L3Pilot Driving Automation

71 questions

3 waves in one survey

27,970 car drivers responded

75% have heard of automated cars

57% intend to use L3

L3Pilot Global User Acceptance Survey

Selected Results

ejct VTT SNF UNIVERSITY OF LEEDS

Facts & Figures: Global User Acceptance Survey

- Online survey on user acceptance of SAE Level 3: Conditionally automated cars
- long term perspective study // global
- 5 continents, 17 countries
- Data Collection in 3 waves:
  05-06/2019 | 02-03/2020 | 01-02/2021
- 27,970 car drivers surveyed
  - Wave 1 n = 9, 118
  - Wave 2 n= 9, 513
  - Wave 3 n= 9, 339

Survey in three waves

- Wave 1 and wave 2 are based on the same questionnaire, addressing different countries and with that different markets, societies, and cultures.
- Wave 3 is based on an adjusted questionnaire, focussing on a representative set of countries from wave 1 and wave 2 . Adjusted to deep dive into selected topics as well as addressing new research questions from the project and scientific community.

Motivation

- **Provide a comprehensive picture** of user acceptance and major challenges
- Conduct the **1st long-term** and **global study on user acceptance**, attitudes, and expectations **towards automated driving** with **focus on L3 technology**
- **Link qualitative pre-competitive, pre-market research** on L3 technology **with quantitative insights** from potential users of the technology
- Develop an **adaptive study design** to respond to upcoming topics
- Derive research-driven and data-based **recommendations for decision-makers**

Address the following research gaps

Analysis of understanding, needs & expectations on L3 technology

Global scope, including different countries

Long-term perspective

Main objectives

Identify **cross-national differences** in knowledge, attitudes and expectations towards automated driving and L3 technology.

Explore user needs and preferences to design L3 technologies that promote acceptance and successful market implementations.

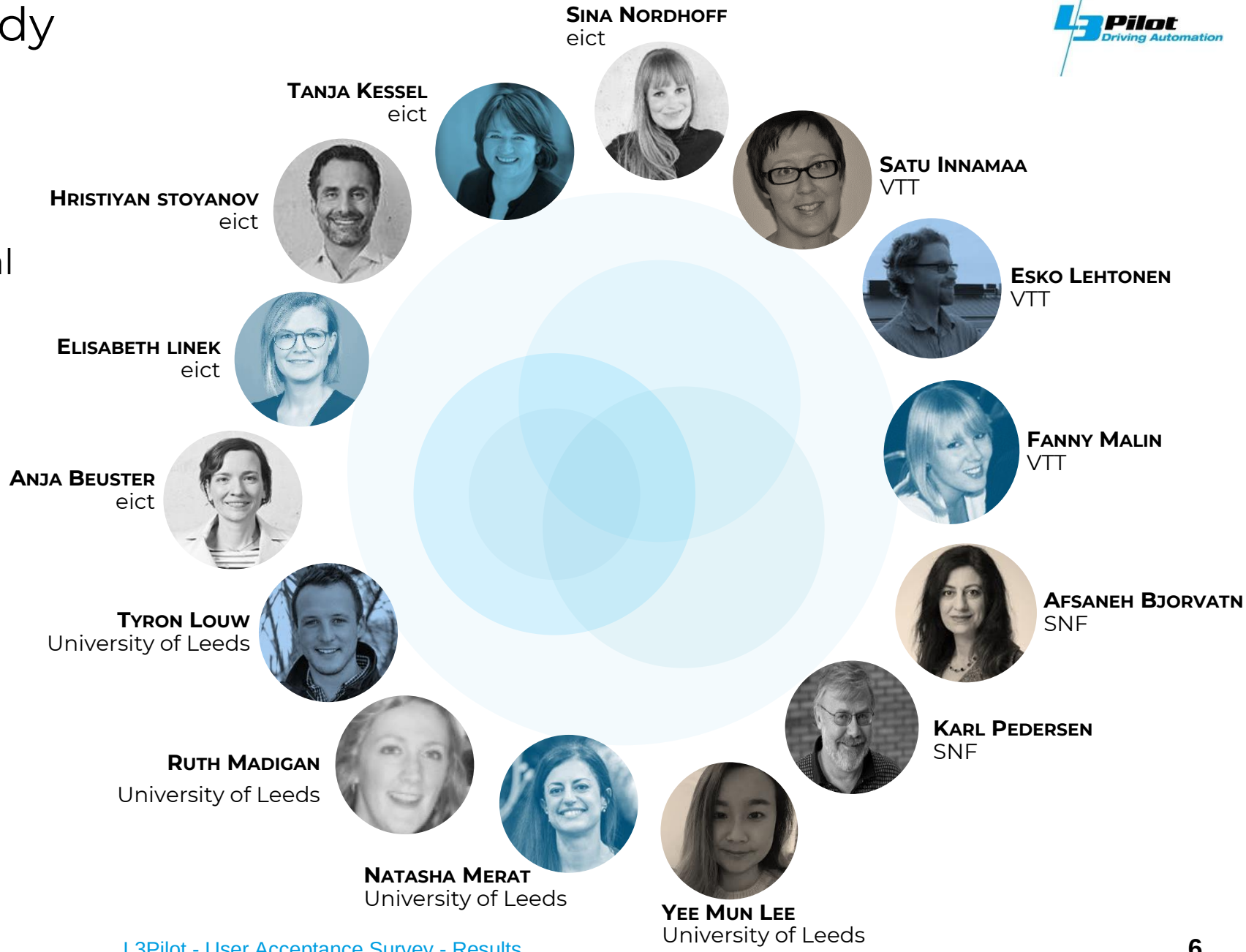
Predict acceptance by identifying **key factors of user acceptance** and expectations about L3 automation.

Contribute to societal discourse about automated driving by deriving strategic recommendations for decision-makers.

Experts behind the study

Interdisciplinary, cross-national expert group to

- Develop survey concept, methodological approach, and questionnaire
- Share data, check quality and discuss insights
- Derive target-group specific presentation of results

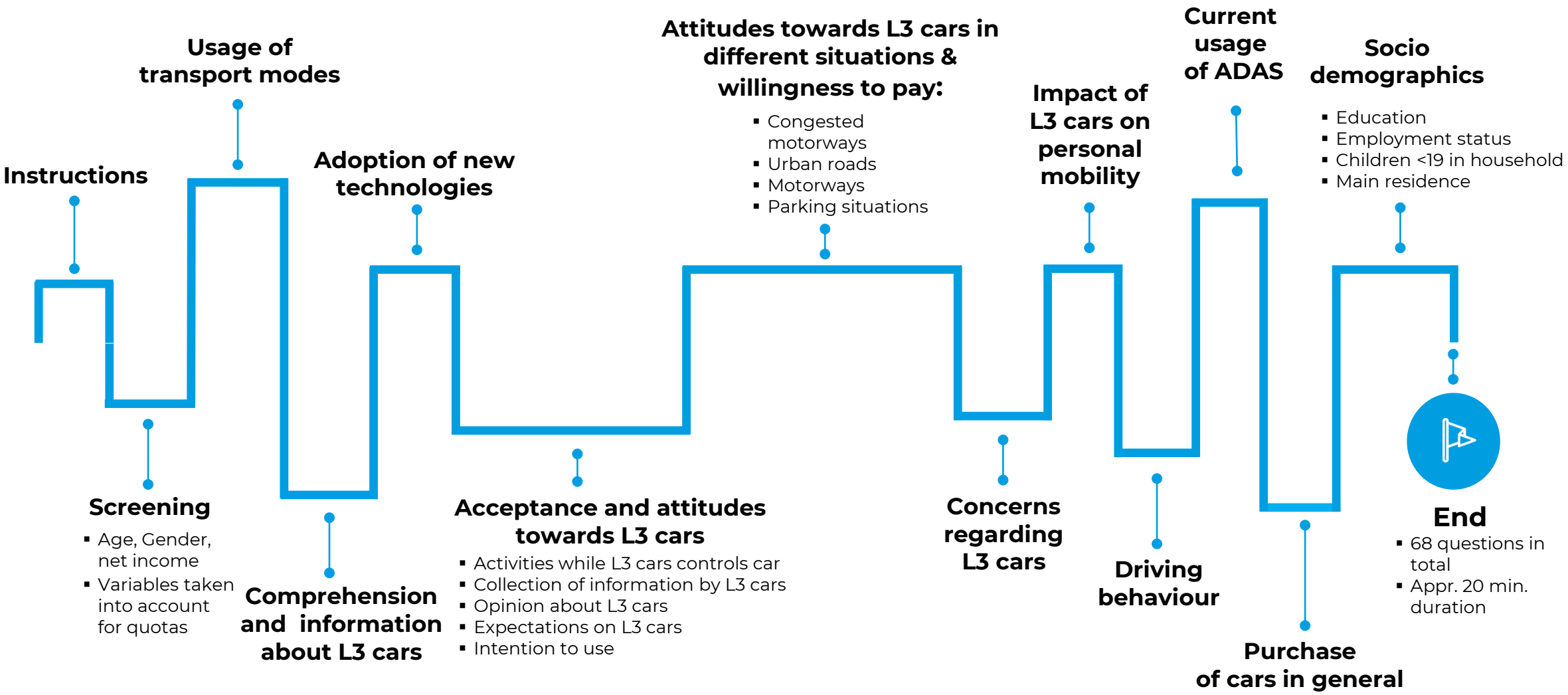


Information about L3 technology given to respondents

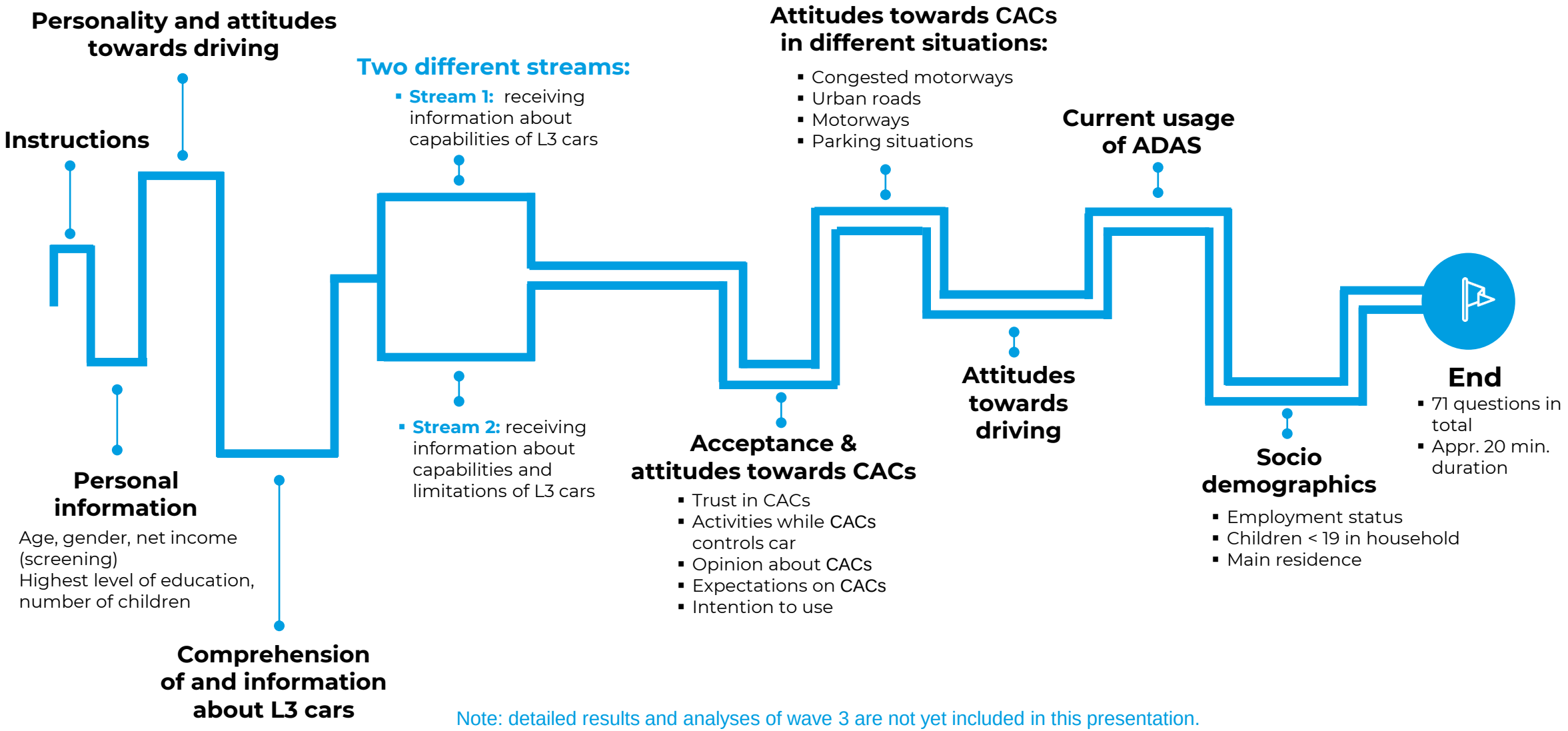
Respondents were first presented with instructions about L3 cars to ensure that they had sufficient understanding of how these worked. The instructions were written out as follows:

> *"There are different terms to define the capabilities of automated cars, such as self-driving, autonomous, automated, pilotless, driverless, and conditionally automated. With this questionnaire, we would like to get your opinion* ***on conditionally automated cars****.*
>
> *Conditionally automated cars can drive under limited conditions, such as* ***driving on motorways, on congested motorways, in urban traffic, and in parking situations****. They will not operate beyond these conditions.*
>
> *Conditionally automated cars do the steering, acceleration and braking. They will stay in the lane and maintain a safe distance to the vehicle in front. They will also overtake slower moving vehicles or change the lane. These cars still have gas and brake pedals and a steering wheel.*
>
> *You are not driving when the car is in conditionally automated mode – even if you are seated in the driver's seat. This will allow you to engage in other activities, such as emailing or watching videos. However, the car might ask you to resume vehicle control anytime, e.g., when approaching a construction site, which means you might have to stop what you are doing and resume control of the car."*

Questionnaire content wave 1 & 2



Questionnaire content wave 3



Note: detailed results and analyses of wave 3 are not yet included in this presentation.

The sample

The target group of the survey was defined to be drivers.

- We needed to get the insights, expectations and potential barriers from car users themselves. Surveying potential future users of conditionally automated cars, including the subgroup of divers who might already have experiences with ADAS, represent the ideal target group.

- Having in mind, that the differentiation between SAE Level 3 and Level 4 is even for experts challenging, it was essential to define the target group to be drivers for the success of the research goal.

Source: SAE Levels of Driving Automation J3016 (Copyright 2021 SAE International)

Cases per Country

UK wave 1: 1,217
wave 3: 1,038

France wave 1: 1,164
wave 3: 1,011

Sweden wave 1: 1,177

Finland wave 1: 1,021

Spain wave 2: 1,074

Germany wave 1: 1,133
wave 3: 1,054

Hungary wave 1: 1,146
wave 3: 1,042

Russia wave 2: 1,079
wave 3: 1,059

Italy wave 1: 1,186

USA wave 1: 1,056
wave 3: 1,009

Japan wave 2: 1,074
wave 3: 1,006

China wave 1: 1,004
wave 3: 1,059

Turkey wave 2: 1,060

Brazil wave 2: 1,057
wave 3: 1,061

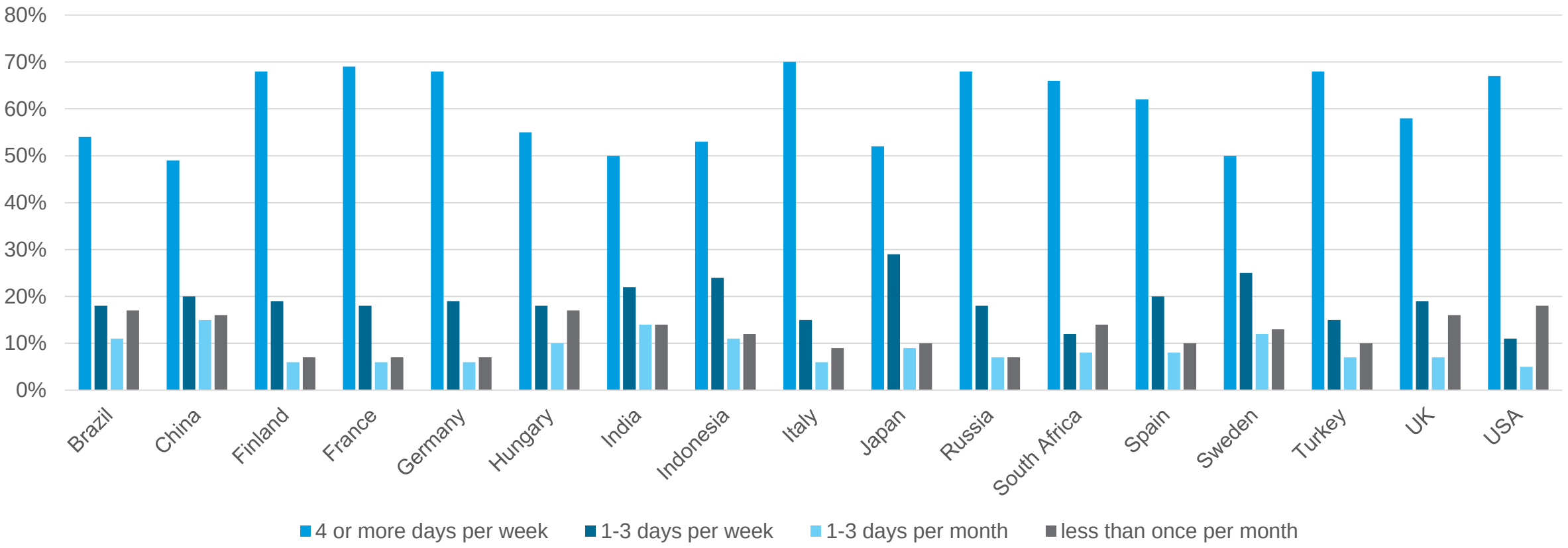
South Africa wave 2: 1,070

India wave 2: 1,054

Indonesia wave 2: 1,059

Private car usage frequencies among the sample

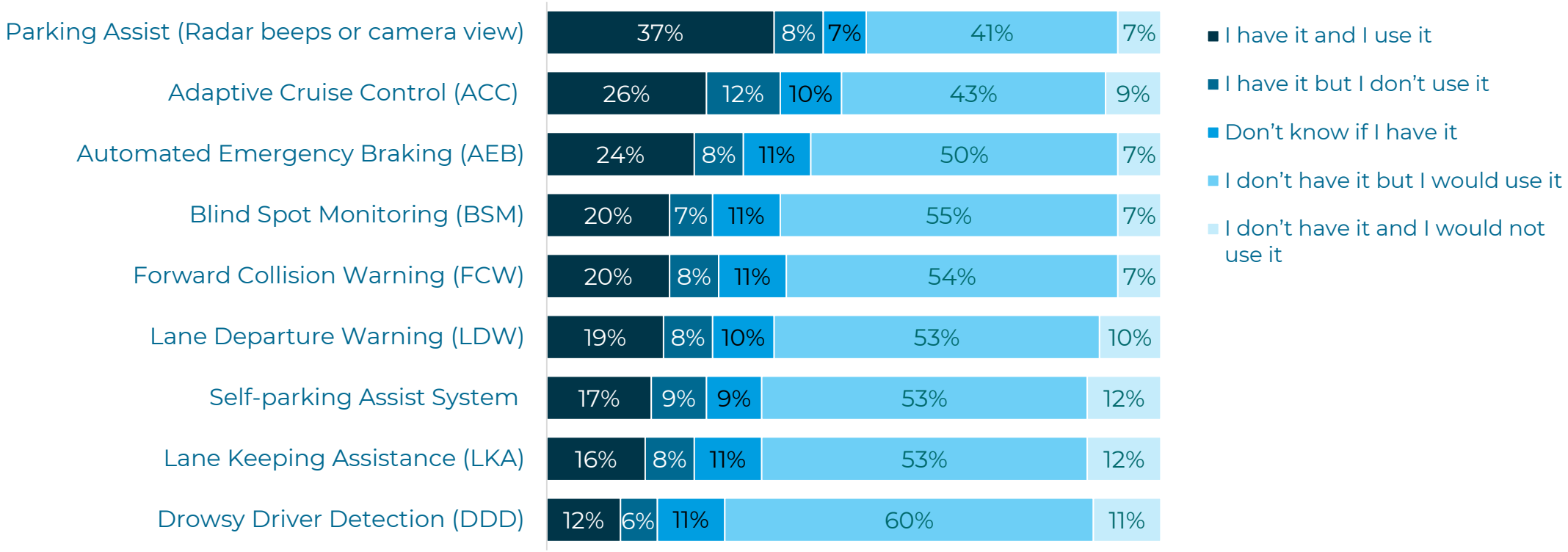
The majority of our respondents, which are drivers from different countries, represent people who drive very frequently:



Current usage of ADAS

Overview: Current usage of ADAS

The currently most often used advanced driver assistance system is the parking assistant followed by the adaptive cruise control and the automated emergency braking.



Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver.
Overview of the current usage of ADAS, overall values, not grouped by countries. n = 18, 631

Interpretation

37%
are using the parking assistant

26%
are using adaptive cruise control while driving

24%
of those who have ADAS are using the automated emergency braking

?!

The current usage of advanced driver assistance systems shows a high potential.

- The data suggests, that there is a high interest among the respondents to use these driver assistance systems future-wise. Even if they are currently not having the technology in their car, round about half of the respondents state, that they could imagine to use driving assistance technologies if they had these already installed.
- Among those who have it, the number of users is higher, compared to those who have it and don't take advantage of it.
- One out of ten respondents is not sure about having the system.

Interpretation

?!

