

THINK GOOD MOBILITY

**AUTONOMOUS VEHICLES
NEGOTIATING A PLACE ON THE ROAD**

A study on how drivers feel about interacting
with Autonomous Vehicles on the road

Executive Summary



THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE





The research data presented in this document was obtained using a combination of focus groups – in four European countries with a total of 48 participants – and an online survey covering approximately 12,000 respondents in 11 European countries.

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ABOUT GOODYEAR

Goodyear, founded in 1898 in Akron, Ohio, is one of the world's largest tire companies. It employs approximately 66,000 people and manufactures its products in 49 facilities in 22 countries around the world.

Its two Innovation Centers in Akron, and Colmar-Berg, Luxembourg strive to develop state-of-the-art products and services that set the technology and performance standard for the industry.

ABOUT LSE

The London School of Economics and Political Science (LSE) is one of the foremost social science universities in the world.

LSE is a specialist university with an international intake and a global reach. Its research and teaching span the full breadth of the social sciences, from economics, politics and law to sociology, anthropology, accounting and finance.

Founded in 1895, the School has an outstanding reputation for academic excellence. 16 Nobel Prize winners have been LSE staff or alumni. The School has a cosmopolitan student body, with around 9,500 full time students from 140 countries. LSE has a staff of over 3,000, with about 46 per cent drawn from countries outside the UK.



BACKGROUND

Autonomous vehicles (AVs) are on their way. How quickly they arrive and their impact when they get here remains unknown.

A wide body of literature already exists on this impending arrival. Much of it focuses on the technical challenges of delivering this new technology, as well as the readiness of drivers to switch to AVs from conventional vehicles. A number of surveys have already shown many drivers to be reluctant, and concerned about the arrival of driverless cars, even though some are enthusiastic. The challenge is to understand the factors underlying these divergent responses. This is crucial if we are to understand how AVs can find their place on the roads.

In 2015, the London School of Economics (LSE) and The Goodyear Tire & Rubber Company researched how drivers carry out and experience interactions with others on the road, analysing the unwritten rules many say they follow. This year, LSE and Goodyear have gone further in studying how drivers feel about interacting with AVs on the road.

INTRODUCTION

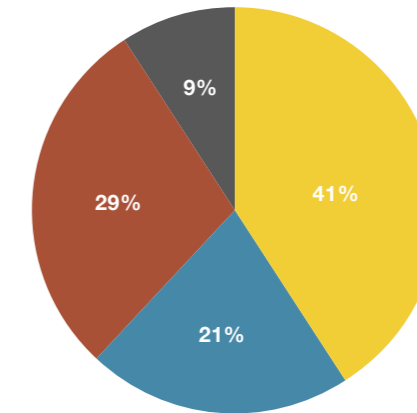
This research views the road as a “social space.” Drawing on a combination of focus groups – in four European countries with a total of 48 participants – and an online survey covering approximately 12,000 respondents in 11 European countries, the research uncovers a number of rationales behind drivers’ responses to AVs.

We aim to measure and understand the level of “openness” people have towards AVs and, conversely, the situations in which people hope to avoid engaging with these vehicles. We argue that a successful introduction of AVs will ultimately depend on understanding and addressing the complex attitudes that define the public’s view of this new technology.

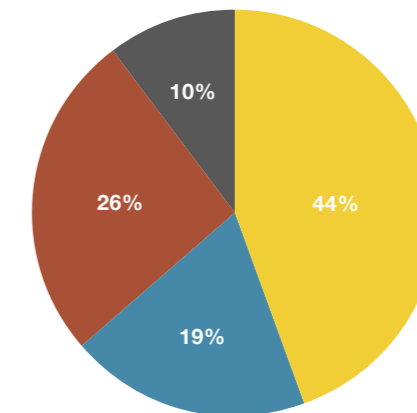
COMFORT

The research gauges people’s readiness to share the road with AVs in two ways. First, we ask how comfortable people are with the prospect by asking two direct questions: “How would you feel about driving alongside autonomous cars?” and “How would you feel about using an autonomous (driverless) car instead of driving a traditional car?”

26% of respondents describe themselves as comfortable (either totally, very, or quite) with the idea of using an AV and 29% for driving alongside one. Conversely, 44% feel uncomfortable about using an AV, whilst 41% feel uncomfortable about driving alongside one.



