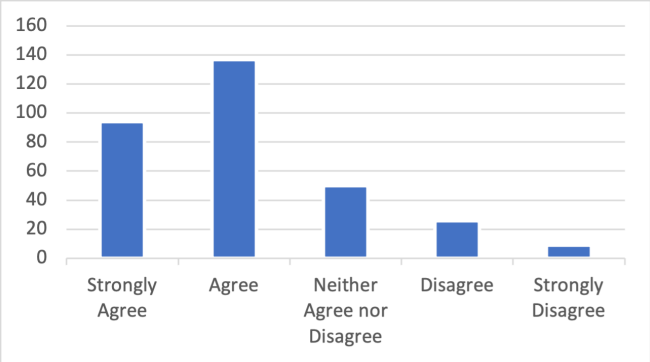
Section 4: Expectations, concerns and policy implications
Recording Devices will increase safety in self-driving cars



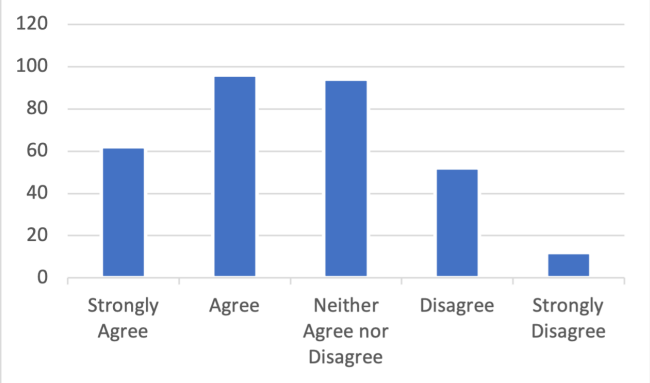
Recording Devices will verify liability in accidents



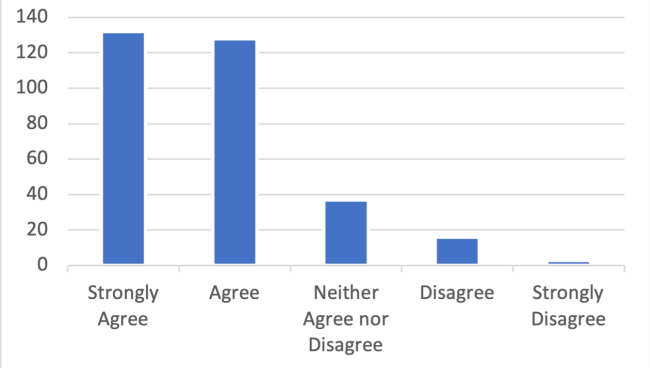
Recording Devices will be an indirect way of monitoring citizens



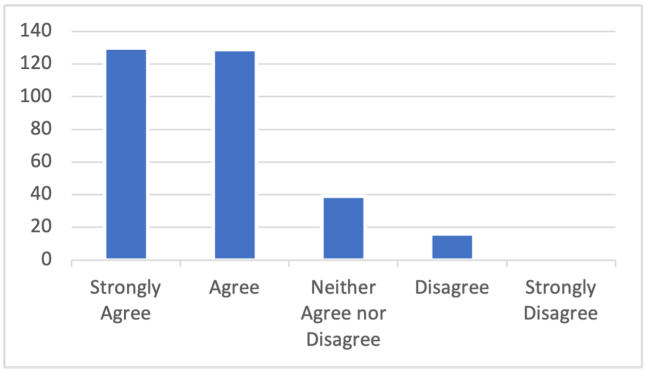
Recording Devices will reduce our freedom



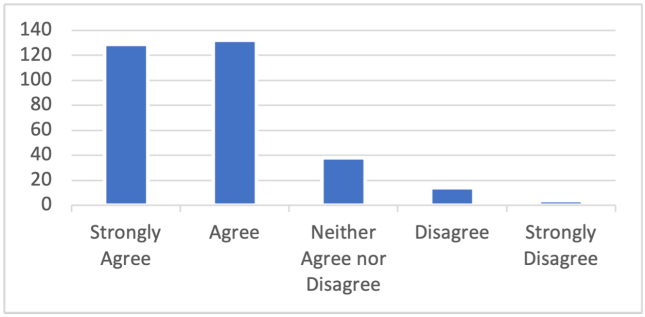
Recording Devices will be a new target for cyber attacks