Usage of the system reflects the differences in market introduction and market penetration.

- Highest usage suggest high familiarity with systems that were first on the market, i.e. parking radar system, ACC and AEB.
- Lowest usage of self-parking assist, LDW, LKA and DDD is plausible given that these systems have only been introduced in the past few years.

The large majority of those who do not have the systems shows a positive attitude towards using them.

- Between 41% to 60% reported not to have access to these systems but would be interested in using it. This suggests that respondents may perceive a need in their current driving behavior that these systems can satisfy.

Interpretation

?!

With regard to the related safety benefits of assistant systems the percentage of respondents that do not use them is surprisingly high.

- Lack of use may suggest that respondents have experienced difficulties using these systems.
- Alternatively, respondents may consider these systems not necessary or frustrating to use. A lack of use may also suggest that respondents do not trust these systems.
- A lack of use can also result from poor communication about the functionality of the system by car dealers (i.e., car dealers not properly raising awareness that function is inside the car, or properly explaining how to use the function).

Recommendation

Current ADAS systems need careful promotion.

- There is a high potential for current and future ADAS on the market, but they are no self-selling items. Further research is needed to get insights about those who do not use available systems and those who do not know, if they have them.

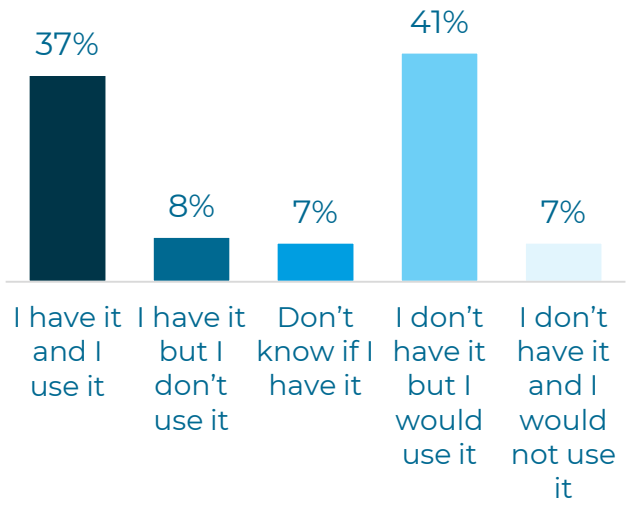
The customer relationship should be modified to increase usage of ADAS.

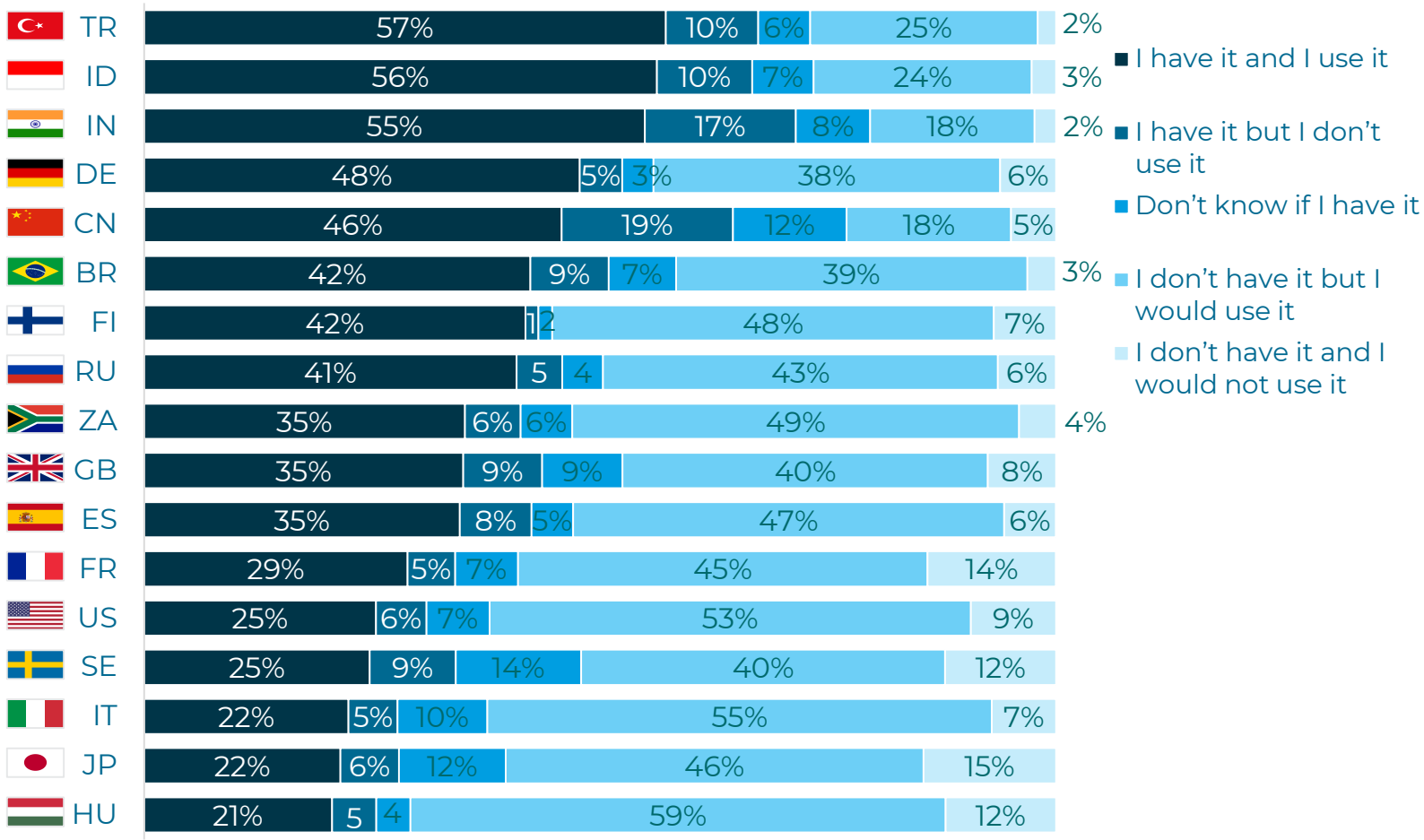
- Beyond marketing and service contacts, explaining and training of system functions and capabilities should be targeted in customer interactions.
- Usage of ADAS could benefit from repeated communication about individual experiences with the systems.
- Beyond newly sold vehicles, the second-hand car market should be addressed as well.

Usage of ADAS per function and country

Current usage of ADAS: Parking Assist (Radar beeps or camera).

Overall:

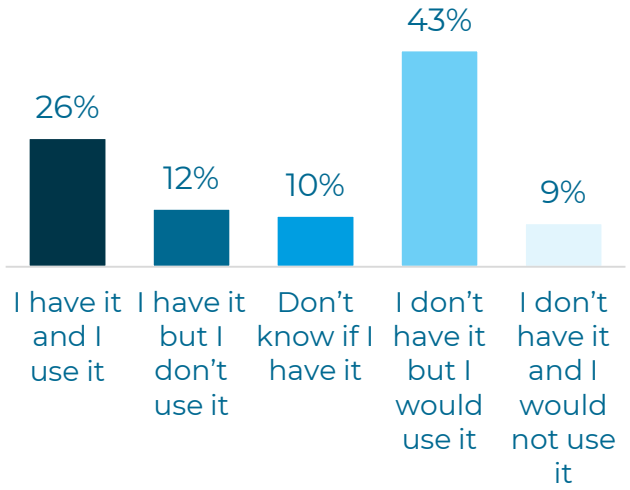


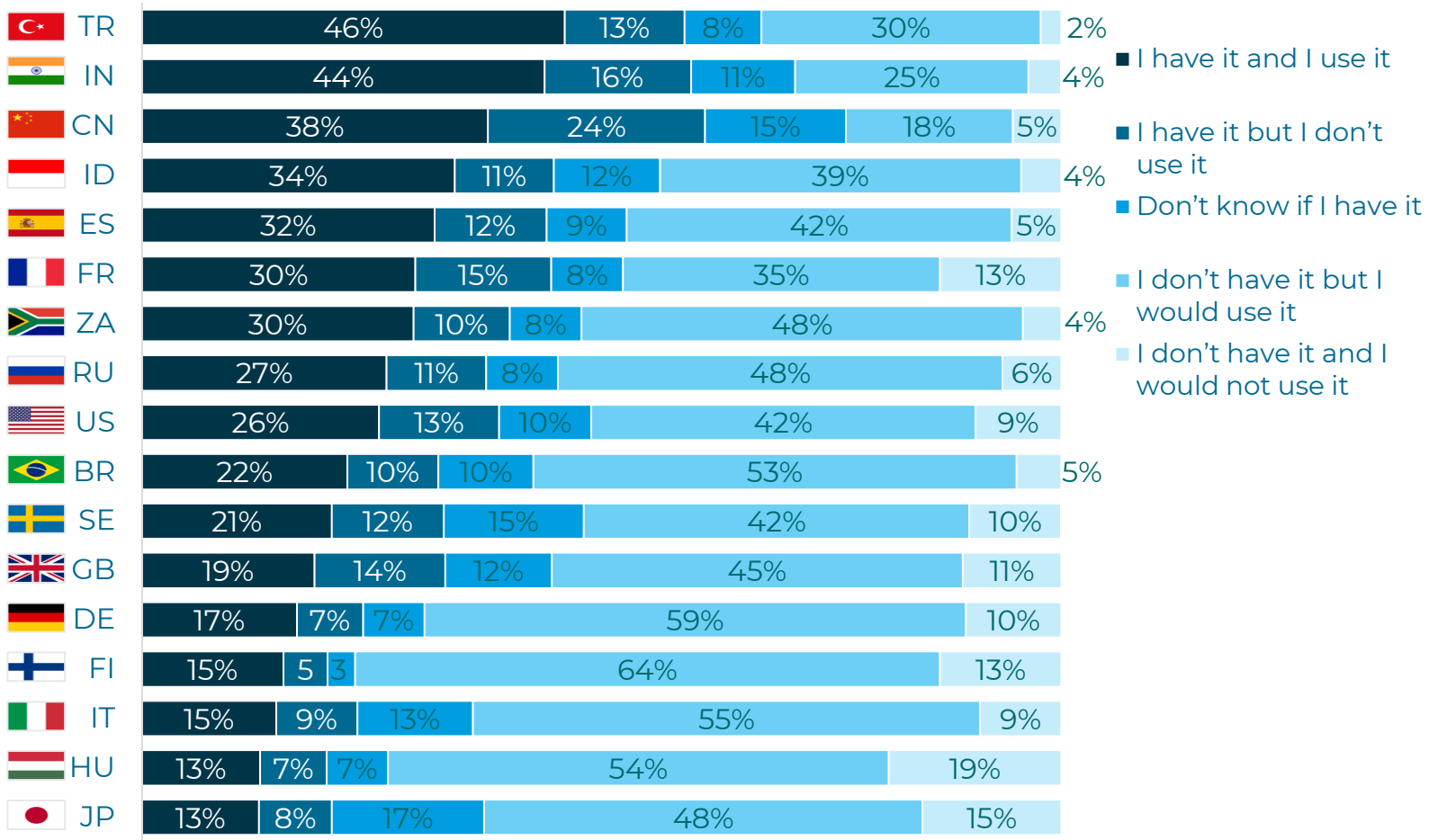


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Parking Assist (Radar - beeps or camera view). The driver is in the car during the parking manoeuvre. n = 18, 631

Current usage of ADAS: Adaptive Cruise Control (ACC)

Overall:

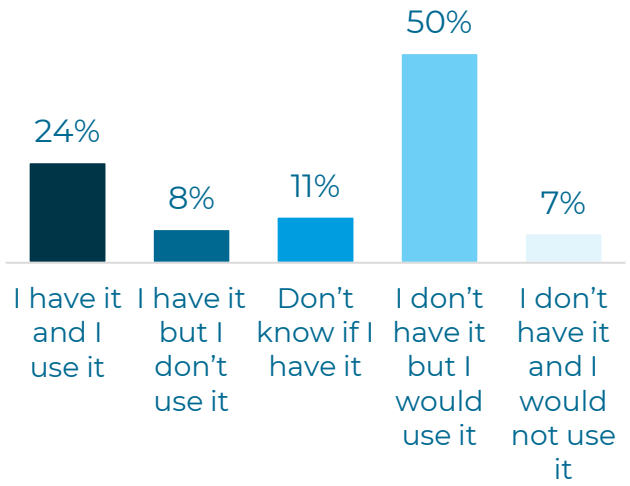


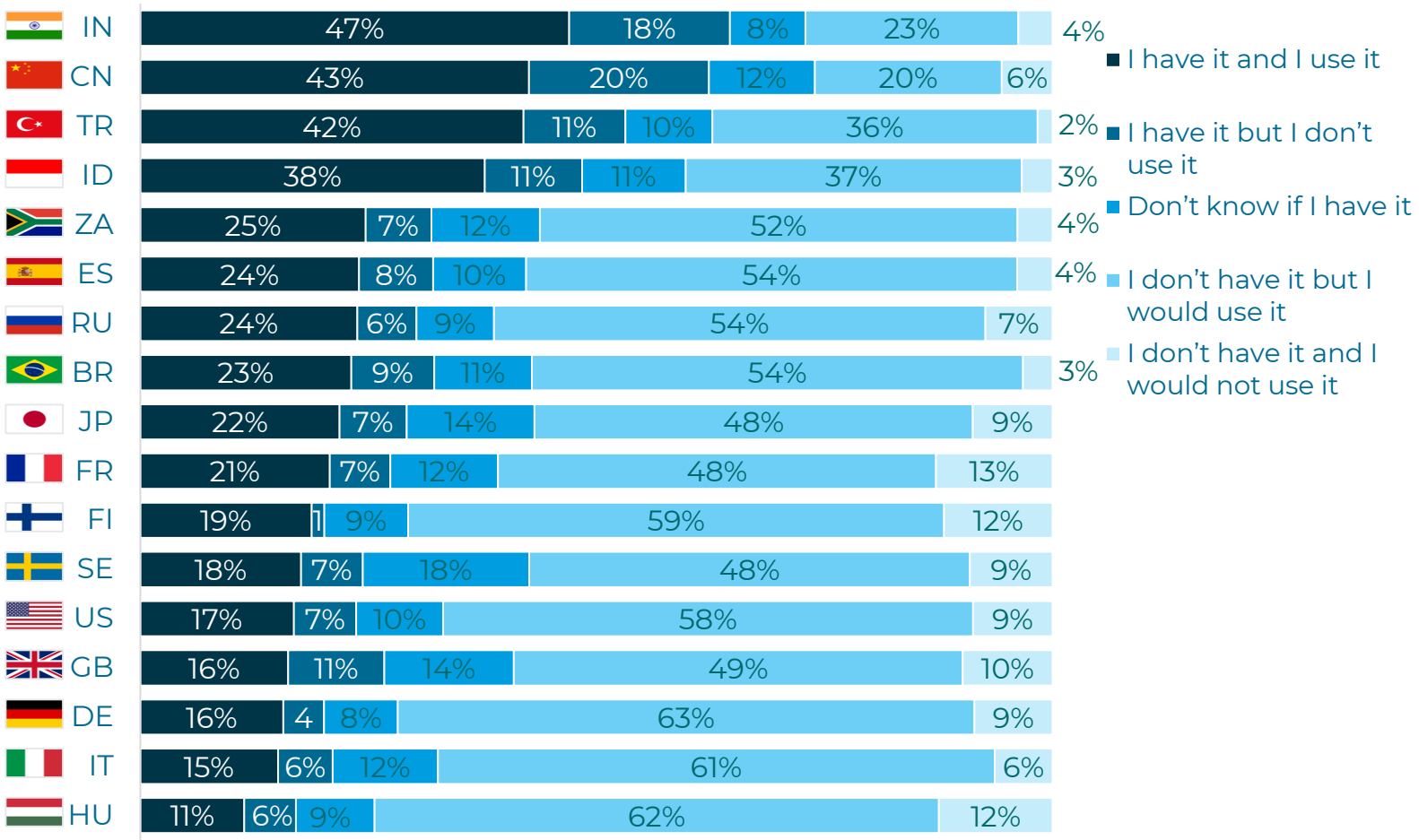


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Adaptive Cruise Control (ACC; A system that maintains vehicle speed while in cruise control mode, but automatically slows down or speeds up to keep a driver-selected distance from a vehicle ahead). n = 18, 631

Current usage of ADAS: Automated Emergency Braking (AEB)

Overall:

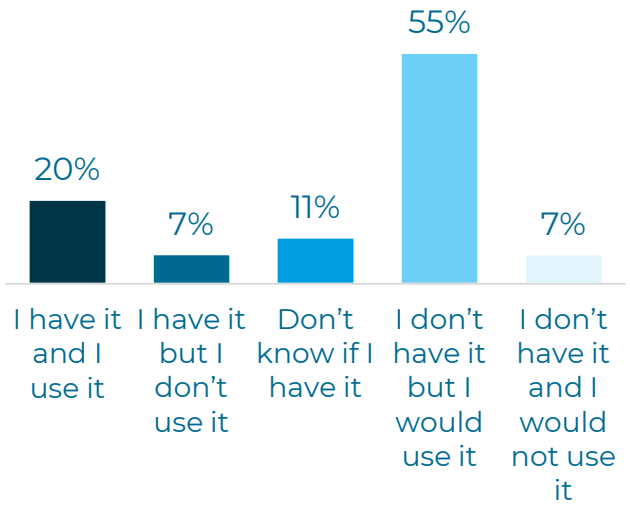


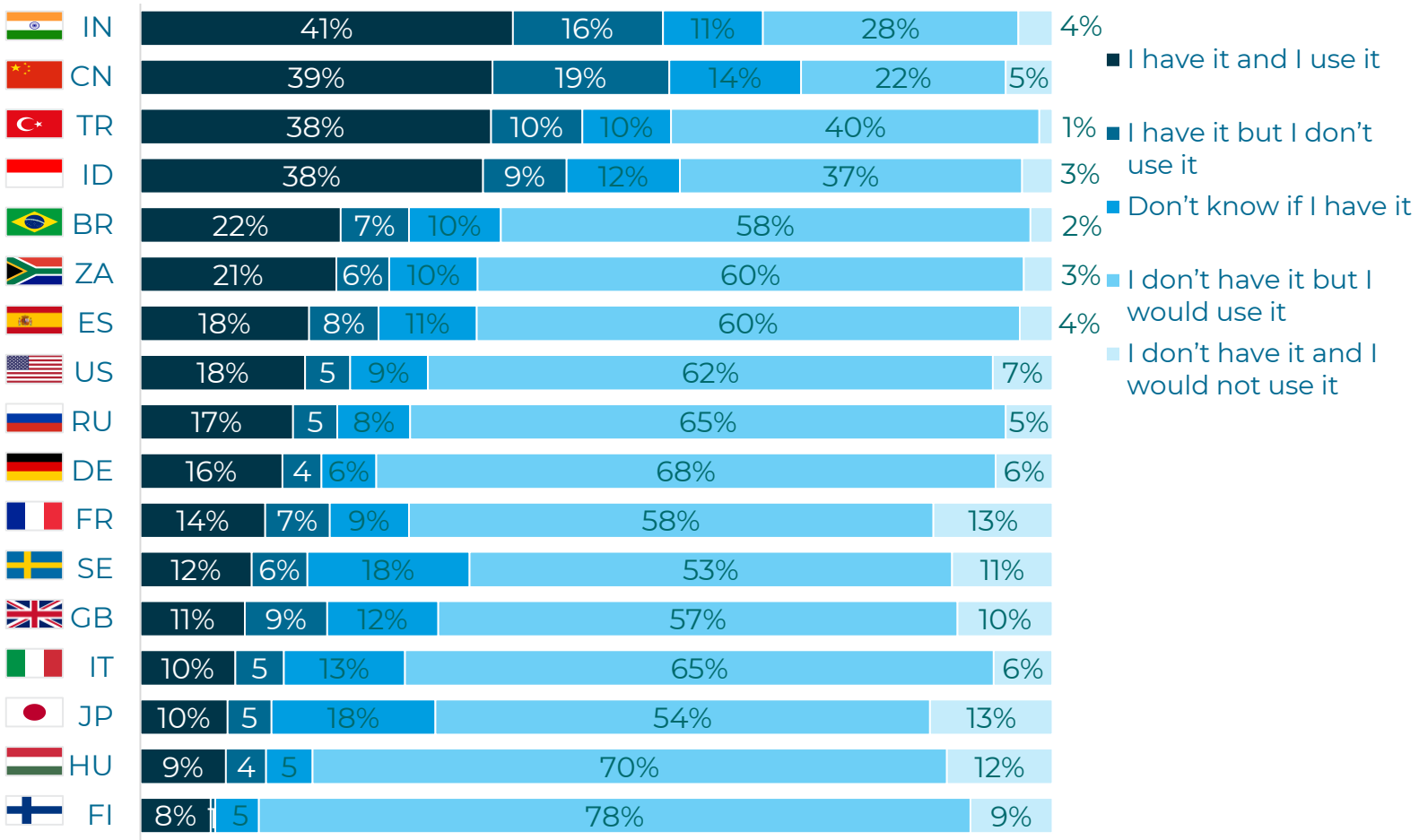


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Automated Emergency Braking (AEB; A system that automatically brakes the vehicle when an impending collision is detected). n = 18, 631

Current usage of ADAS: Blind Spot Monitoring (BSM)

Overall:

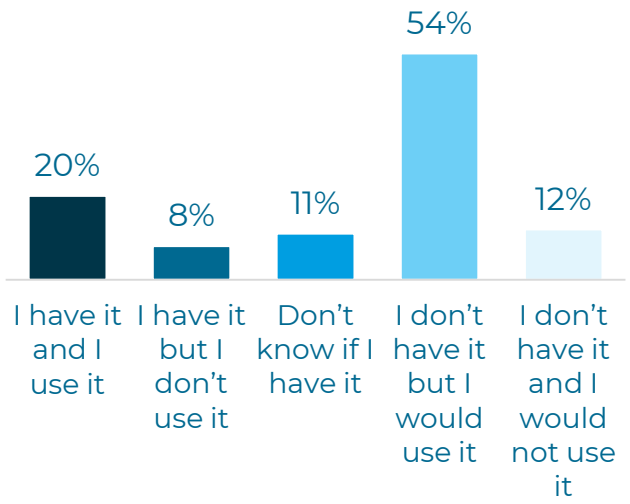


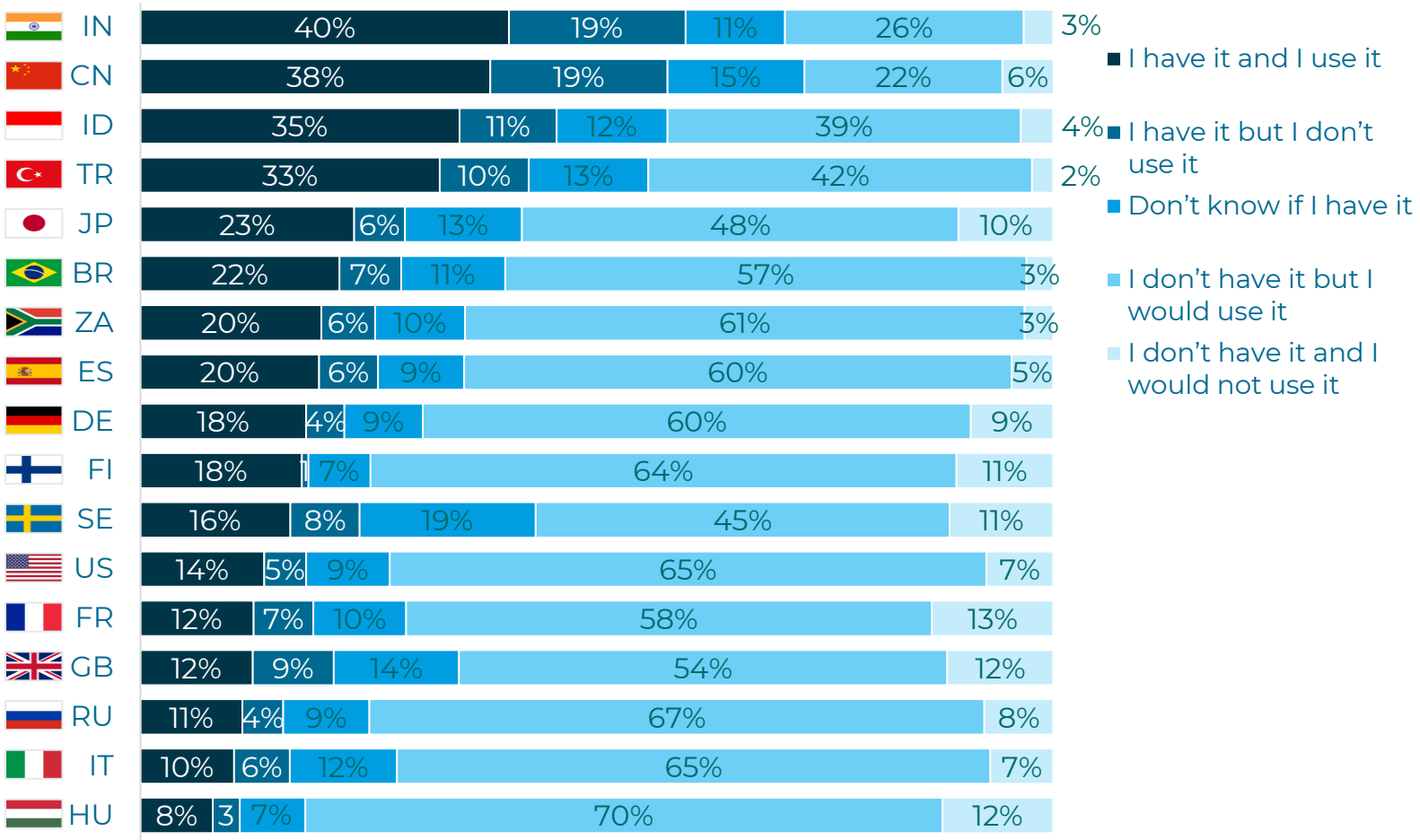


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Blind Spot Monitoring (BSM; A system that monitors the driver's left and right blind spots for other vehicles. Often, drivers receive a visual or audio alert whenever a vehicle is present). n = 18, 631

Current usage of ADAS: Forward Collision Warning (FCW)

Overall:

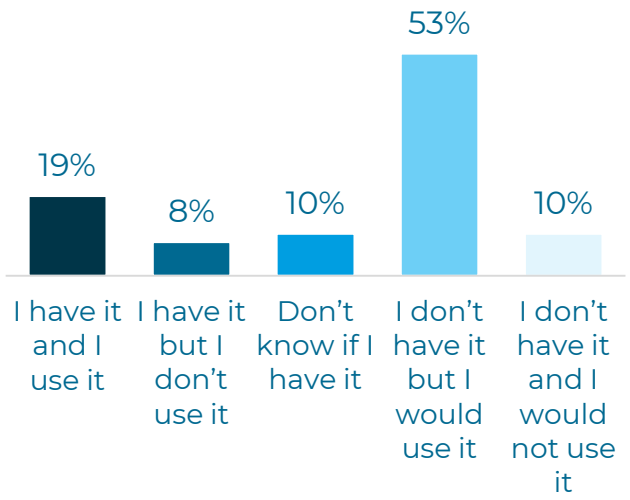


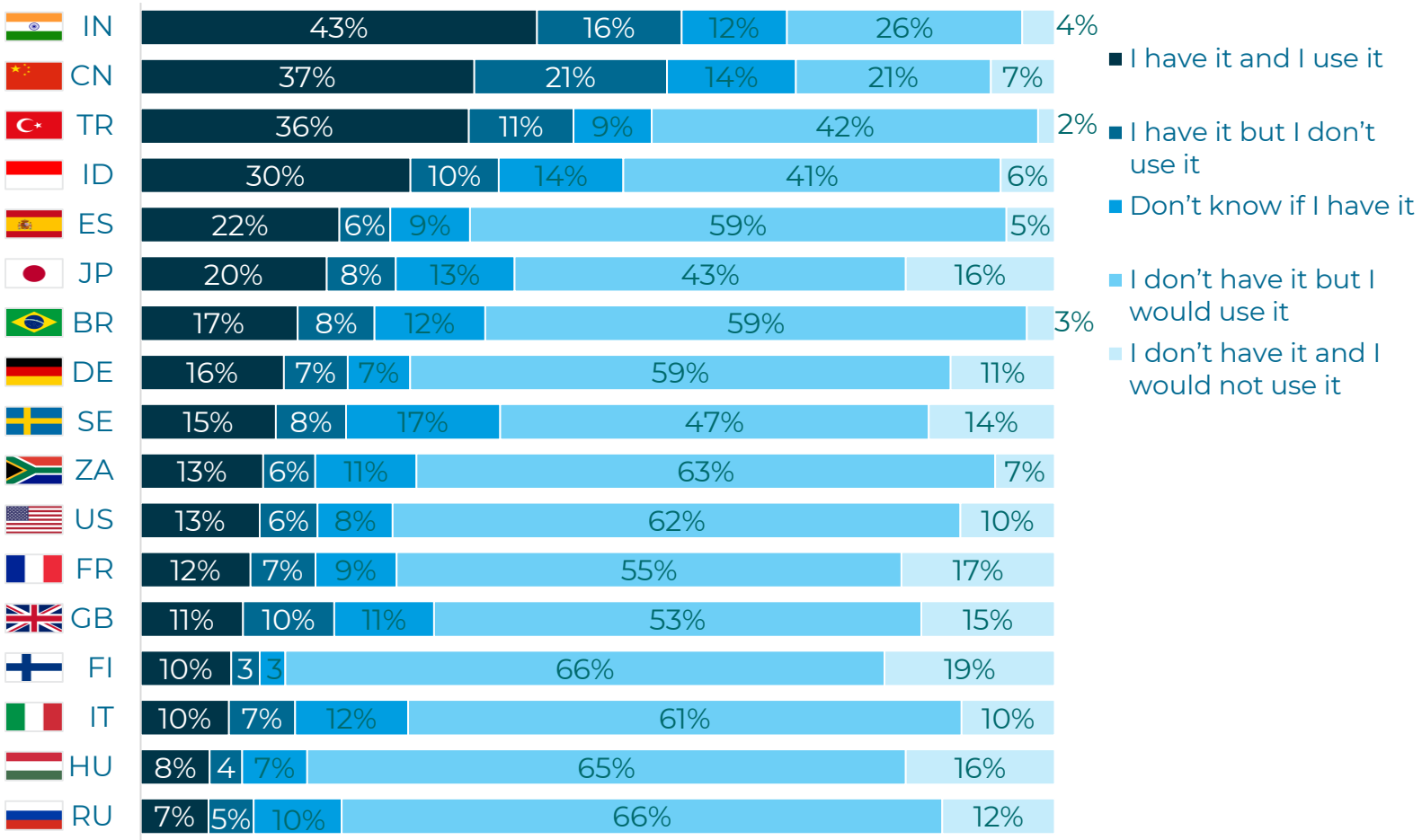


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Forward Collision Warning (FCW; A system that provides warnings for potential collisions with the vehicle in front). n = 18, 631

Current usage of ADAS: Lane Departure Warning (LDW)

Overall:

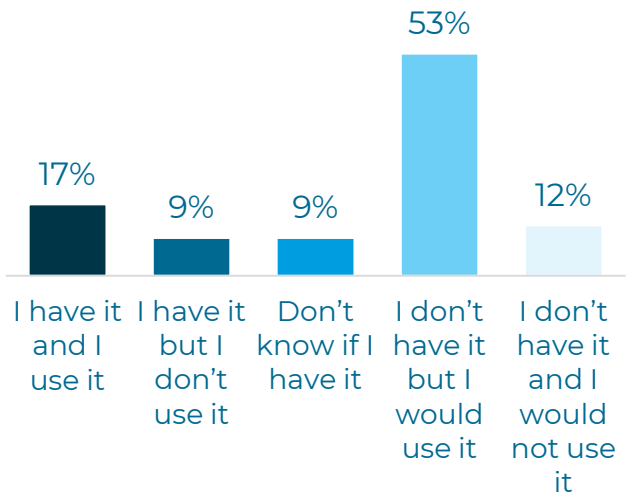


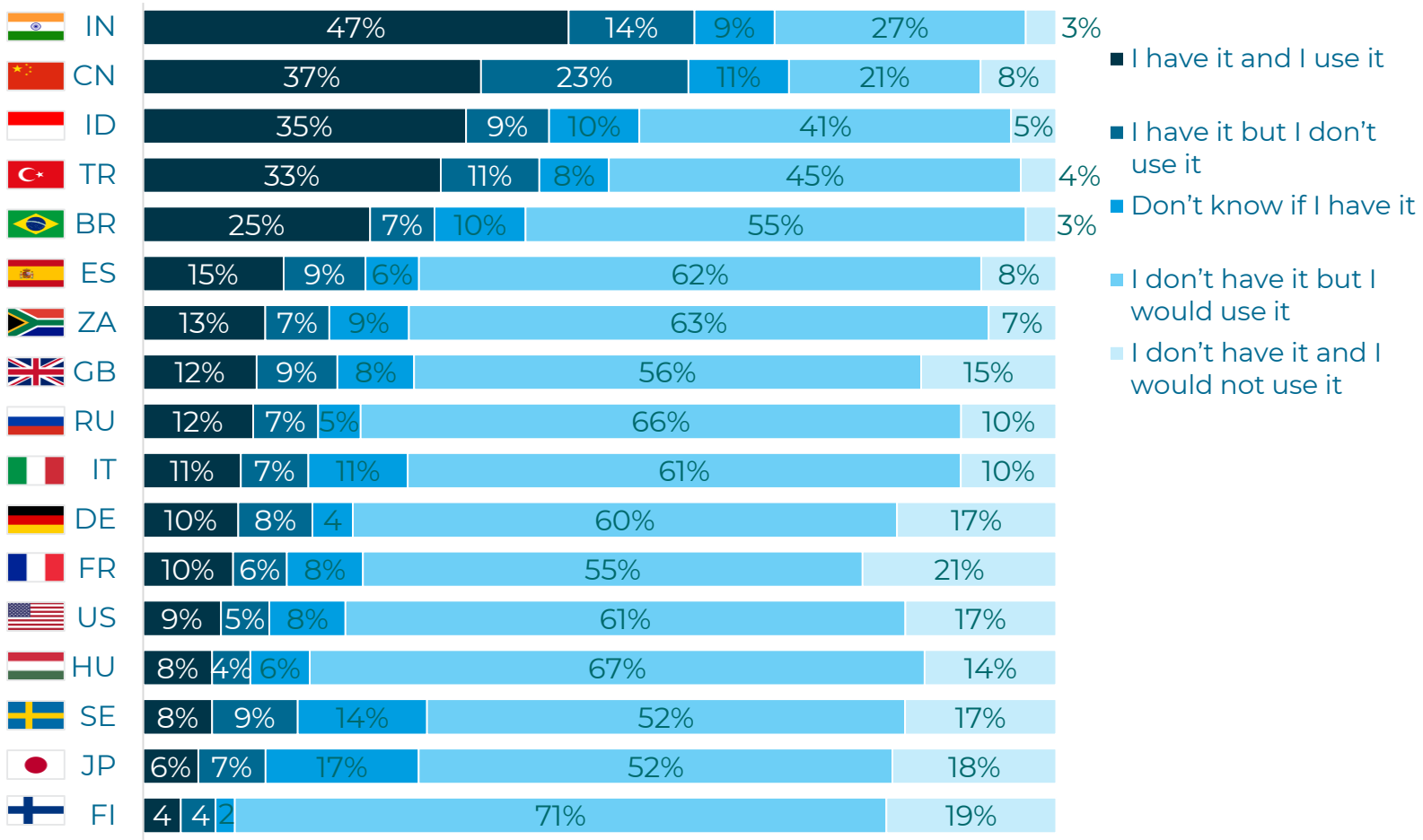


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Lane Departure Warning (LDW; A system that provides assistance with lane-keeping by sounding warnings when the vehicle travels outside the current lane's markings/boundaries of the current lane). n = 18, 631

Current usage of ADAS: Self-parking Assist System

Overall:

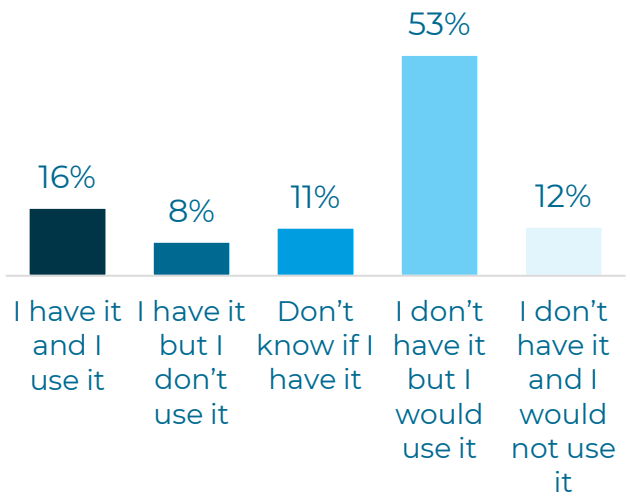


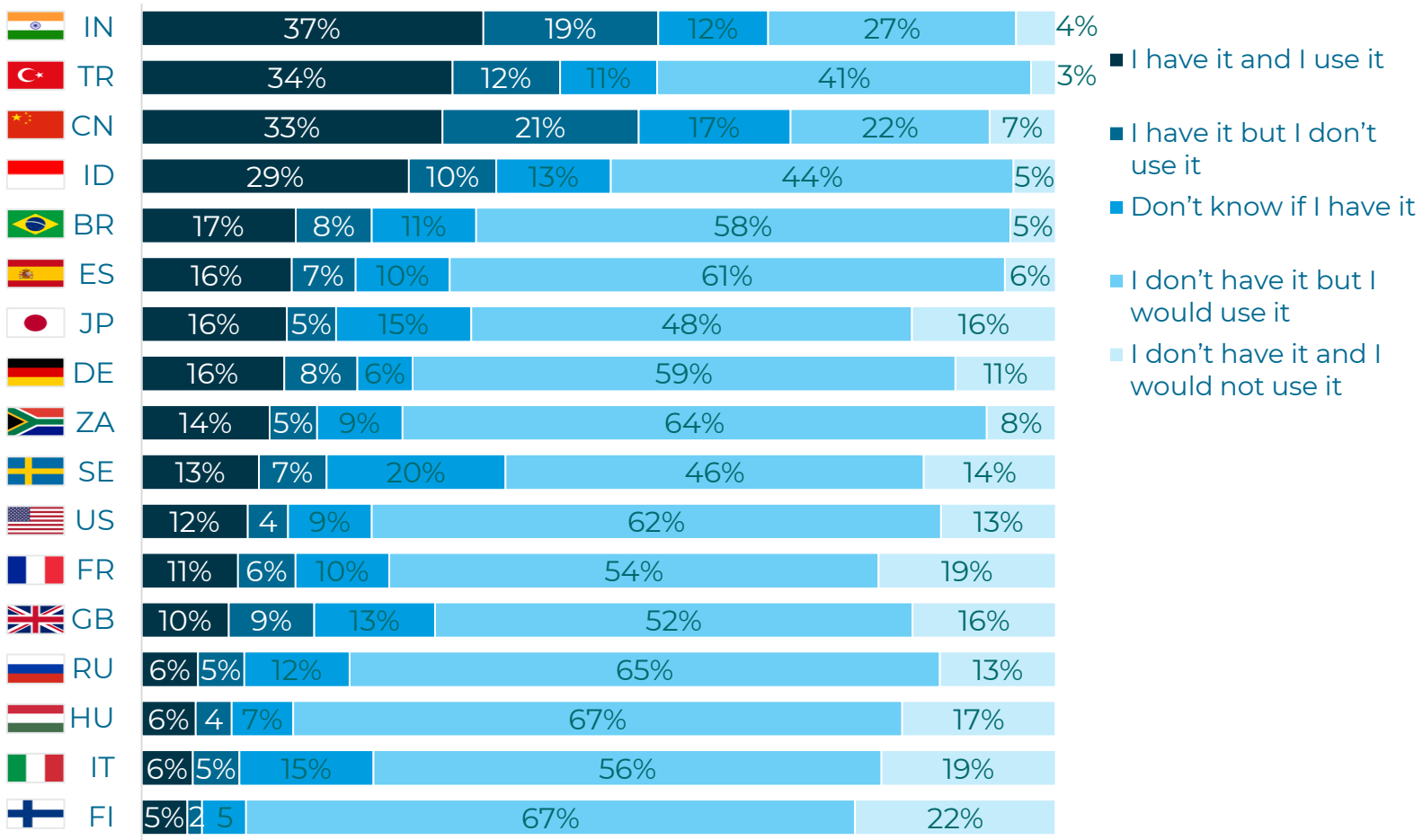


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver.
Self-parking Assist System (A system that controls the vehicle for parallel or reverse parking. The system may control both steering and the throttle, or only control the steering (the driver presses the brake and throttle) during the parking. n = 18, 631

Current usage of ADAS: Lane Keeping Assistance (LKA)

Overall:

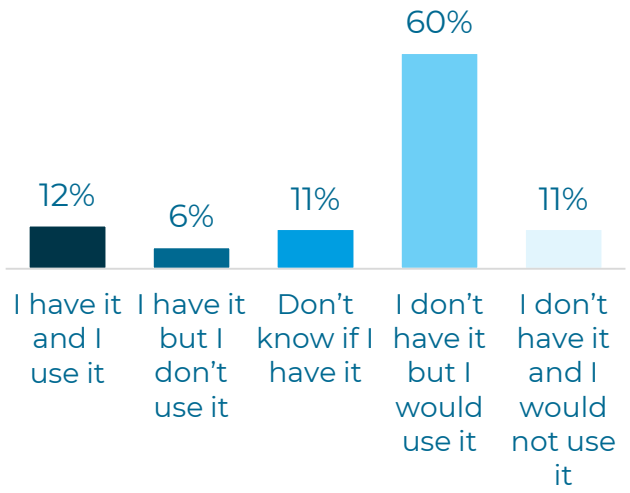


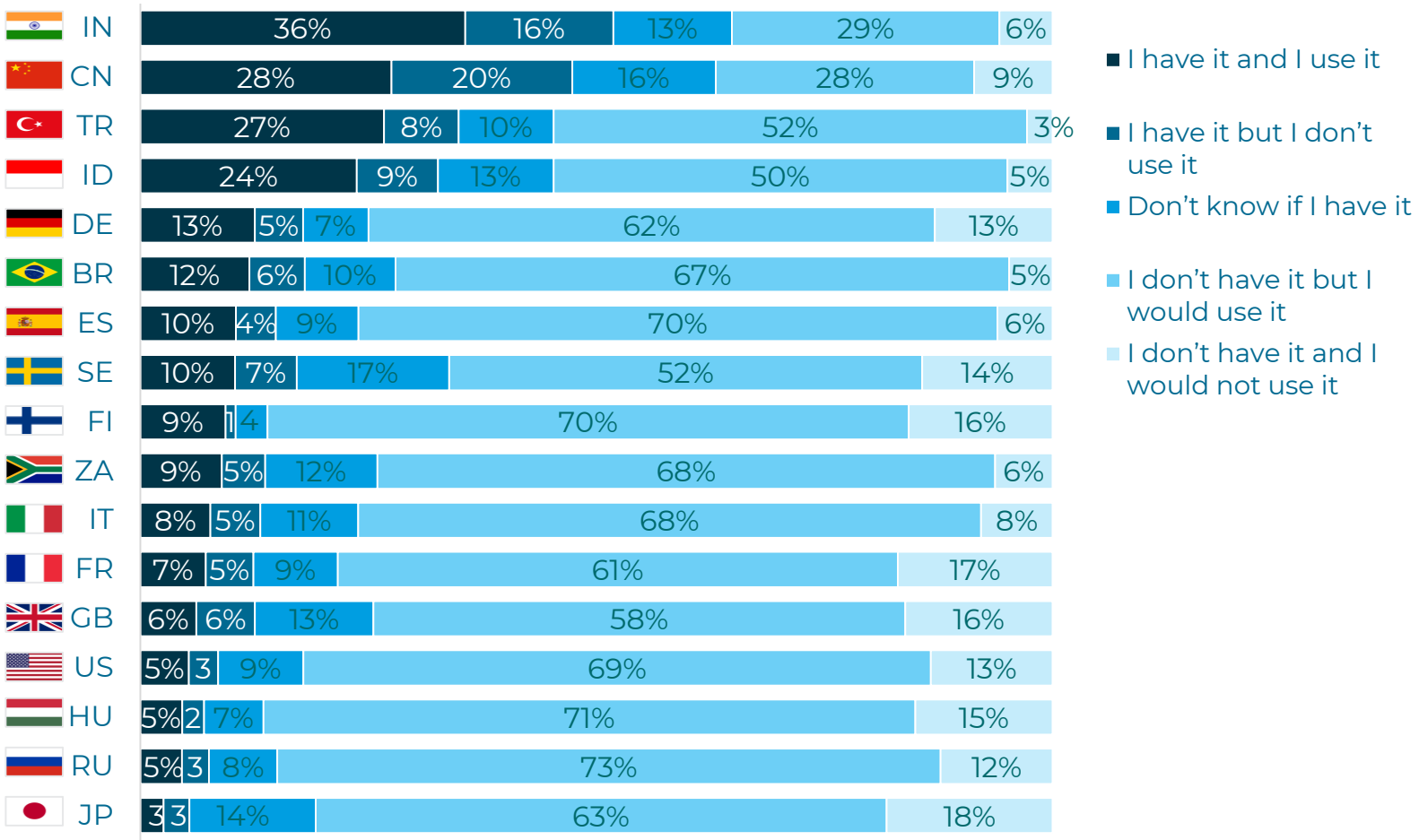


Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Lane Keeping Assistance (LKA; A system that helps the driver to avoid inadvertently moving out of a lane). n = 18, 631

Current usage of ADAS: Drowsy Driver Detection (DDD)

Overall:



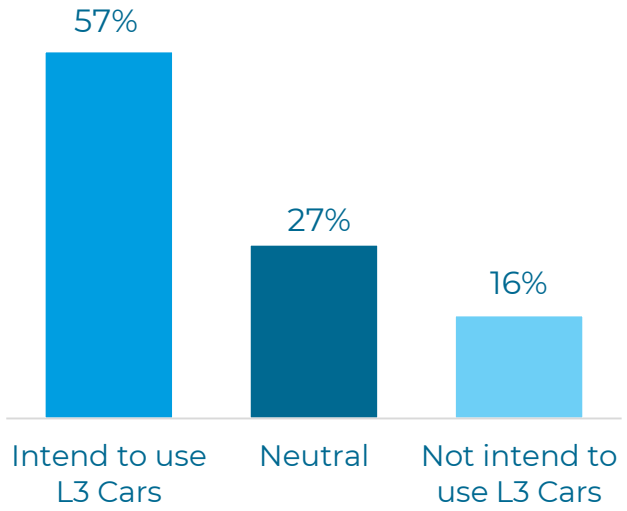


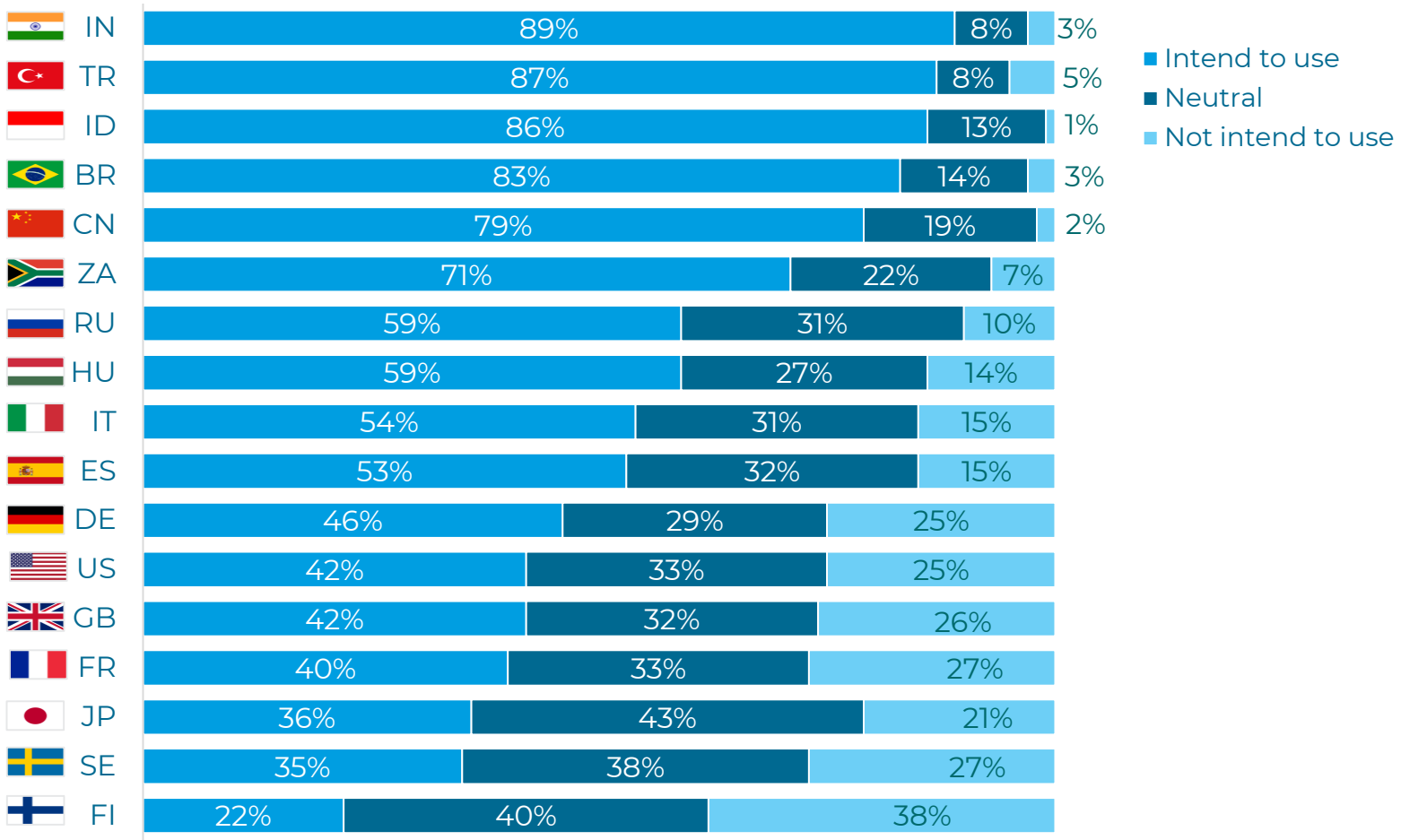
Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver. Drowsy Driver Detection (A system that detects driver drowsiness). n = 18, 631

What is the acceptance of L3 cars?

Intention to use

Overall:

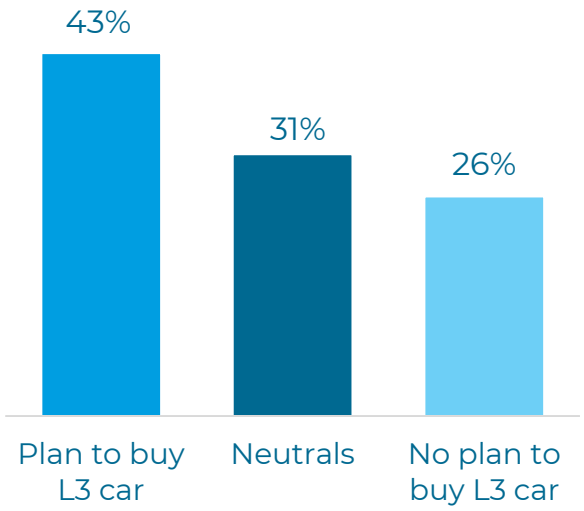


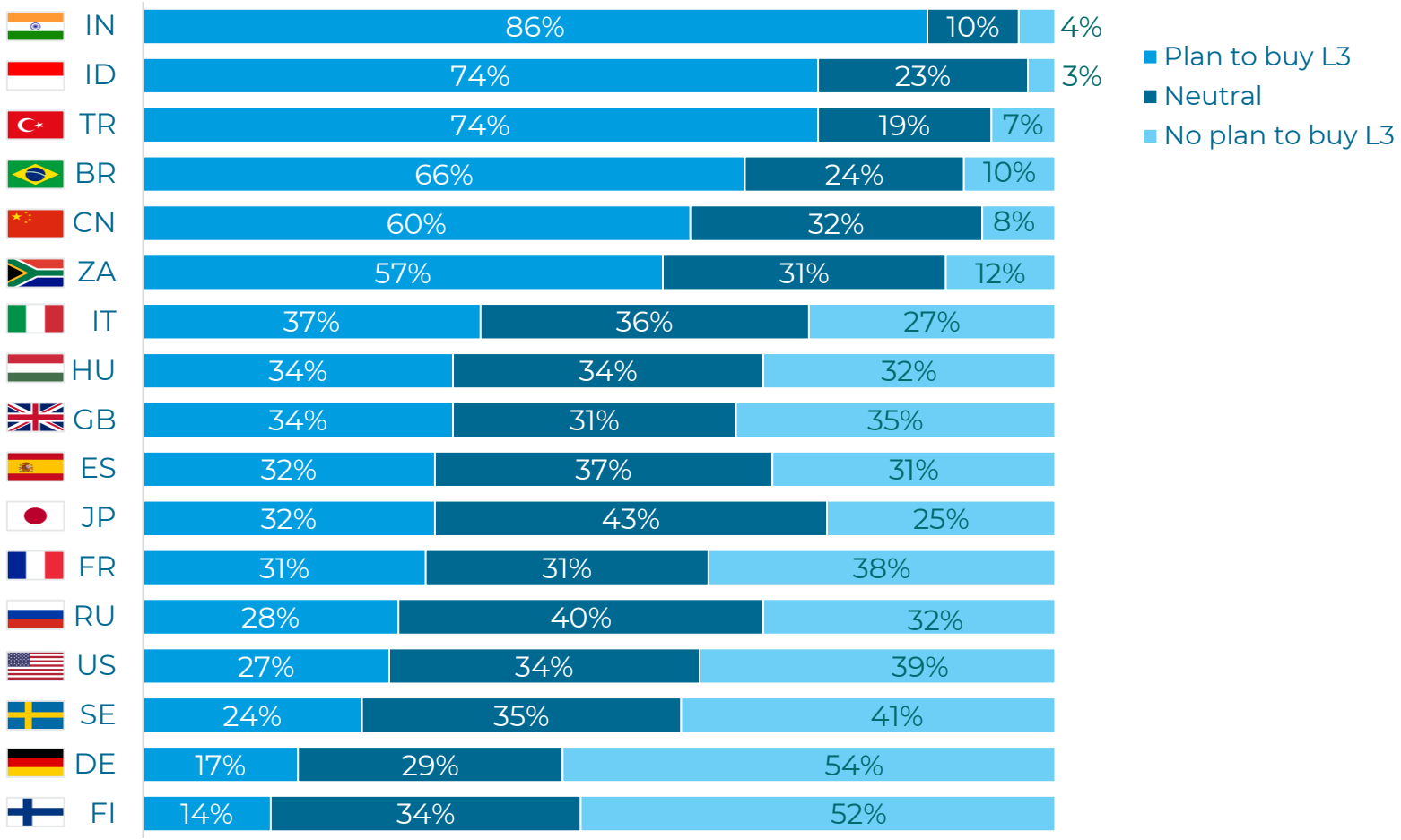


Q16_10. Now, we kindly ask you to give your opinion on conditionally automated cars. Please indicate to what extent you agree with the following statements: "I intend to use a conditionally automated car in the future." n = 18, 631

Plan to buy

Overall:





Q16_23. Now, we kindly ask you to give your opinion on conditionally automated cars. Please indicate to what extent you agree with the following statements: "I plan to buy a conditionally automated car once it is available." n = 18, 631

Interpretation

57%
Intend to use L3 cars

43%
Plan to buy L3 cars

Car drivers show great potential of using Level 3 automated cars and a relevant share of respondents would consider to buy.

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Overall, more than half of the surveyed drivers consider the use of L3 functions. This corresponds to the amount of drivers, that do not have ADAS but would like to use them.

- Only a rather small group of respondents reject currently (16%) the option of using L3 functions.
- A smaller value considering the plan to buy a L3 car was to be expected and can be found in the majority of countries. The intention to use conditionally automated cars being higher than the purchase intention can possibly be explained by respondents' lack of physical exposure to L3 cars.

Recommendation

The public could be “warmed up” for conditionally automated cars promoting currently available partially automated cars.

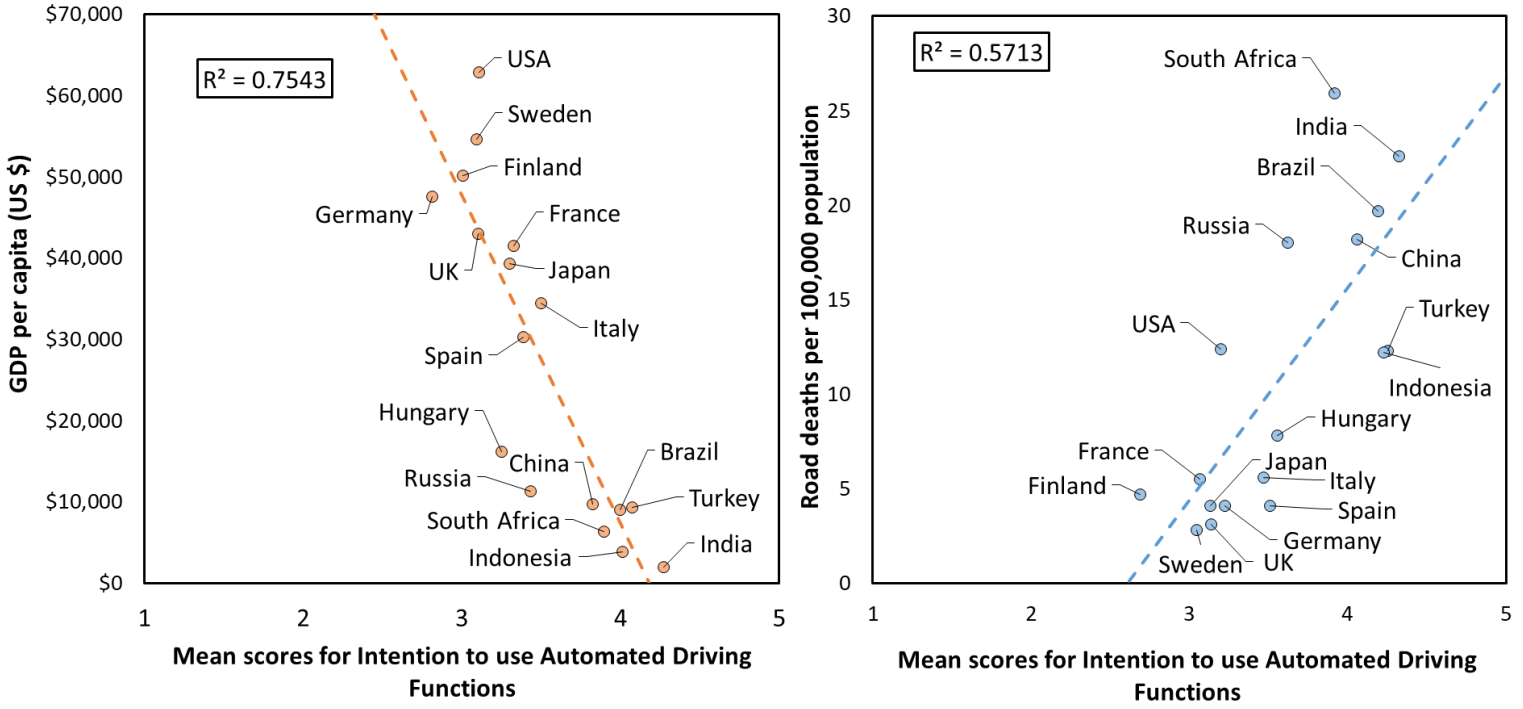
- Automated cars could be subsidised, motivated by proven safety benefits (e.g., tax exemption, reimbursement, discount on registration), particularly in lower GDP-countries.
- Intention to buy can also be encouraged by exposing public to conditionally automated cars when the technology is available, e.g., by opening up living labs or giving people the option to test the technology in the context of test rides on a longer-term basis (e.g., subscription basis).

Car dealers could be better trained about system capabilities and limitations, offering consumers the possibility to test conditionally automated driving functions.

How does intention to use vary by a country's GDP and road death rate?

How does intention to use vary by a countries GDP and road death rate?

Correlation between 17 countries overall mean scores for intention to use L3 cars across all environments, and their respective GDP per capita (left), and estimated road deaths per 100,000 population (right, WHO, 2018). Higher score = greater intention to use.



Intention to use L3 cars is strongly related to both GDP and road death rate. Countries with lower GDP per capita , and higher road death rates, generally have higher intentions to use an L3 car. These results highlight the relevance of cross-national and socio-demographic differences when investigating acceptance of potential future users of L3 cars, and their role in the development and deployment of L3 cars.

Recommendation

Development and deployment strategies for L3 cars may need to be tailored to different markets and customers with different socio-economic profiles, to promote the uptake and safe use of this technology.

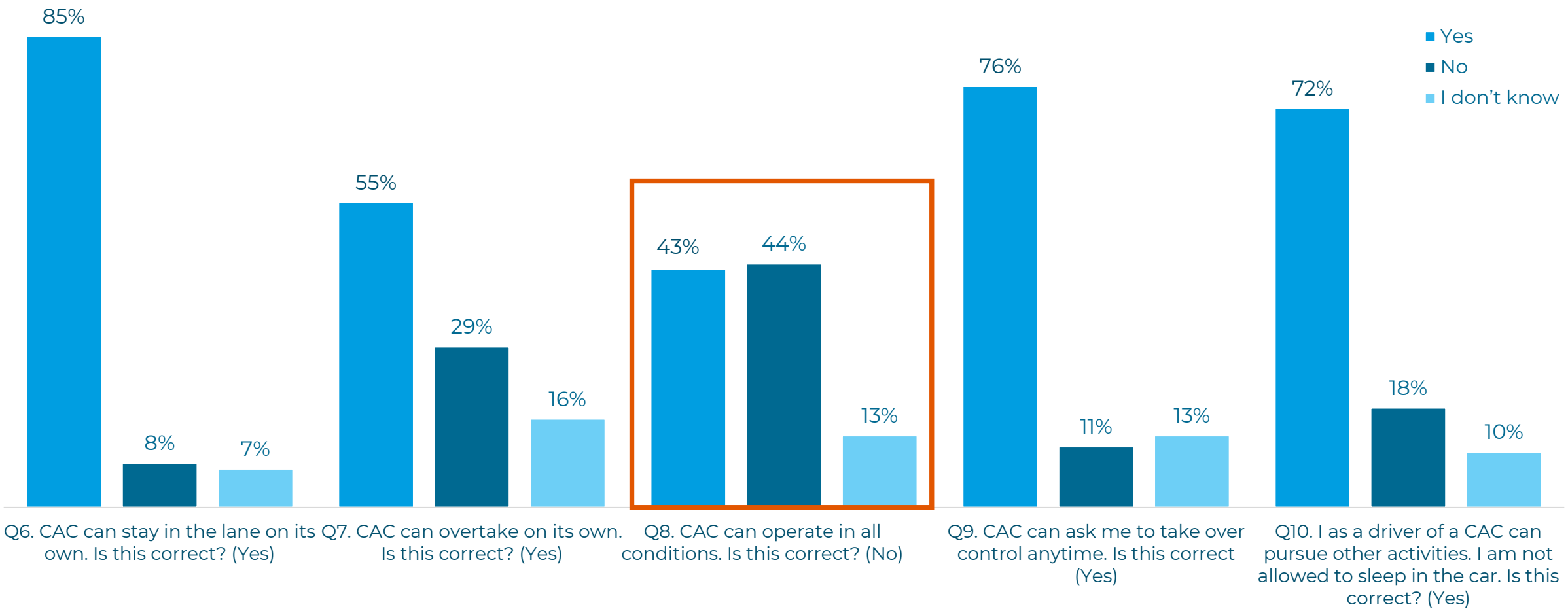
- In markets where intention to use L3 cars is low, more emphasis should be placed on communicating the safety benefits of the technology, especially to older cohorts.
- In markets where intention to use L3 cars is high it may be necessary to develop a pathway for accessing L3 cars that avoids cost being the barrier to adoption (e.g., government-funded grants, vis-à-vis electric vehicles).
- It is crucial to communicate the realities of the limitations of the technologies to avoid potential misuse due to inflated expectations, especially amongst younger cohorts.

What do our respondents recall about L3 cars?