Total: driving alongside
No. of respondents: 11,827



Total: using an AV
No. of respondents: 11,827

- All levels of uncomfortable
- Neither comfortable nor uncomfortable
- All levels of comfortable
- Don't know

OPENNESS

To understand these diverging levels of comfort, we ask respondents for their reaction to arguments for and against AVs including perceptions of safety, the reliability of the technology, the likely ease of interacting with AVs and overall attitudes towards and enjoyment of driving. Using responses to 14 of these survey items we built a scale measuring respondents' "openness to AV."

Analysing the responses to the questions used to generate this scale gives an interesting picture of both the positive potential that respondents see in AVs, as well their persistent concerns with the technology.

Safety is clearly an area where respondents feel more positively about AVs. Twice as many respondents agreed (43%) than disagreed (19%) with a key argument for AVs, that "Most accidents are caused by human error, so autonomous vehicles will be safer." Moreover, almost twice as many agreed (37%) as disagreed (21%) that "Machines don't have emotions so they might be better drivers than humans." In both instances the remaining respondents either said they didn't know or that they neither disagreed nor agreed.

However, concerns about AV technology persist, with 73% of respondents fearing that "Autonomous Vehicles could malfunction." As do concerns about AVs social skills, with 60% agreeing that "Machines don't have the common sense needed to interact with human drivers."

Despite the wide publicity accorded to AVs recently, the technology is unfamiliar to most people. Few people have sat in an AV, and many have never even seen one of the test vehicles on the road. So this cautious response does not necessarily mean the public will not come to terms with AVs.

Focus group participants generally acknowledge that AVs will one day be a familiar sight on our roads, and some suggest that people will need to get used to the idea. Over half (60%) of survey respondents say they "don't know enough about driverless cars" when asked to think about the reasons behind their opinions. So there is an opportunity to reassure and inform.

FAMILIARITY

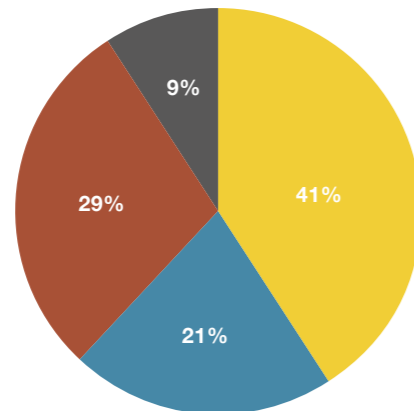
Although people have had little exposure to AVs to date, it is noticeable that survey respondents became more positive the more they reflected on AVs. Even when required to think about AVs for an average of just 20 minutes, respondents were more likely to express themselves comfortable with the prospect.

Having been asked about their comfort with AVs at the beginning of the survey, they were asked again at the end. Ultimately 32% of respondents said that they would be comfortable using an AV, while 34% that they would be comfortable driving alongside one, increases of 6 and 5 percentage points respectively.

Total: driving alongside

Early in questionnaire

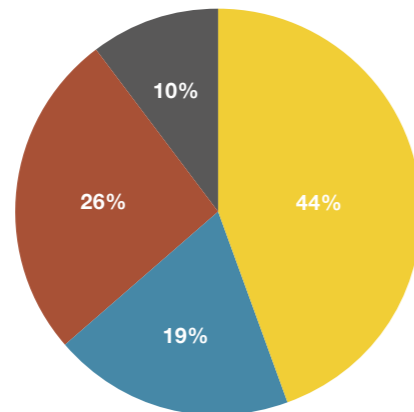
No. of respondents: 11,827



Total: using an AV

Early in questionnaire

No. of respondents: 11,827



agreed most accidents are caused by human error.



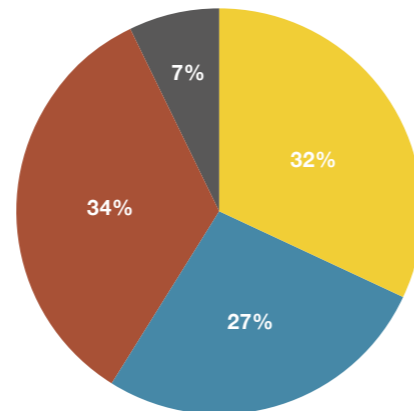
of respondents say they don't know enough about driverless cars.

- All levels of uncomfortable
- Neither comfortable nor uncomfortable
- All levels of comfortable
- Don't know

Total: driving alongside

At end of questionnaire

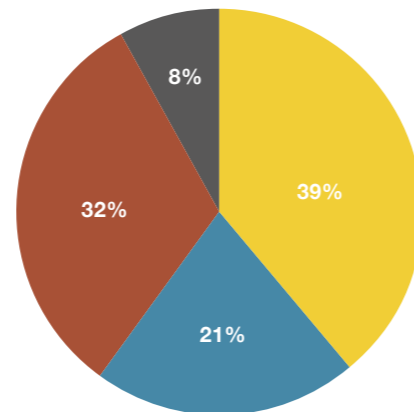
No. of respondents: 11,827



Total: using an AV

At end of questionnaire

No. of respondents: 11,827



This suggests that greater familiarity has the potential to alleviate people's concerns regarding AVs. However, as we saw above, many people still have fundamental misgivings about the technology. Exploring these feelings is crucial to understanding people's overall openness to AVs.