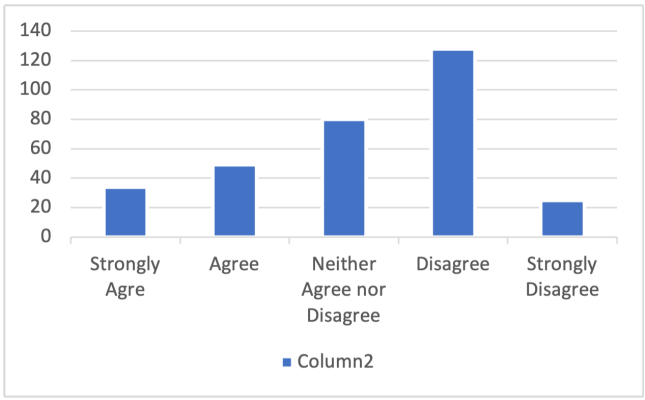
An independent body should be established to investigate accidents involving AVs



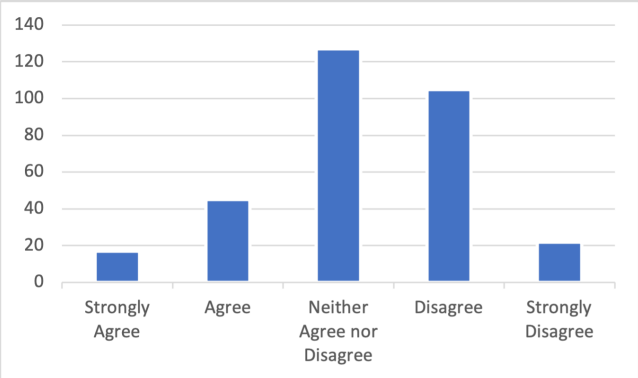
An independent body should be established to regulate data from AVs and recording devices



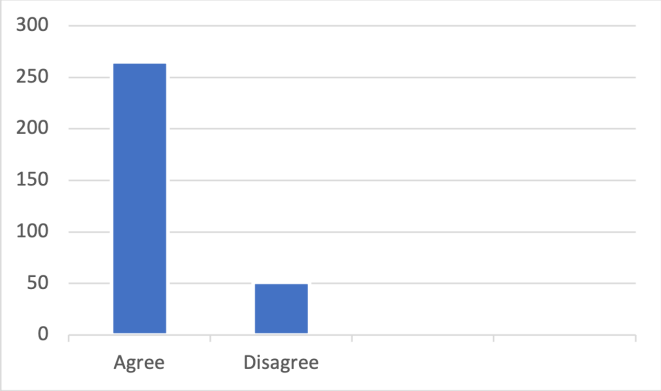
Police already investigate accidents, a new body is not necessary



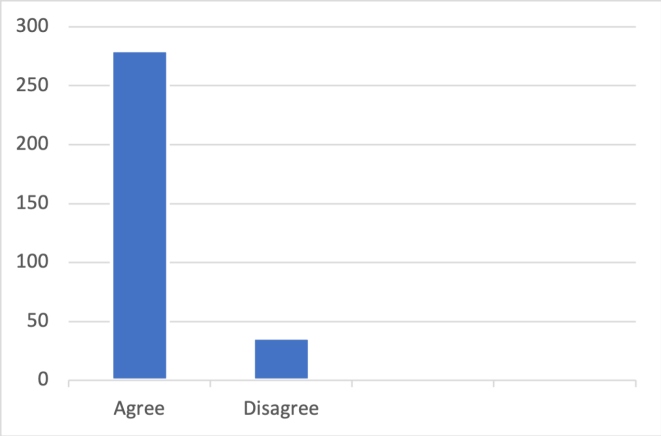
Personal data is already regulated by the Information Commissioners Office, a new body is not necessary



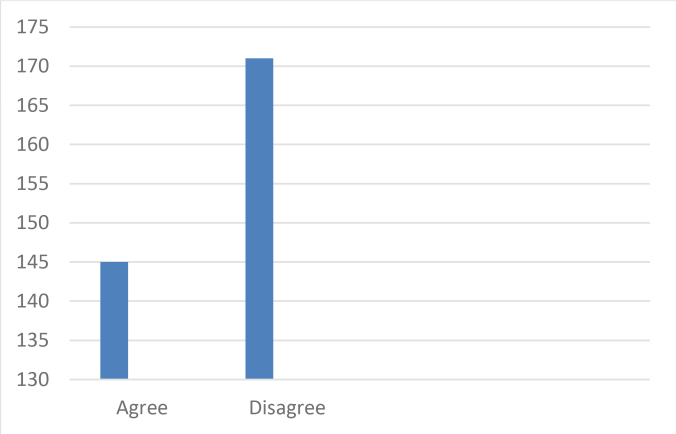
The driver/operator should be provided with ALL DATA related to near miss events