Context

- To ensure we knew that respondents had a basic knowledge of L3 capabilities, at the start of the survey they were given a list of system features.
- They were then asked comprehension questions to gauge the knowledge and recall.
- It is not possible to know respondents' level of knowledge prior to the survey, but the responses below highlight their comprehension of the system descriptions.

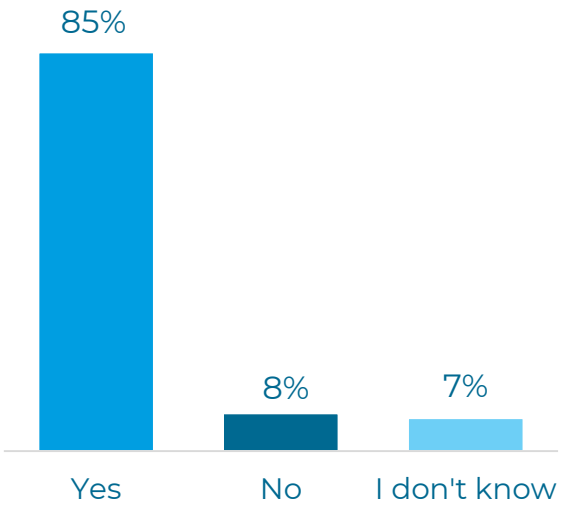
What our respondents recall about L3 cars?

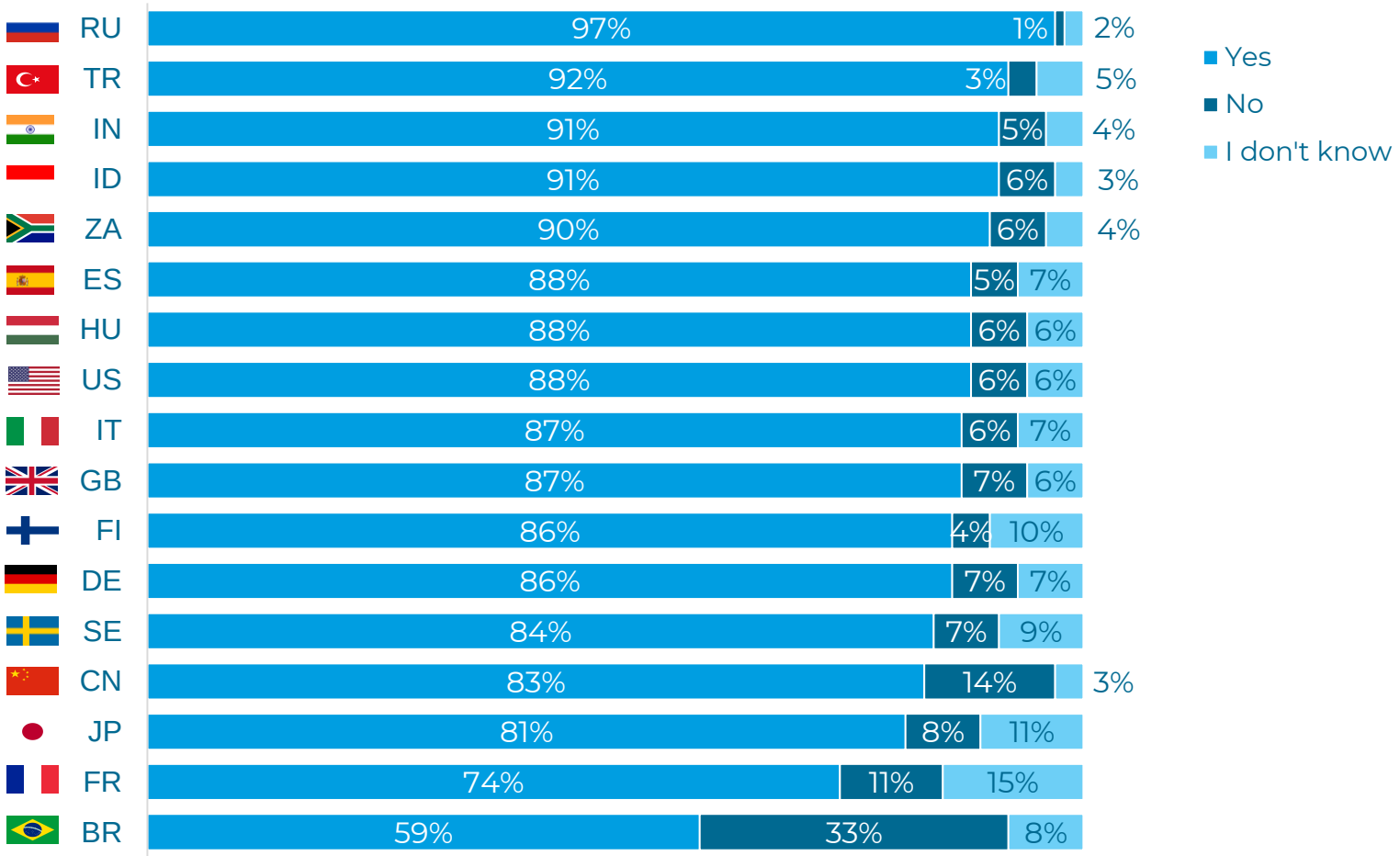


Note: Answers are based on an introduction to L3 vehicle automation respondents received prior to survey participation. Correct responses are in brackets at the end of each question.

Comprehension of L3 functionality: L3 car staying in the lane on its own

Overall:

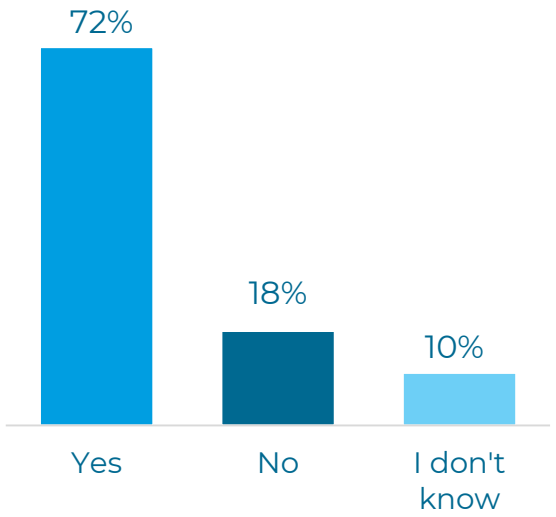


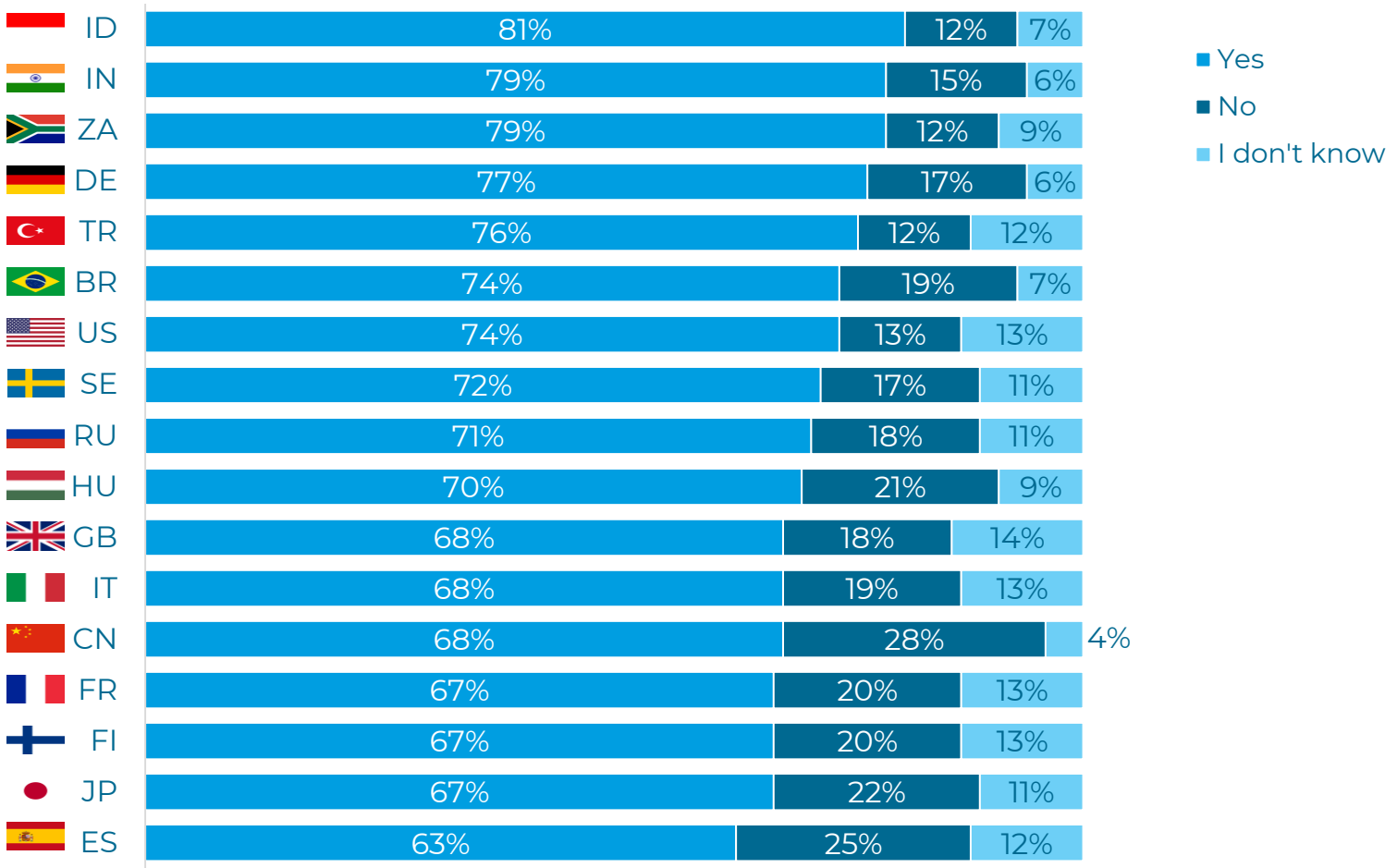


Q6. A L3 car can stay in the lane on its own. Is this correct? (Yes); n = 18,054

Comprehension of L3 functionality: Pursuing activities other than sleeping

Overall:

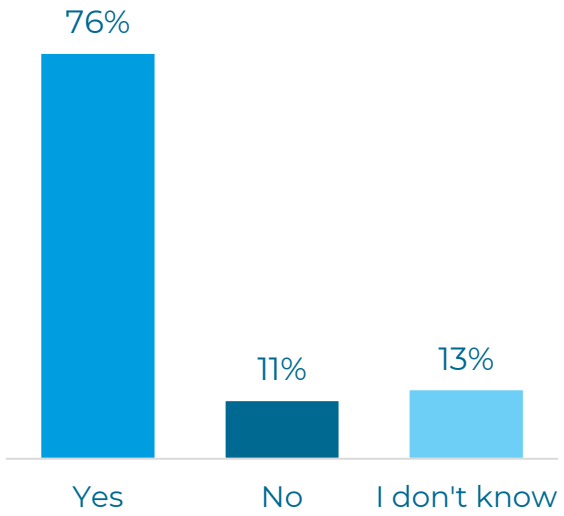


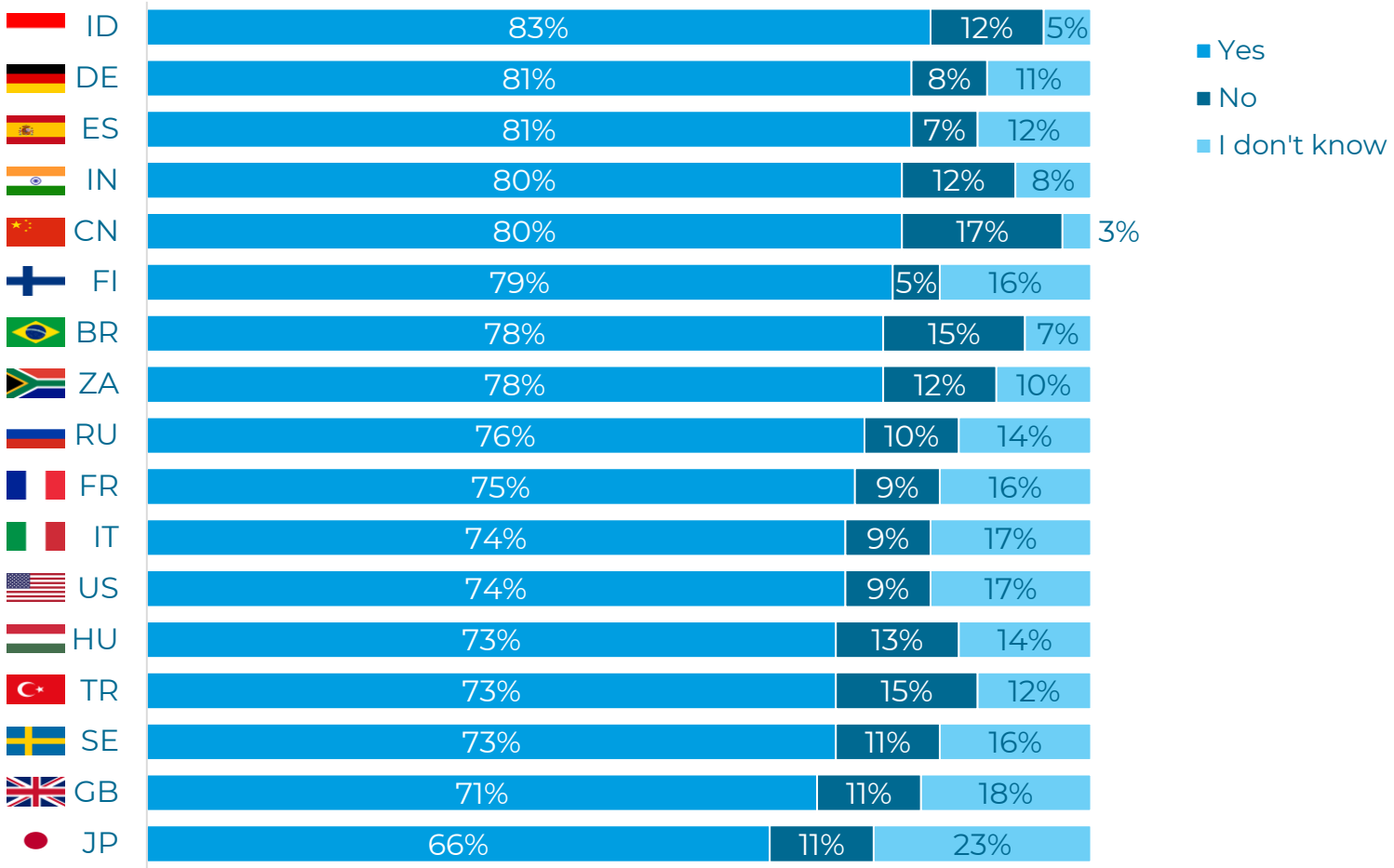


Q10. I as driver of a L3 car can pursue other activities. I am not allowed to sleep in the car. Is this correct? (Yes); n = 18, 631

Comprehension of L3 functionality: Asking human driver to take over control anytime

Overall:

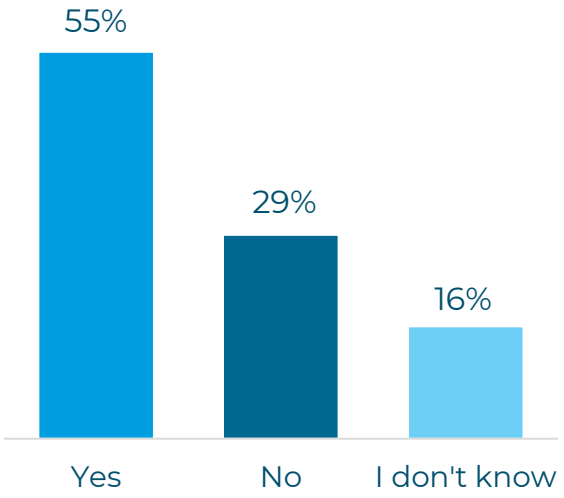


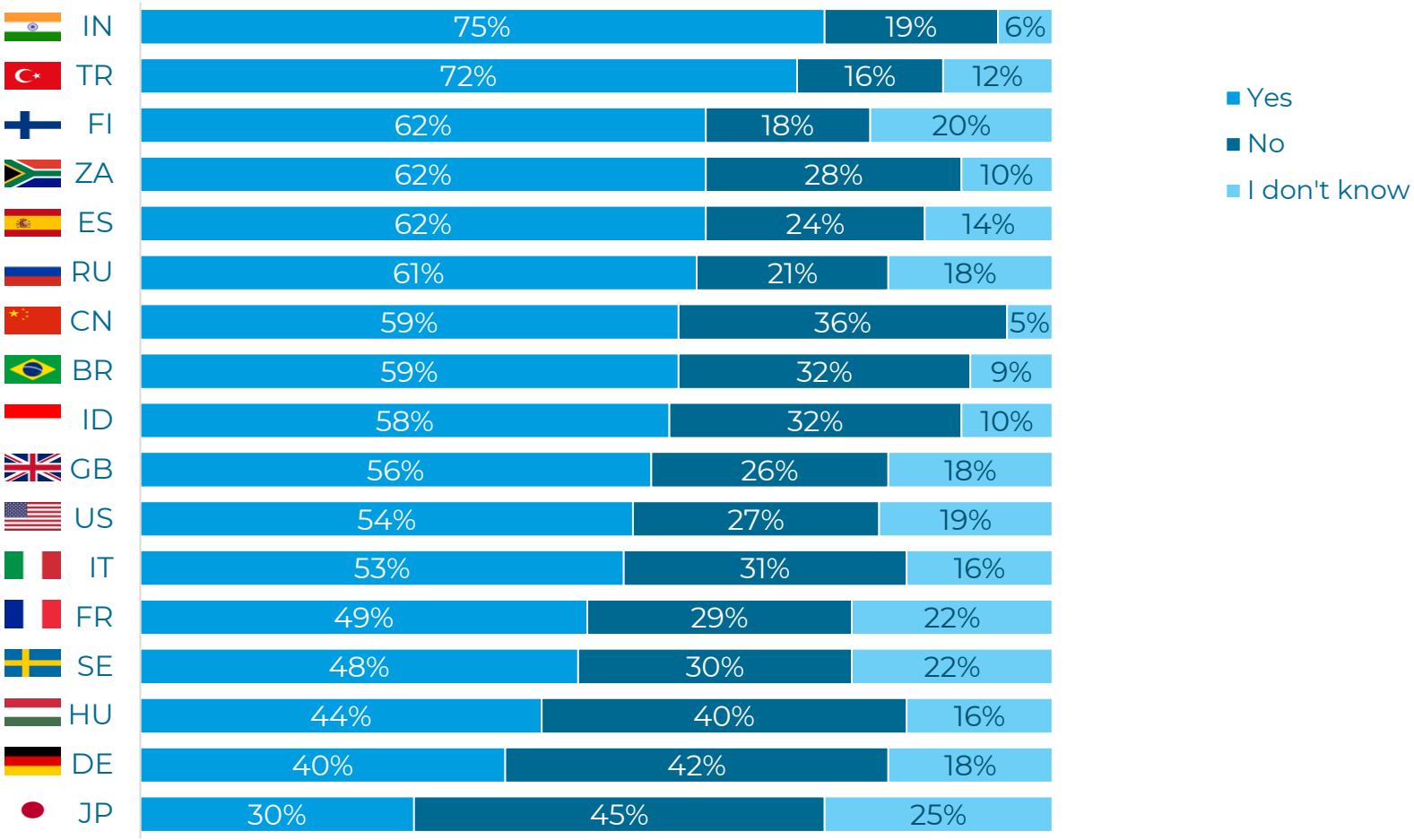


Q9. A L3 car can ask me to take over control anytime. Is this correct? (Yes); n = 18,631

Comprehension of L3 functionality: Overtaking on its own

Overall:

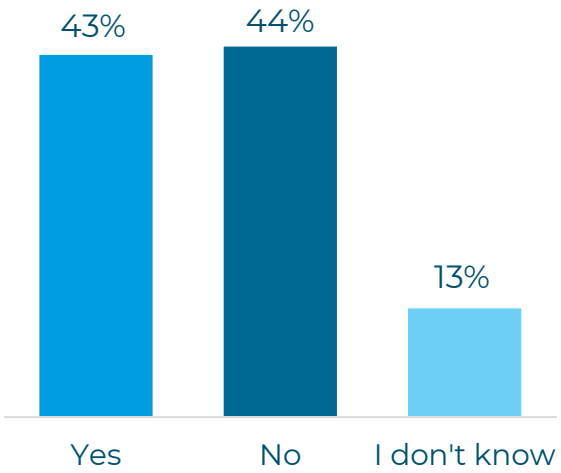


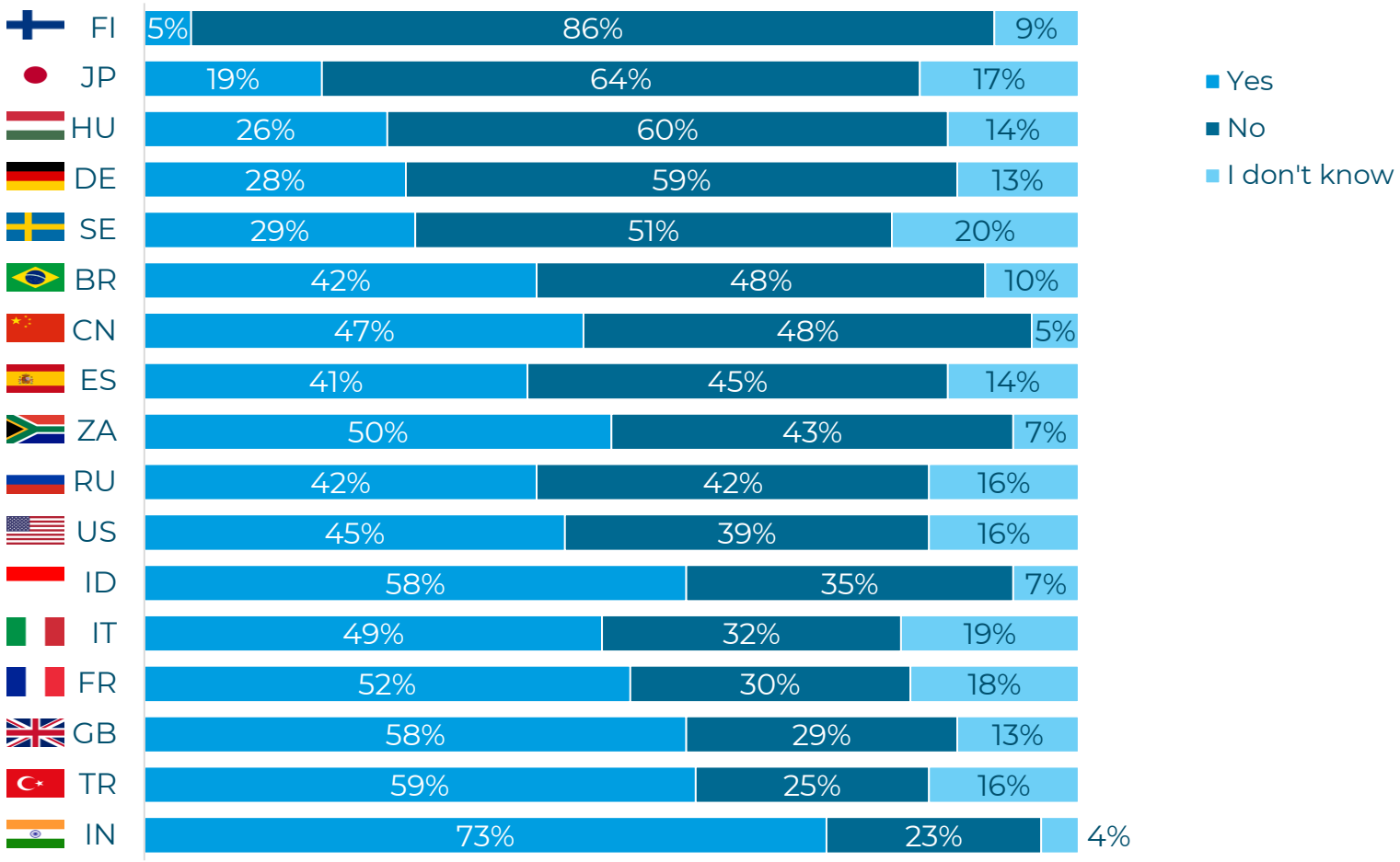


Q7. A L3 car can overtake on its own. Is this correct? (Yes); n = 18,631

Comprehension of L3 functionality: Operating in all conditions

Overall:





Q8. A L3 car can operate in all conditions. Is this correct? (No); n = 18,631

Interpretation

85%
Correctly recalled that a L3 car can stay in the lane

76%
Correctly recalled that a L3 car can ask to take over control

72%
Correctly recalled that the driver can pursue other activities

Good understanding of functionality of L3 cars is important for a successful market introduction.