PERCEPTION

The purpose behind creating the scale measuring people's openness to AVs is to compare this to other attitudes that may contribute to their level of openness. Enjoyment of driving, broader ideas about what driving constitutes and ultimately the way in which respondents look at AVs all have a significant relationship with their openness to the technology.

An important element of drivers' experience is the need to feel in control of their driving. Drivers who use technology in the car, such as cruise control or satnav, are already ceding some of this control. Not surprisingly, the research shows that respondents who already rely more on in-car technology are, on average, more open to AVs. So, while only 15% of respondents say that they regularly use cruise control, of these 61% are in the top half of the scale in terms of openness to AV.

Nevertheless a "gut feeling" persists among most survey respondents that there needs to be a human driver in control of the vehicle, with 70% agreeing that "As a point of principle, humans should be in control of their vehicles." Moreover, when asked whether they thought an AV should have a steering wheel, 80% of respondents said it should.

When seen, therefore, as the outcome of a gradual increase in automation, there is still concern about AVs when the level of automation is felt to go too far. Perceptions change when AVs are seen as no longer being a "car" in the traditional sense of a vehicle with a human driver.

Without a driver in control in the driving seat, some focus group participants viewed AVs less as a car and more as a taxi or bus providing a mobility service.

"A car without a driver isn't really driving anymore. You'd just get on a bus, or on a train."

(Spanish Participant)

Removing the driver from the equation notably softens participants' concerns when they consider the potential of AVs to weed out the bad behaviour of others. Participants generally expect AVs to be 'well-behaved' and abide by the rules of the road.

"We'll be overwhelmed by niceness."

"They're never going to do anything horrible to us. They're nice cars. They're not going to cut us up or get up our backsides and all the other things."

(UK Participant)

As in our previous research, which showed that good driving encourages others to drive more co-operatively in what we called a "ripple effect", some focus group participants imagined human drivers responding in kind to AVs.

"Eventually it might cause people's own driving behaviour to evolve."

(UK Participant)

Within focus group discussions, participants readily discussed the advantages that would come from giving up control as a driver, such as being able to have a coffee or read the newspaper. Survey respondents were less ready to embrace the possibilities, few saying that they would sleep (19%) or watch a video (18%) if they didn't have to pay attention to the road.

And fully 82% answer "probably or definitely" to the question "If using an AV and not needing to pay attention to the road, would you...prefer to keep aware of the road around you?"



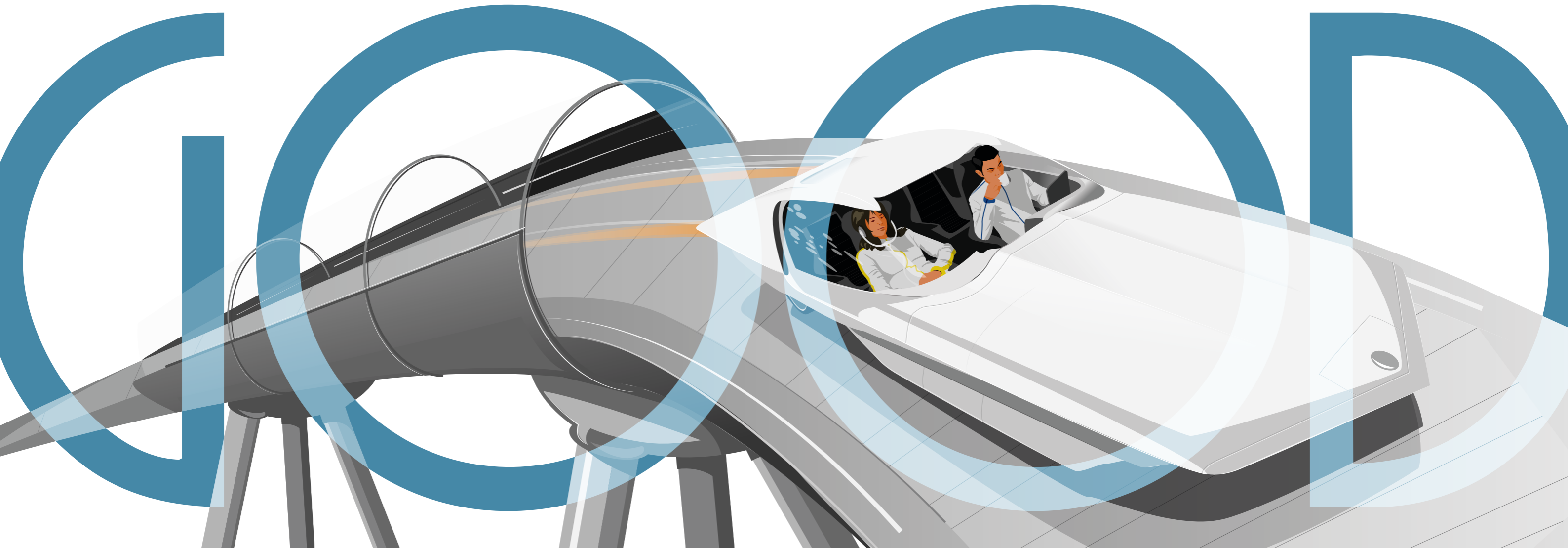
agree that humans should be in control of their vehicles.