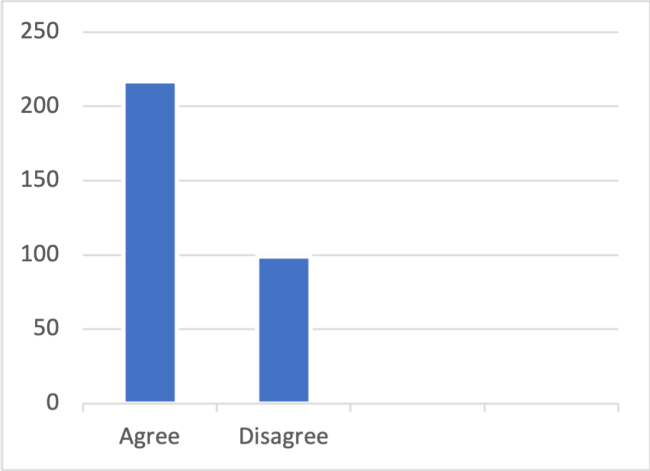
The driver/operator should be provided with a periodic report summarising near-misses



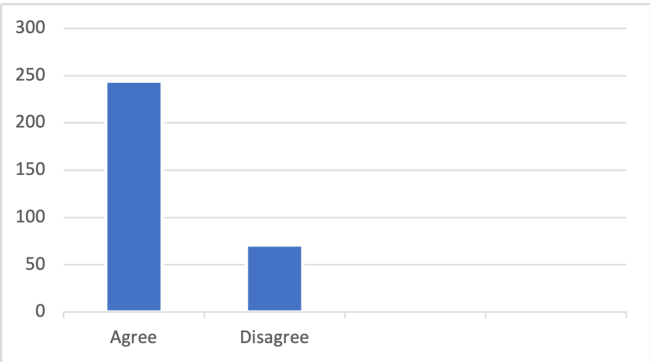
Insurers should be provided with ALL DATA related to near miss events



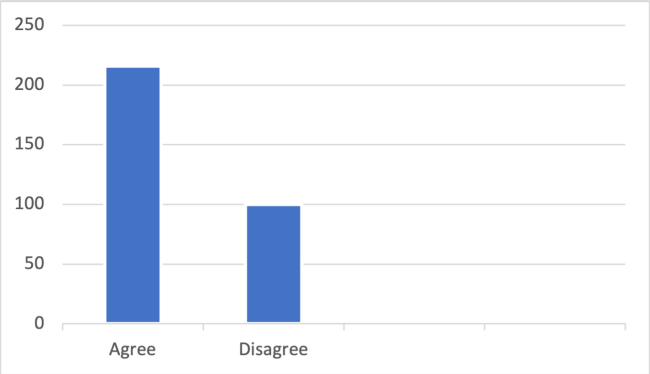
Insurers should be provided with a periodic and aggregated report summarizing all near miss events



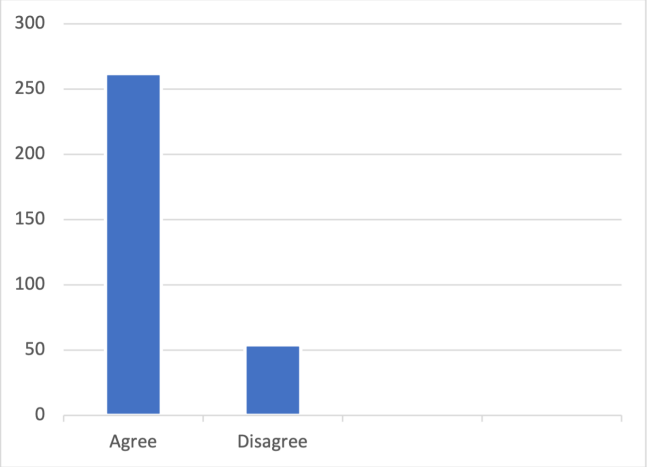
An independent body or commission should be provided with a periodic and aggregated report summarising all near miss events



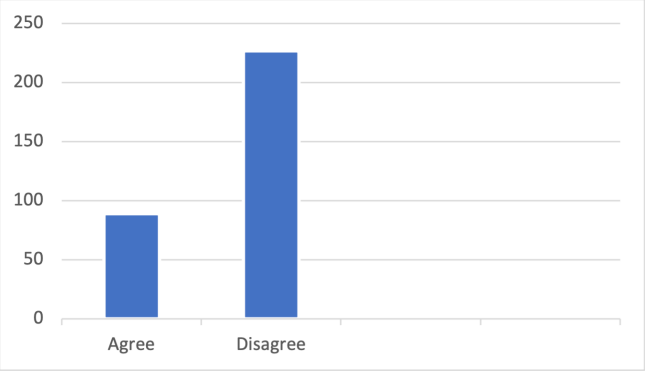
An independent body or commission should be provided with ALL DATA related to near miss events



AV data should not be provided to a third party for the purpose of marketing and advertising products, or to provide drivers/operators with discounts



All AV data can be provided to a third party for the purpose of advertising as long as the driver/operator is aware and agrees



Only aggregated and anonymised data can be provided to a third party for the purpose of advertising if the driver agrees