?!

Solid understanding about less complex SAE level 3 functions may reflect the relatively high penetration rates and experiences with ADAS in today's vehicles.

- Reflect relatively high spread of and experience with lane departure warning and lane keeping systems in today's vehicles.
- Vital change between ADAS and L3 systems, i.e. the shift of the driving tasks from the driver to the system under certain conditions is well recognized.
- Major benefit for the driver to use the time in a L3 car for other activities but also their limitations are well recognized and understood.

Interpretation

43%

Yes, a L3 car can operate in all conditions

44%

No, a L3 car cannot operate in all conditions

Generally, respondents failed to recall the complex concept of operational design domains (ODD) for L3 automation.

?!

The tendency to overestimate the capabilities of the AD system might derive from the technology name and related brand names, like “autopilot” or “self-driving”.

- Limited level of understanding about L3 functions may reflect high expectations of the public caused by optimistic marketing campaigns.
- Confused understanding or maybe more assumptions or attributions of more complex capabilities of L3 cars.

Interpretation

?!

Highest confusion about operational design domain (ODD) in which L3 systems are designed to function, e.g. roadway types, lighting, and weather conditions.

- Notable finding: Countries facing inclement weather conditions (FI, JP, DE, SE) showing better understanding about constraints of operating domains.

Recommendation

Raise the level of knowledge about the different levels of automation among the general public.

- Set up communication campaigns and harmonized user education programs to educate the general public but also politicians, and legislators about the potentials and limitations of different automation level technologies.
- Translate the complex SAE level descriptions of automation levels into easy-to-read and understand instructions for the users.
- Develop transparent user-facing taxonomy of the different automation level technologies with clear designation of primarily responsible for safety.

Calibrate expectations using multiple communication channels.

- Advertising and information campaigns should have a strong focus on what an L3 car is and is not capable of, and communications should be consistent across platforms.

Recommendation

Develop harmonized safety-related driver training modules for AV's.

- Incorporate new requirements for the driver, such as handing over and resuming control of the vehicle in the driver training to gain practical experiences and thus a safe performance of the driving task.
- Develop and disseminate driver training guidelines with focus on traffic safety-related use of the automated systems to avoid misuse and/or disuse by the driver.

Expose the public to L3 cars by showing safe and reliable operation in extensive road experience campaigns.

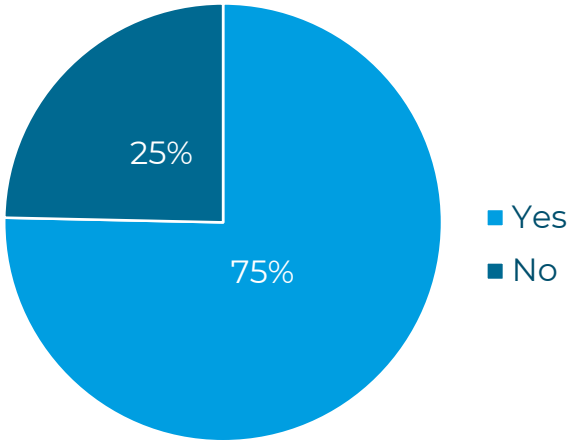
- Develop user-friendly ODD lexicon that support user informed safety.
- Individual tendency to adopt new forms of technology should be efficiently guided towards avoiding misuse or disuse.
- "Informed safety" is imperative to remove obstacles from the future adoption of AVs and avoid inappropriate system use.

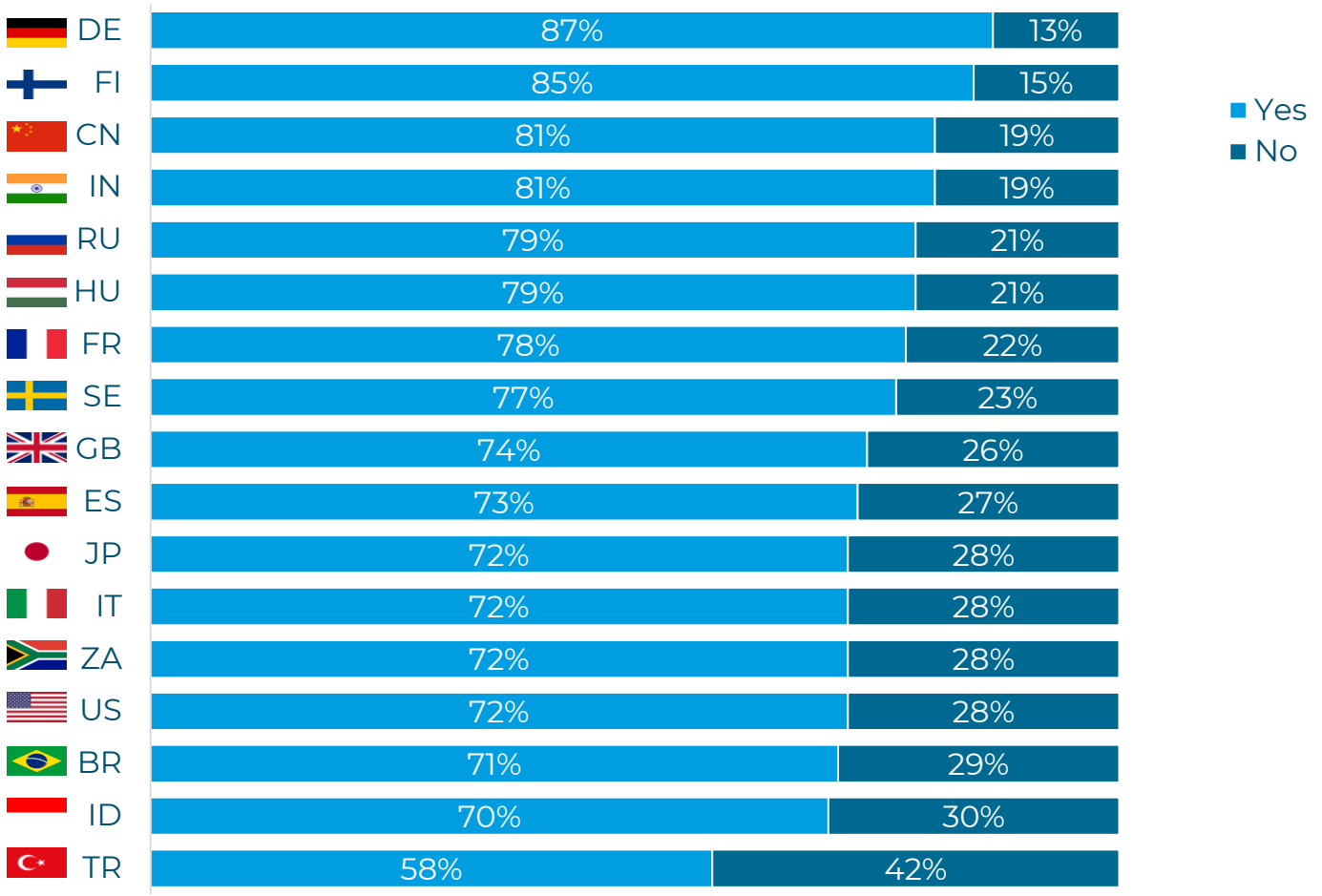
How aware are the respondents of automated driving?

What is the awareness of automated driving?

The topic of automated driving is very present among the respondents.

Overall:





Q11. Have you ever heard of automated cars before taking part in the present questionnaire survey? n = 18,631

Interpretation

75%

Had heard of automated cars before survey

The hype is real. Widespread awareness of automated cars across countries and cultures. Automated cars have become a topic of the global public discourse.

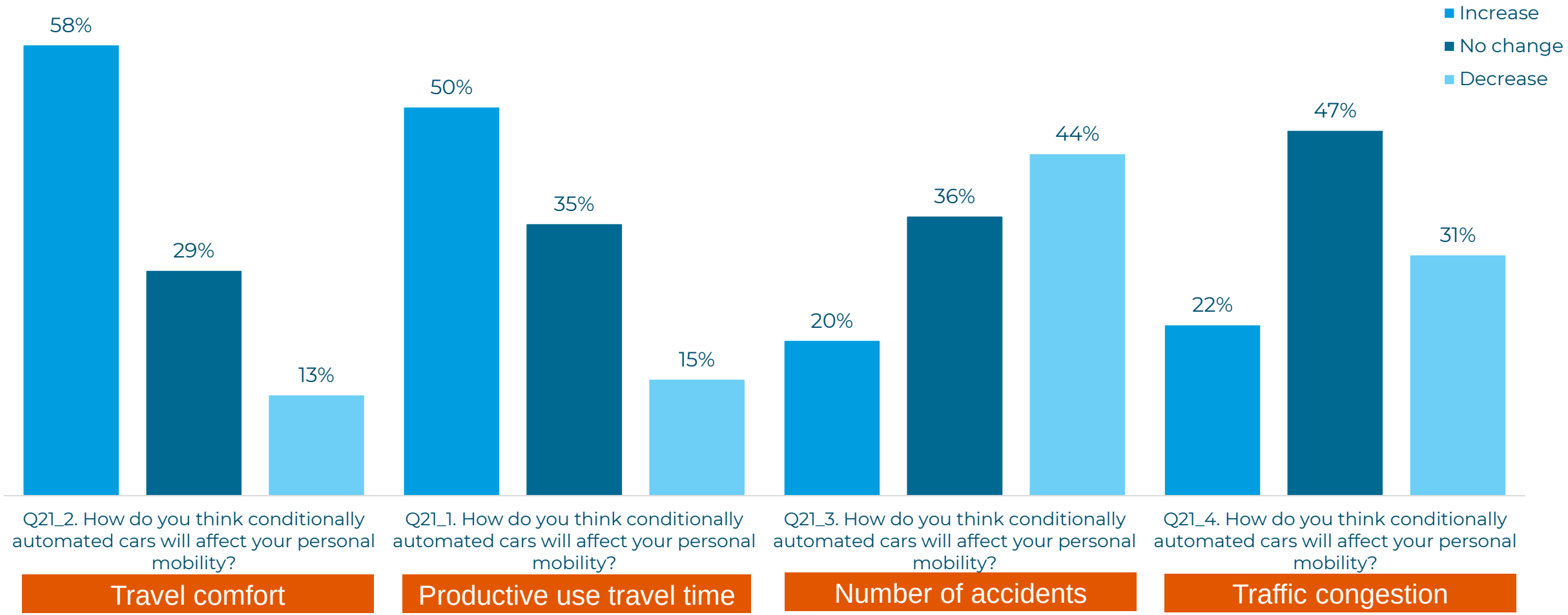
?!

Observation of an reversal: “Leaders” in acceptance are the last in line regarding awareness and vice versa.

- Leading countries in awareness (DE, FI) are among the least accepting nations of L3 cars.
- Enthusiasm for new technologies especially in emerging economies with lower GDP might be an expression of the need for new mobility solutions to improve transport safety, efficiency, and comfort.
- China and India as exceptions with high awareness (among top 5) and simultaneously high acceptance rate (top 5).

What are the expectations towards L3 cars?

What are the expectations towards L3 cars?



Interpretation

58%
L3 cars will increase personal travel comfort

50%
productive use of travel time will increase

The surveyed car drivers value the productive use of time while travelling in a L3 car.

?! **This is in line with a positive attitude towards L3 automation and perceived benefit of using travel time for non-driving-related activities.**

- Congested transport systems might reinforce the preference for productive use of travel time.
- Commuters might value the possibility to work in the car office and thus using travel time more efficiently while others rather consider it as pleasure or a contribution to increasing well-being.
- China and India affinity to innovation and trend towards heavily increased urbanization with 60% by far endorses the productive value of travel time.

Interpretation

44%

No change of number of accidents

20%

Increase of number of accidents

The primary benefit of partly automated transport systems to improve safety for all road users is seen with some doubts.

?!

Reservations about automated driving safety improvements may result in

- Mass media coverage of accidents with automated vehicle and its frequency of reporting (USA where the first tragic reminders of the remaining challenges took place is among the countries with the lowest trust in safety improvements).
- Lack of long-term safety records / detailed safety impact assessment reassuring the users and thus building confidence.
- AD systems as part of a safer system: AD vehicles in transport system not yet ready for it in terms of street design, traffic conditions, signs and signals.

Recommendation

Build up confidence and trust through verified safety.

- Continue the good practice established by the automotive and mobility industry leaders: publishing First-of-its-Kind Framework for Safe Automated Driving Systems (“Safety First for Automated Driving” (SaFAD) white paper).
- Emphasize safety by design and reach out to the general public with written in plain language safety principles.

Reassure the driver: prove safety through extensive Field Operational Test (FOT) campaigns on public roads.

- Safety and security are key: detailed impact assessment based on real world data will shape users’ expectations.
- Develop harmonized validation & verification tools: Series of Code of Practices (CoP).

Recommendation

Information from trustable sources can build confidence and help the public to learn the new vocabulary.

- Strengthen the role of government regulatory agencies, driver safety organizations and automotive magazines (e.g. ADS 2.0: A Vision for Safety published by NHTSA, USDOT).

Investigate the value of travel time and how users of L3 cars will use the time in the vehicle in long-term studies.

- Conduct qualitative in-depth studies to obtain detailed knowledge about travel patterns, user requirements and preferences for travel time use. Supplement qualitative insights with global surveys to gain a broad and solid knowledge base. Link quantitative results to impact assessment and cost benefit analysis.

Recommendation

Provide a comfortable driving experience in L3 cars while focusing on the design of clear and smooth driver-vehicle interactions.

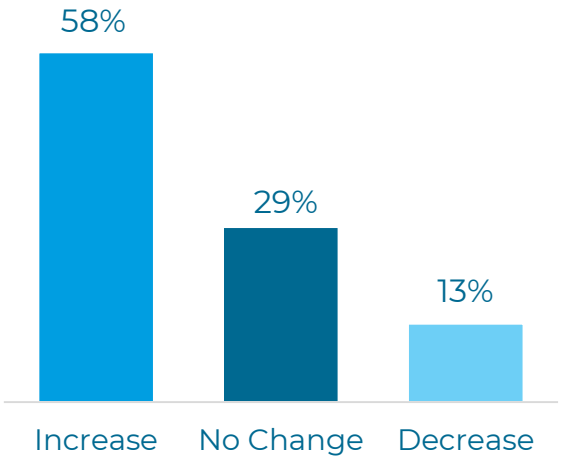
- Develop comfortable driving strategies and distinct communication between vehicle and driver to overcome potential discomfort (urge to take over vehicle control), like travel progress, rule following, safety margins. Design the interior around new opportunities and requirements for the driver.

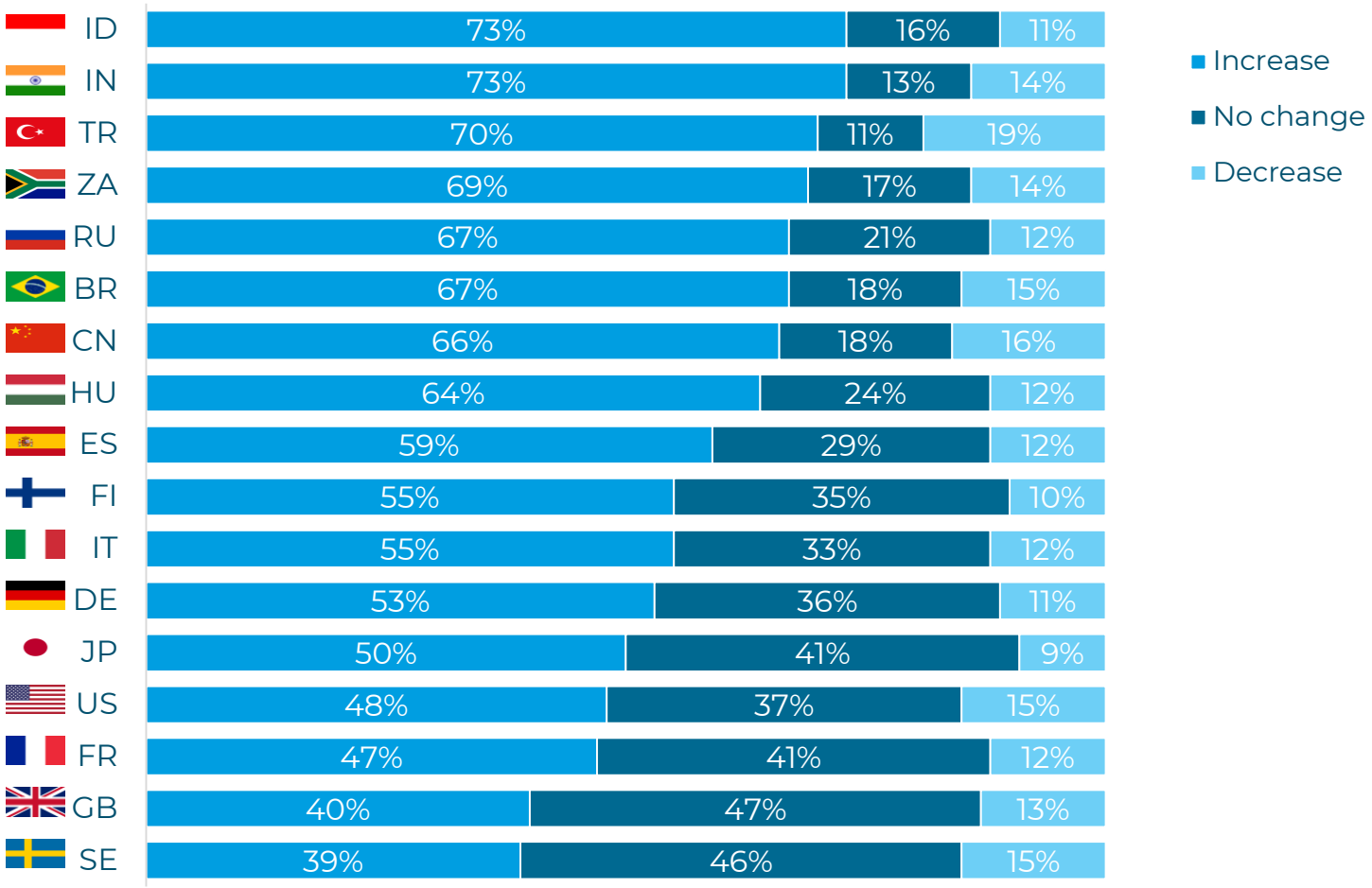
- Understand underlying causes of motion sickness in a L3 car and design driving strategies and driver vehicle interactions accordingly.