think AVs should have a steering wheel.



would sleep in a driverless car.



TECHNOLOGICAL OPTIMISM AND DRIVER SOCIABILITY

As few respondents or participants are likely to have actually travelled in an AV, their response to AVs is based less on experience than on their feelings towards technology in general and their experiences of life on the road as a driver. Understanding both of these factors and how they interact with one another is therefore crucial in developing a clearer picture of their overall attitudes towards AVs.

Perception of technology has shifted considerably over time and today, technologies tend to change quickly from being a novelty to becoming everyday essentials. Our “TechOptimism” scale uses responses to seven items from the survey to measure participants’ levels of optimism about technology. When correlated with our “Openness to AV” scale, it shows that respondents with higher levels of “TechOptimism” are, not surprisingly, more open to AVs, on average.

Whether or not you see driving as a social activity and enjoy negotiating your way through the road reflects your sociability as a driver, and also influences how open you are to AVs. To measure this, we use a “driving sociability” scale, generated by the responses to 12 items from the survey, to indicate whether respondents are more “co-operative” or more “combative” drivers.

One of these items was the statement: “When I am in a queue of traffic that is merging with another, I just force my way in.” Of those measured in the top half of the “driving sociability” scale, 90% said they would never, or only occasionally, do this. In contrast, of those measured in the bottom or more “combative” half, 42% agreed they would “sometimes, usually or always” do this.

Again by correlating our “driving sociability” and “Openness to AV” scales, we show that more “co-operative” road users tend to be less

open to AVs. Thus, although only 25% of all respondents say they will “sometimes, usually or always” push in to the queue, of that group, 64% are in the top half in terms of openness to AV.

More “co-operative” drivers see driving more as a social activity and enjoy the interaction with other drivers on the road. If you view the road as a social space, you will consciously negotiate your journey with other drivers. People who like that negotiation process appear to feel less comfortable engaging with AVs than with human drivers.

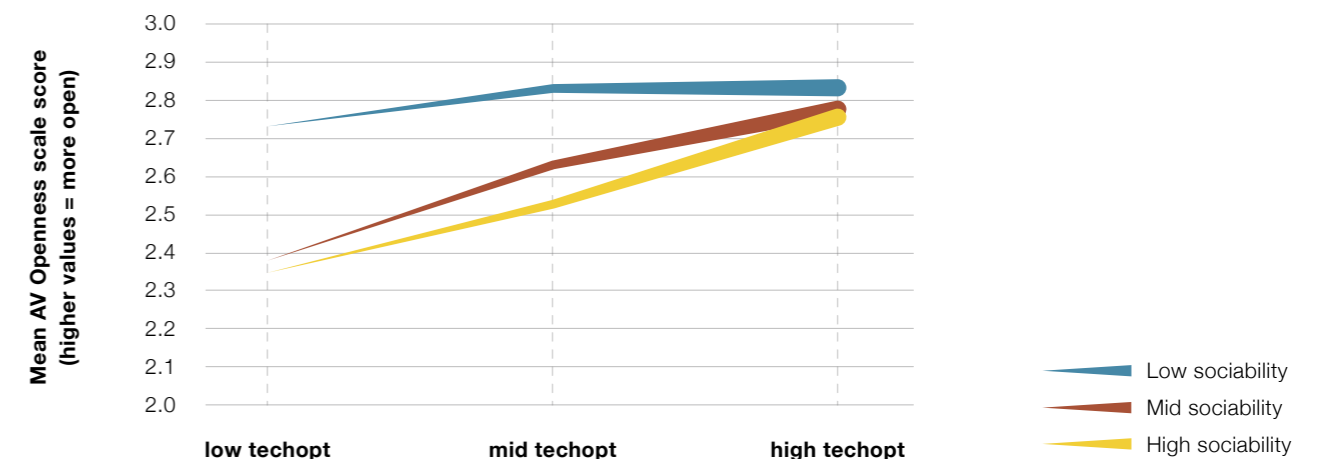
Bringing together technological optimism and driving sociability, again highlights that no one perception or view explains openness to AVs. Openness is not simply an expression of general technological optimism. How respondents experience the road today informs their expectations of what the road should be like, and how AVs should fit into it.