Expectations per country

Expectations towards L3 cars: Travel comfort

Overall:

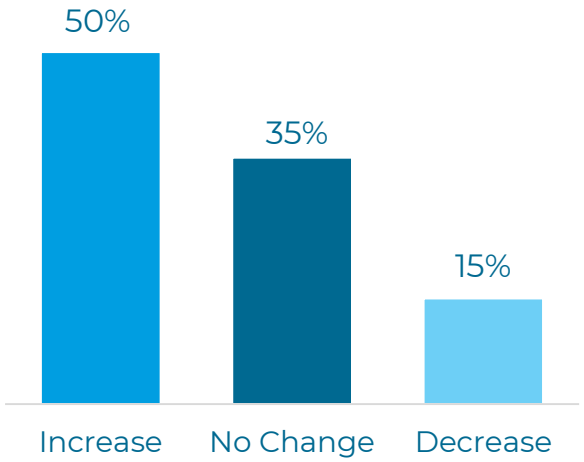


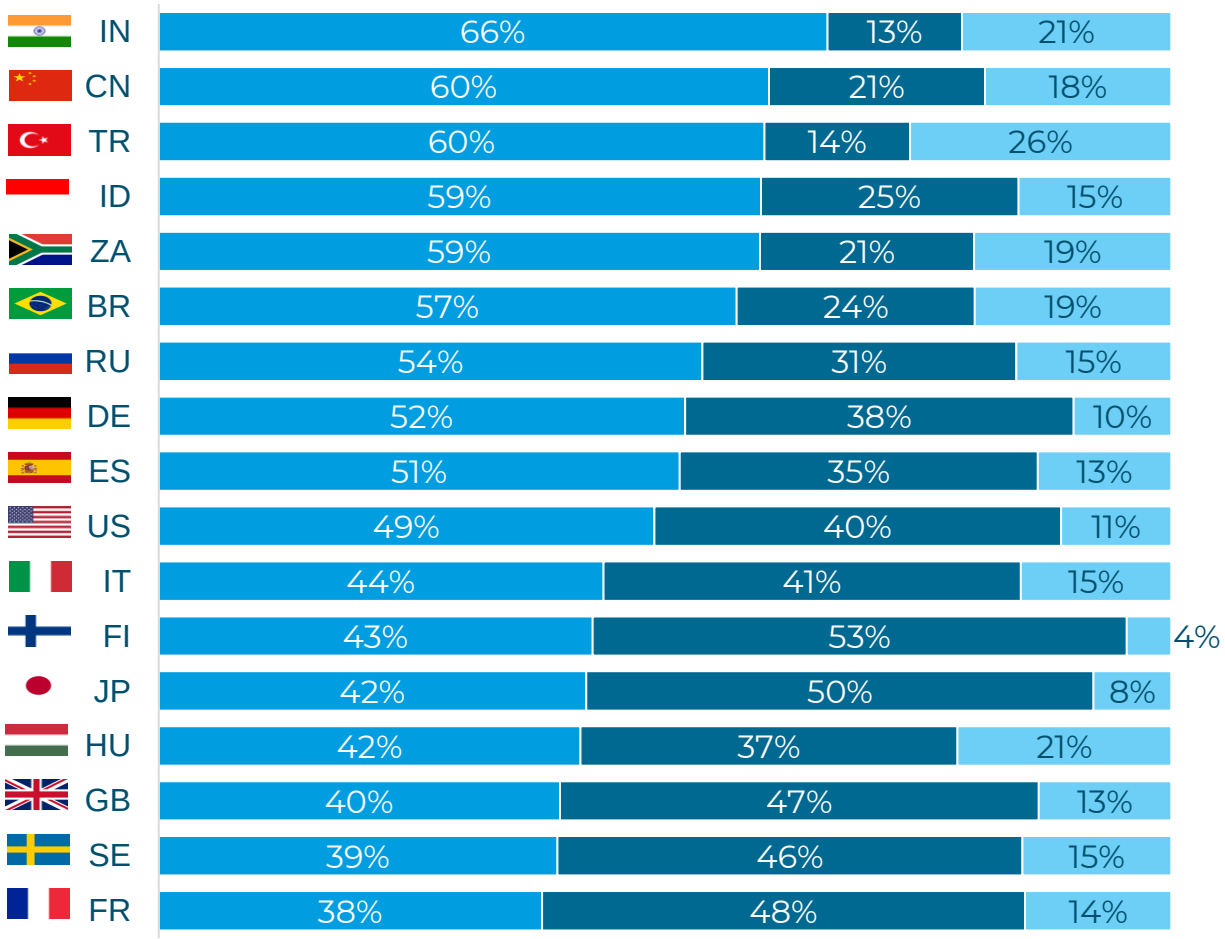


Q21_2. How do you think conditionally automated cars will affect your personal mobility? "Travel comfort"; n = 18,382

Expectations towards L3 cars: Productive use of travel time

Overall:

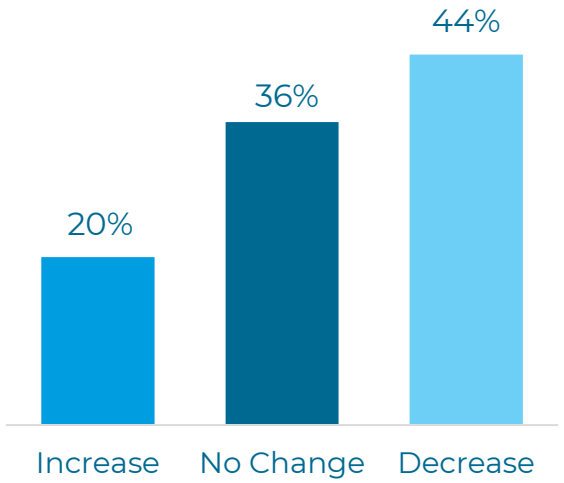


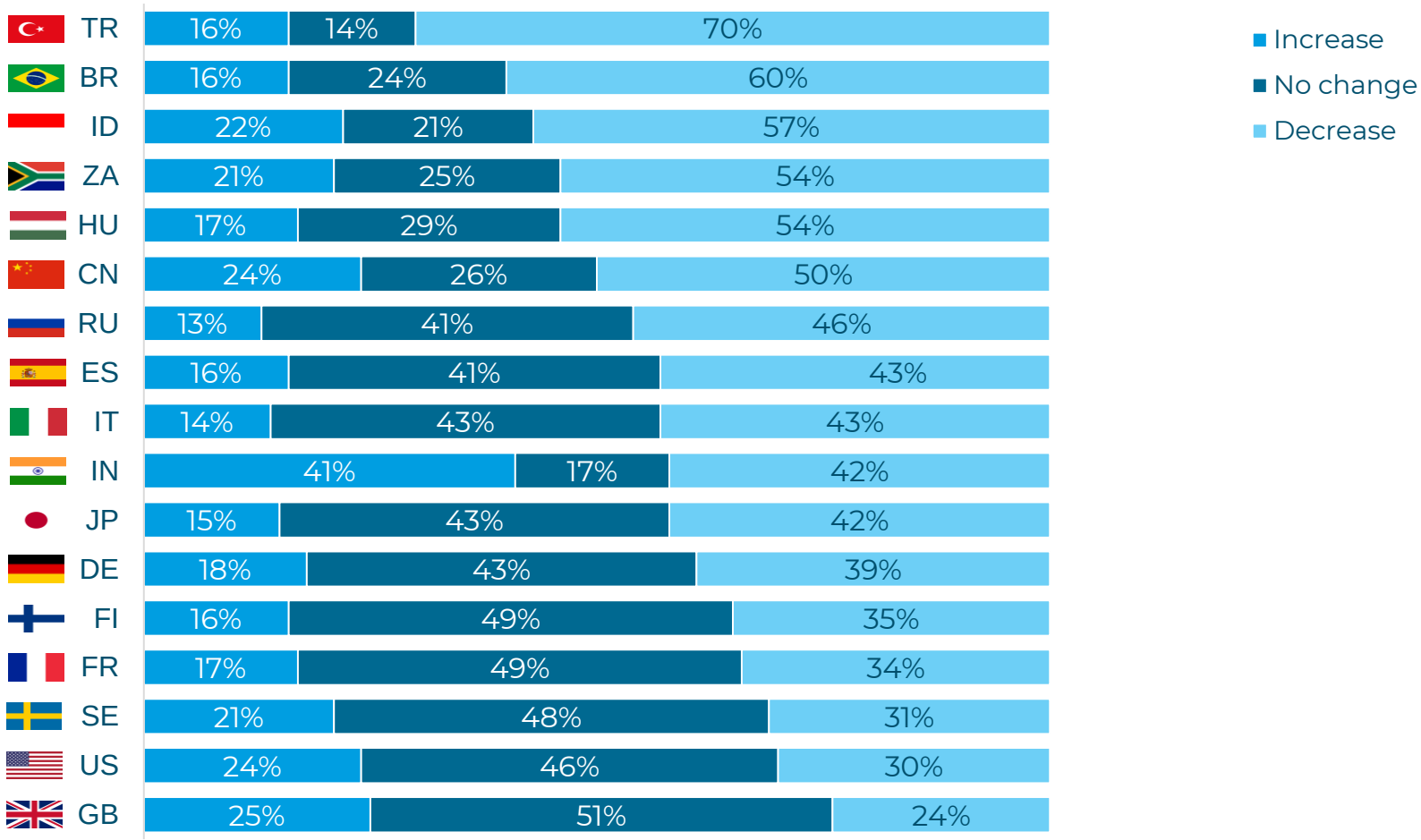


Q21_1. How do you think conditionally automated cars will affect your personal mobility? "Productive use of travel time"; n = 18,631

Expectations towards L3 cars: Number of accidents

Overall:

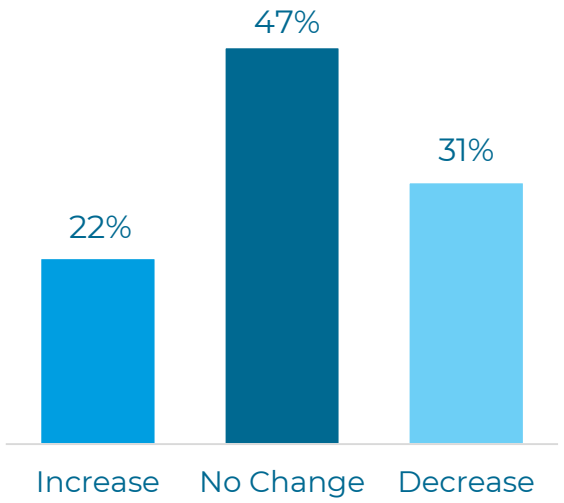


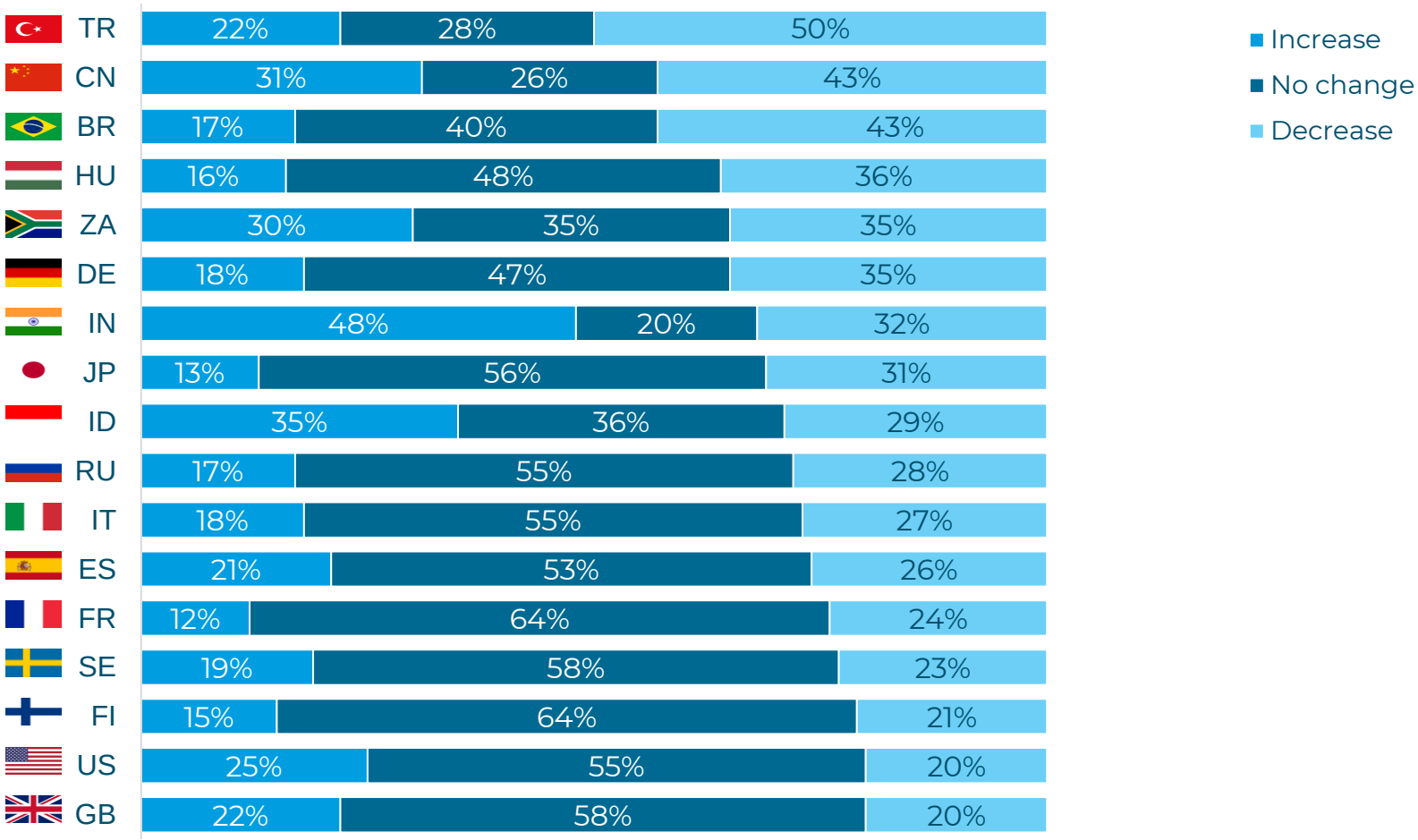


Q21_3. How do you think conditionally automated cars will affect your personal mobility? "Number of accidents"; n = 18,631

Expectations towards L3 cars: Traffic congestion

Overall:

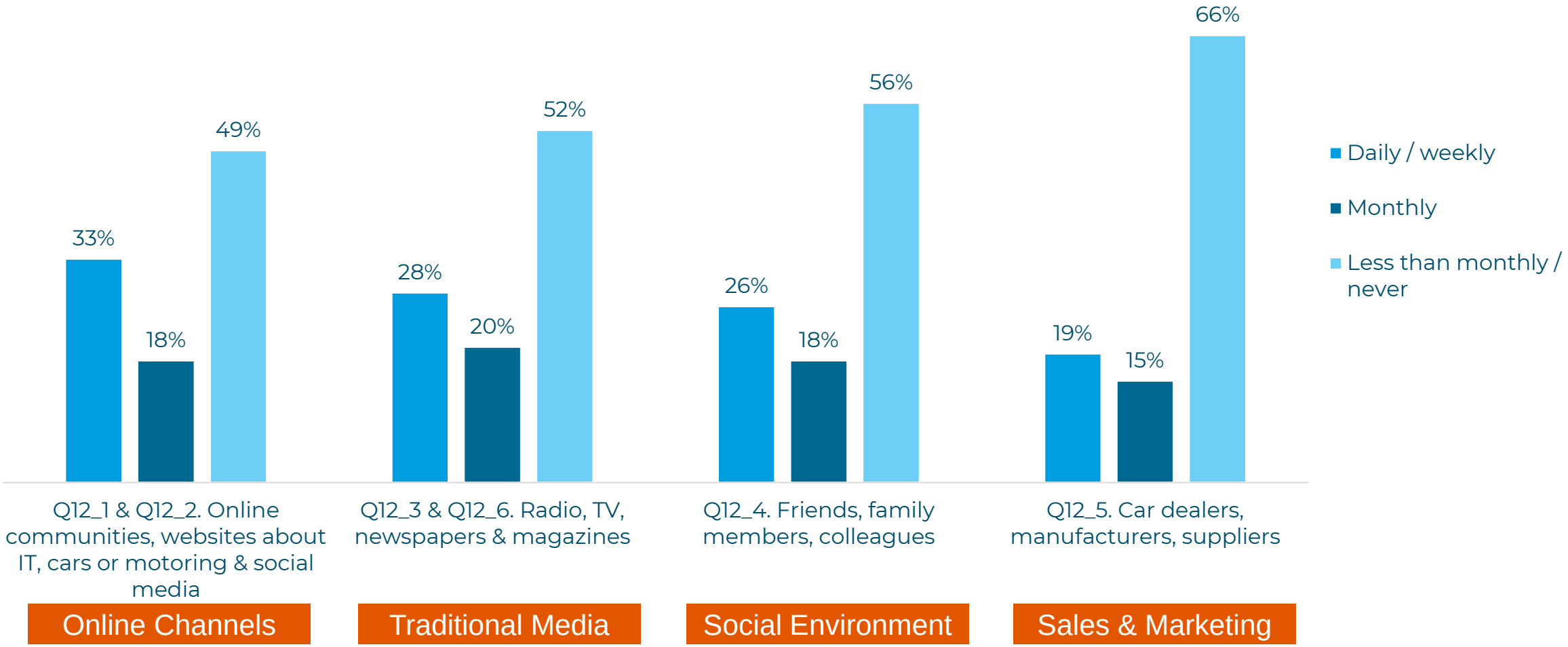




Q21_4. How do you think conditionally automated cars will affect your personal mobility? "Traffic congestion"; n = 18,631

How often do respondents receive information about automated driving?

How often do respondents receive information about automated driving?



Interpretation

51%
Receive information **daily / weekly or monthly** via online channels

48%
… via traditional media

44%
… via social environment

34%
…via sales & marketing

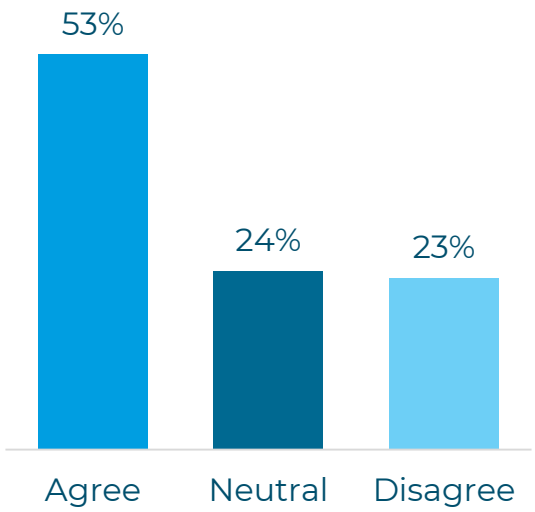
?! **High awareness of automated driving among drivers is also reflected in information sources and communication channels.**

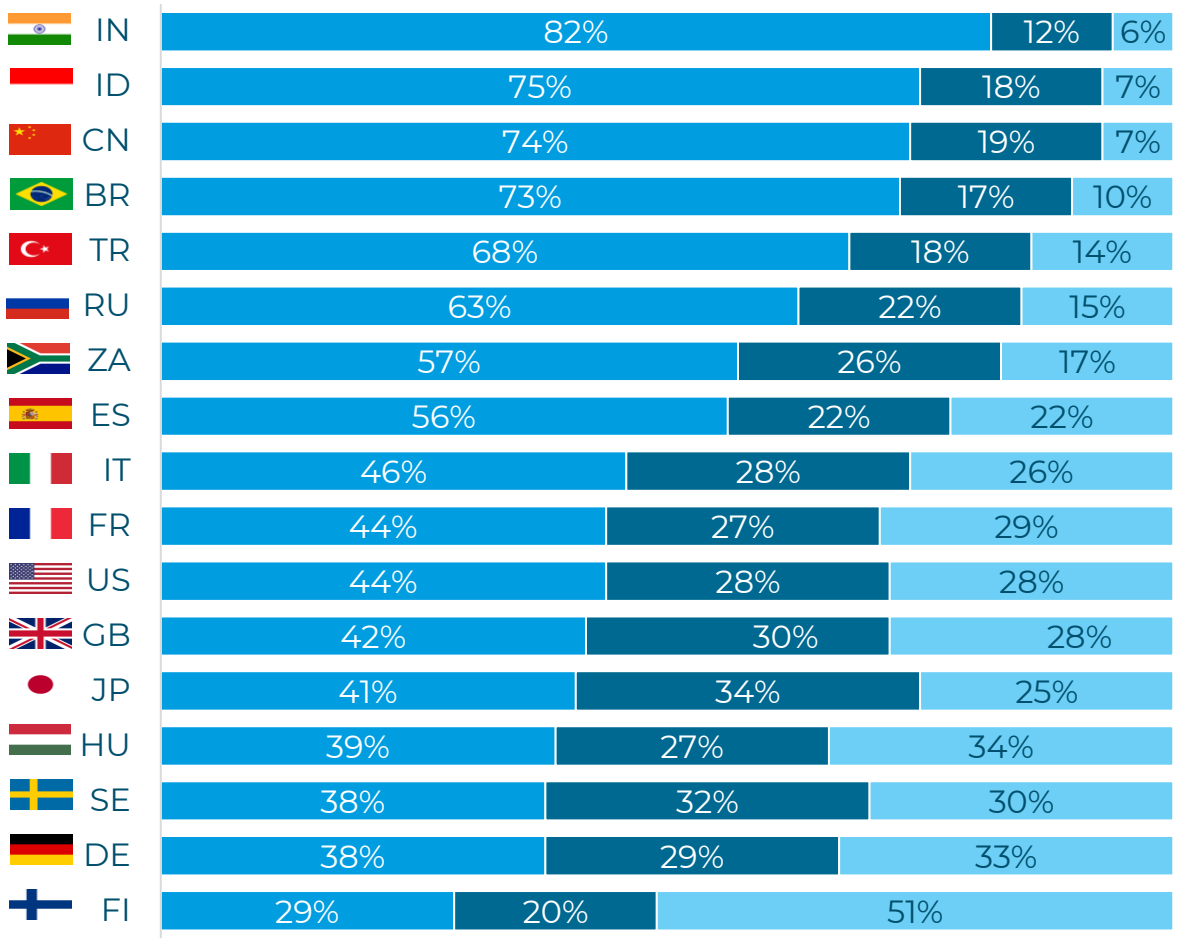
- Online channels are the most frequent means to receive information.
- Traditional media still hold a very strong position as information source.
- The social environment of friends, family, and colleagues play a relevant role as information and discussion arena.
- Even sellers via dealership or as a vehicle producing company reach about one third of the respondents on a regular basis.