Generally speaking, we found that the respondents least open to AVs are those who are more sociable drivers with lower optimism about technology on average. By contrast, the people more open to AVs are

those who have a more “combative” view of the road and are more technologically optimistic on average, who perhaps see AVs as easier agents to deal with on the road than other humans.

The relationships between the “TechOptimism”, “driving sociability” and “Openness to AV” scales are illustrated in the graph below.

Association between sociability, technological optimism and openness to AVs (mean scale scores by group; scale of 1-5)



Ultimately, both the survey and focus groups showed there to be a clear tension between respondents' technological optimism for AVs and their real concern over these vehicles' ability to integrate with the social space of the road successfully.

Some focus group participants were quick to identify the safety and quality of life improvements they could perceive resulting from AVs.

“I'd love it, really. Bearing in mind that we're talking about safety, and it was 100% safe, and all that, I think it'd be great.

You travel by car, and instead of wasting your time driving, you can be doing loads of other things.”

(Spanish Participant)

At the same time, however, many participants worry that AVs could not have the same understanding of the road as human drivers and would lack common sense. Some see AVs as a potential nuisance, while others see an opportunity to take advantage of, or “bully” AVs.

“[The AVs are] going to stop. So you're going to mug them right off.

They're going to stop and you're just going to nip round.”

(UK Participant)

This concern with AVs' ability to be competent agents on the road is echoed by survey respondents, who are sceptical at the idea of mixing human drivers and AVs. 34% agreed that they did not like the idea of mixing human drivers and AVs, whereas only 20% were not troubled by the idea. This concern was also highlighted in the focus groups.

“If there were only autonomous cars, however, I would maybe feel even safer. But this mix, I don't like so much.”

(German Participant)

34%

don't like the idea of mixing human drivers with AVs.





CONCLUSION

AVs are not simply another new technology. They are a technology that is gradually emerging into an intensely social space. It is therefore no surprise that (1) a wide range of factors influence the public's levels of openness towards AVs and (2) that drivers have strong feelings about how AVs should act on the road.

AVs may have great potential to change the face of transport, the experience of our daily commute, and ultimately make our roads safer places. However, our survey finds that the majority of respondents remain concerned at the prospect of AVs, even if over a quarter of respondents are open to the arrival of AVs on our roads. When considering current

levels of knowledge and experience of AV technology, it is to be hoped that greater familiarity will allay some of the concern.

But this research identifies a number of deep-seated reservations – to the willingness to give up control, to the reliability of AV technology and to AVs' ability to integrate in the "social space" that is the road. It is necessary to understand these reservations, rather than just assume that the public needs more information if AVs are to negotiate a place for themselves on the road.

Arguments that focus simply on promoting greater safety, lifestyle enhancements or economic efficiencies will not gain traction if AVs do not fit comfortably into the public's picture of what the road should be like for them to drive on.

Last year, Goodyear and the LSE looked into the road as a social space. We demonstrated how drivers themselves create the very environment they operate in and that, through considerate driving, they could create a ripple effect of safer journeys. This year we explored how the road might evolve with the arrival of Autonomous Vehicles and how people may interact with AVs as they enter this intensely social space. For human drivers and AVs to be "connected", drivers express a need to be able to interact socially.

METHODS

We used a combination of focus groups, coupled with an online survey, to collect data on public attitudes towards AVs.

In total, six focus groups of eight participants were held, two in both Poland and the UK, and one each in Germany and Spain.

The online survey of approximately 12,000 drivers covered 11 European countries.

The survey included sections that addressed respondents' openness to (1) technology and technological progress generally and (2) driving and interacting with fellow road users, as well as questions about AVs.

Respondents were also given four diagrammatic representations of a typical driving scenario and asked to respond to statements about that scenario.

We also asked for more information about what technology respondents had (and used) in their normal vehicle.



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