Which activities are the most attractive?

Task engagement: Willingness to engage in other activities

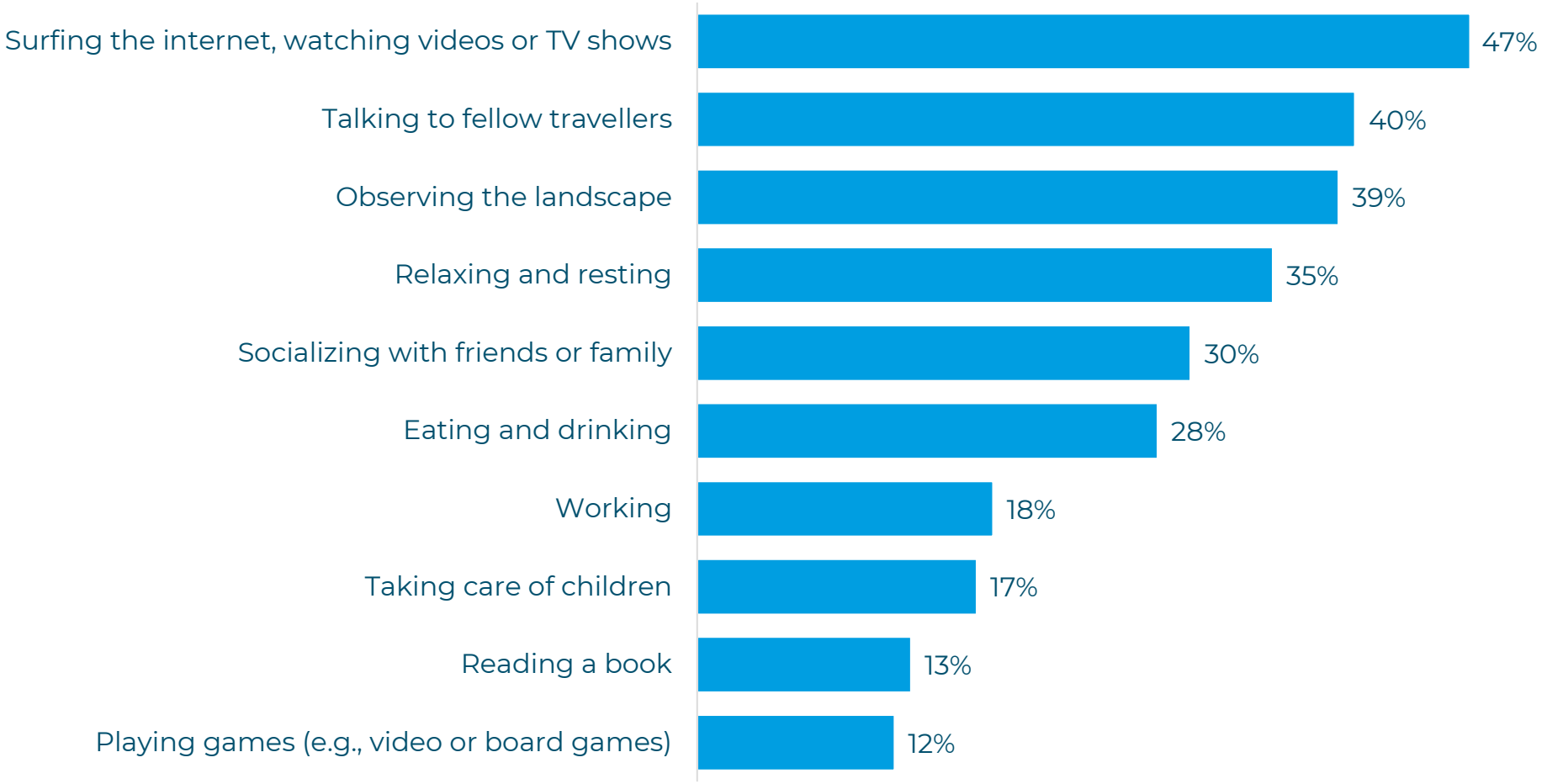
Overall:





Q14. I would use the time during which the conditionally automated car is driving for other activities; n = 18,631

Which activities are the most attractive?



Q14b_1-Q14b_10. Which activities would you like to perform in a conditionally automated car? Please select a maximum of three activities; n = 10,052

Interpretation

53% Would like to use time in L3 cars for other activities**.**

One of the main benefits of automated cars – engagement in secondary, eyes-off road activities – <u>not</u> seen by 47% of respondents.

?!

Large variation among countries about willingness to engage in other activities.

- Drivers may not feel fully at ease engaging in non-driving related tasks while automation is engaged due to a lack of confidence about the reliability of the system. It could also be indicative for a curiosity to look at how the system behaves.
- Respondents could not fully envision their interaction with L3 cars due to their lack of actual physical experience with L3 cars, which may have made it difficult to accurately understand the function and the benefits offered by this technology.
- Higher willingness to use car for other activities might also reflect higher level of trust and general excitement and enthusiasm for this topic.

Interpretation

?!

Respondents value engagement in familiar and traditional activities they perform in cars & public transport that demand less attentional resources.

- Low preference to engage in secondary eyes-off activities might be concerns about discomfort, due to the emergence of motion sickness, by having the eyes off the road.
- Respondents might not fully trust L3 cars to operate safely and reliably.
- Surveyed car drivers might still have image of classical automobile in mind steered by human drivers.
- Low willingness to take eyes off the road might reflect nature of L3 automation, which places considerable demands on the sensory, motoric and cognitive state of the human driver.

Recommendation

Accommodate car interior to enable comfortable engagement in people's most favorite activities and promote popularity of engaging in eyes-off road activities.

- Design the car interior to allow for relaxation activities, e.g., equipping the car with comfy couch and providing fast access to the internet.
- Alternatively, promote trust in L3 cars to motivate people to engage in activities that demand many attentional resources to fully reap the benefits of L3 cars.
- Demonstrate that L3 cars are safe and reliable.
- More effectively market the idea of L3 automation among the public and its association with taking eyes off the road safely and comfortably.
- Demonstrate that automation driving styles and interiors result in high comfort levels even when taking the eyes off the road.
- Effectively communicate benefits of eyes-off road activity engagement to users.

What are the influencing factors of L3 acceptance?

Examination and prediction of L3 acceptance

Which factors are related to the acceptance and to what extend?

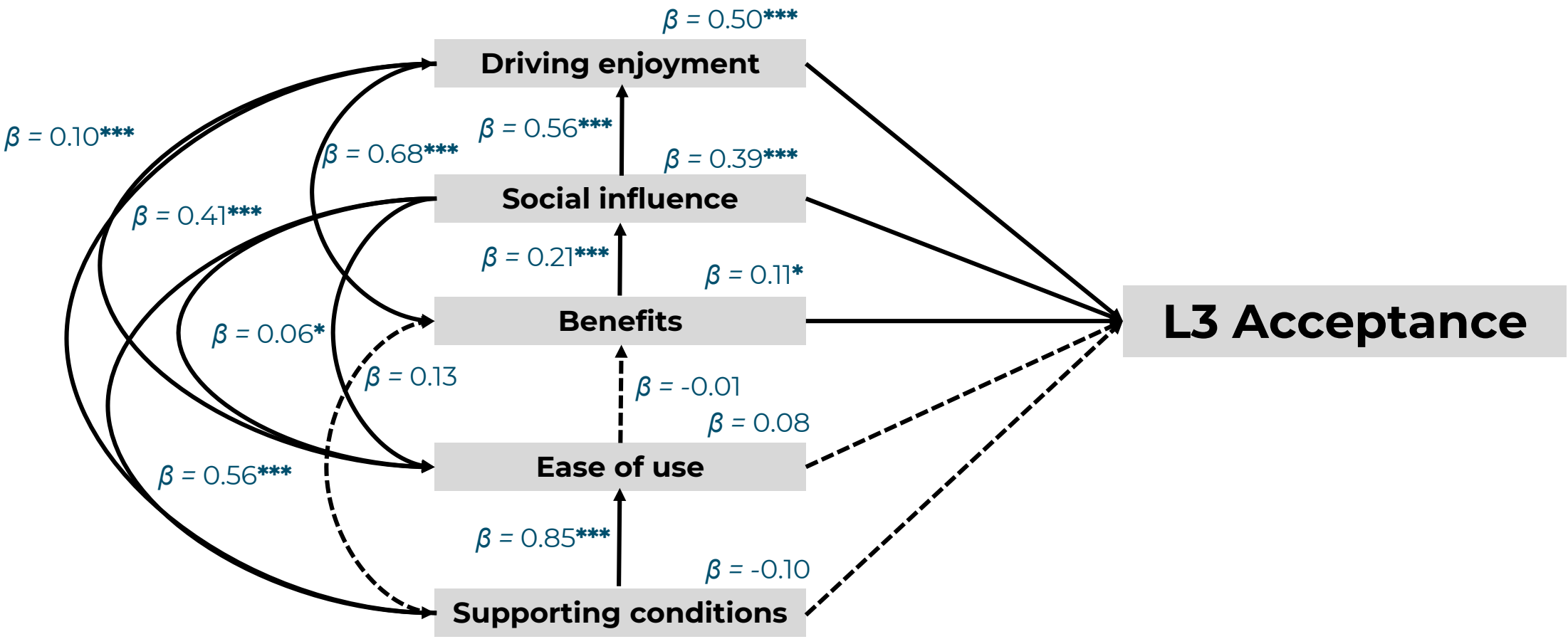
- In the first step, a confirmatory factor analysis was conducted to evaluate the relationships between the observed variables (questionnaire items) and the underlying theoretical construct. In this step, latent and observed variables are linked together in order to understand the relationships between the questionnaire items and their underlying theoretical constructs in order to assess whether the questionnaire items serve as valid and reliable indicators of their theoretical constructs they are supposed to represent.
- In structural equation modelling, the theoretical constructs are linked in order to determine the direction and strength of their relationships. The assessment of the structural equation modelling involved reporting the standardized regression weights, their level of significance, and the amount of variance accounted for by these latent variables. Maximum likelihood estimation (MLE) was used for this calculation.

Factors included in the analysis

Construct	Definition
Performance expectancy	The degree to which the technology is perceived to be useful
Effort expectancy	The degree to which using the technology is perceived to be easy to use
Social influence	The degree to which using the technology is appreciated in the social network important to the individual
Facilitating conditions	The degree to which the individual believes to be in possession of the resources to use the technology
Hedonic motivation	The degree to which the technology is perceived to be enjoyable
Price value	The cognitive trade-off between perceived benefits and monetary costs of technology usage
Habit	The passage of time from the initial technology usage

According to Venkatesh et al., 2003; 2012

The direct and indirect influencing factors of L3 acceptance



*Note that β is the correlation coefficient, which measures the strength of relationships between two variables. It measures the differences in the means of the variables in terms of standard deviations. Dashed errors denote no effects. *** = p < 0.001, ** = p < 0.01, * = p < 0.05*

Interpretation

?!

Increasing the perceived enjoyment of driving a L3 car is the most effective means to promote L3 car acceptance.

- Strongest influence of perceived enjoyment on L3 acceptance means that behavioral intention can best be promoted by increasing the perceived enjoyment.
- The second-strongest predictor of acceptance was social influence, implying that users who rely on their social networks have a higher L3 acceptance.
- The third-strongest predictor of acceptance were the perceived benefits, meaning that drivers who consider L3 cars useful are more likely to intend to use them.
- Effort expectancy and facilitating conditions did not predict L3 acceptance, implying that an increase in L3 acceptance can’t be achieved by making driving with L3 cars easy or by providing the necessary conditions to facilitate use.

Interpretation

?! **Interrelationships between factors show important avenues of how to promote L3 car acceptance**

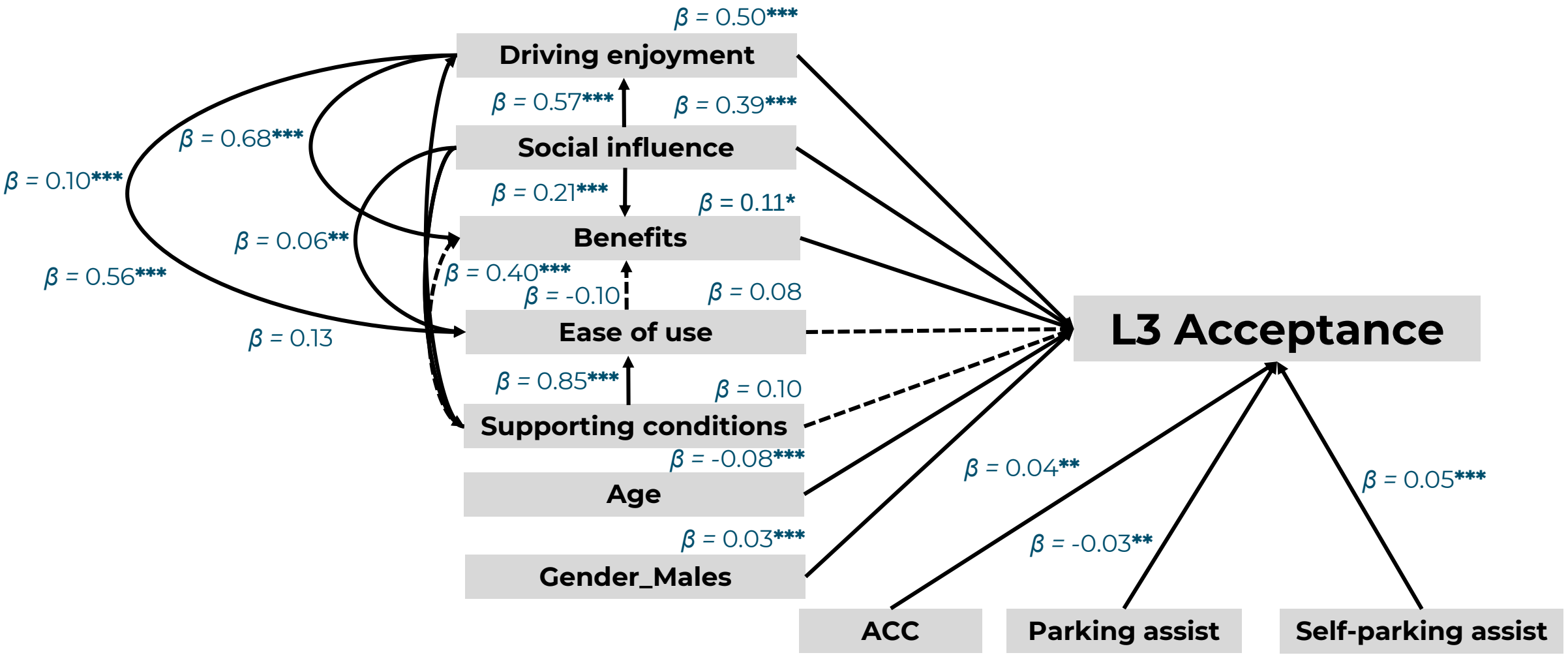
- Role of social influence & supporting conditions for driving enjoyment
  - Increasing the reliance on users' social networks and providing conditions supporting the use of L3 cars helps to promote the perception that driving a L3 car is enjoyable.
- Role of supporting conditions, enjoyment, & social influence for ease of use
  - Providing the necessary conditions to support use of L3 cars, making driving with L3 cars enjoyable, and strengthening reliance of social networks can help to promote the ease of use of L3 cars.

Recommendation

Benefits of L3 cars must be clearly demonstrated and promoted by public (e.g., media, policy-makers) and private decision-makers (e.g., manufacturers) via established communication channels and in social networks.

- Make driving with L3 car fun: Entertain the driver.
- Increase relevance of social networks (both online and offline) in promoting the benefits of L3 cars.
- Establish “bring a friend/relative” campaigns.
- Focus on recommendations by friends/relatives to leverage the potential of trustful social relationships.
- Push formation of governmental agencies with private organisations to launch joint education campaigns about the benefits of automated cars.
- Implement living labs and enable test rides to expose the general public to automated cars.

What are the indirect influencing factors of L3 acceptance?



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Interpretation

?!

Effects of age, gender, and experience with ADAS on behavioral intention

- Elderly people were less likely than younger people to accept L3 cars but effect size was small.*
- Males were more likely than Females to accept L3 cars, but effect sizes were small.
- Age and gender may not have a strong influence on acceptance of L3 cars.
- People with experience of ACC are more likely to use L3 cars.
- People who currently use parking assist are less likely to use L3 cars.
- People who currently use self-parking assist systems are more likely to use L3 cars, probably because of perceived difficulty of parking and added value of self-parking systems in making parking less stressful.

*) see limitations at the end of slide deck

Recommendation

Convince females and elderly people to use L3 cars.

- Sell benefits of L3 cars among Females and elderly people, exposing them to automated driving technology in living labs.
- Study interactions between age, gender and other psychosocial variables to better understand effect of age and gender on acceptance of L3 cars.

Familiarize public with ADAS via information and demonstration campaigns.

- Inform and educate the public about expected safety and efficiency benefits of using ADAS and create opportunities for testing, e.g., via car dealers, roadway organizations.
- Create trust in activating ADAS.
- Explore reasons for non-use / deactivating ADAS.

The impact of L3 automated vehicles on public transport and active travel

Hypotheses and scope

- L3 AVs are expected to increase travel comfort and effective use of travel time

  → Popularity of passenger cars over public transport and active travel may increase

- Self-rated expectations on the travel mode changes will be investigated as a function of willingness to use L3 AVs and current travel behaviour

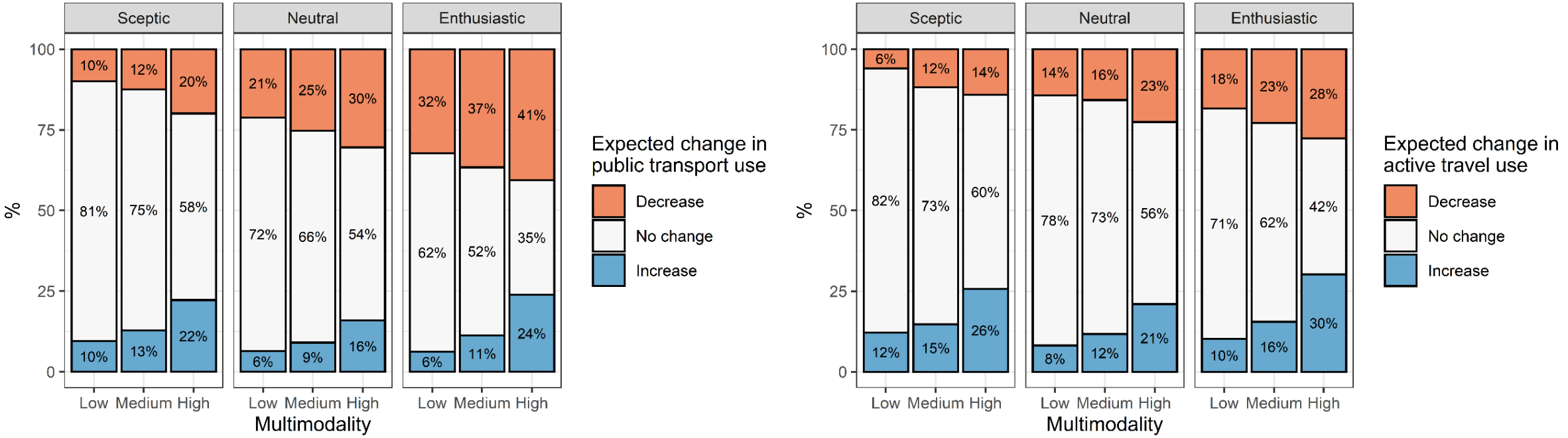
- Analysis focused on Europe

Methods

- Respondents were divided into three groups based on their willingness to use L3 automated vehicles:
  - Sceptic | low agreement on intention to use scale
  - Neutrals | moderate agreement on intention to use scale
  - Enthusiasts | high agreement on intention to use scale)
- The main dimension of the travel behaviour was multimodality:

  Car drivers who use only car - car drivers who use other modes besides car
- Low, medium, and high multimodal groups were formed

Results



- Enthusiasts were more often expecting to decrease the use of public transport and active travel modes
- High multimodal individuals were more often expecting changes in either direction
- Impact of L3 cars on the use of other modes may depend on the attitudes and current travel behaviour

Recommendation

Travellers should be nudged away from car-based monomodality towards multimodal travelling by the creation of multimodal environments.

- Compact form and prioritizing public transport and active travel, as in the eco-city concept should be promoted.

The use of L3 cars in urban areas should be reduced.

- Implement conventional measures such as congestion charging and controlling the price of parking.

Wrap up

Short summary of results

- **Current Usage of ADAS shows high potential.**
  - High interest among drivers not having these systems.
  - Ambivalent situation among drivers with ADAS available and their usage.
- **Users welcome L3 functions.**
  - High intention to use and significant intention to buy L3 cars.
  - Enthusiastic attitudes towards L3 level automation in emerging economies.
  - Intention to use L3 cars is strongly related to both GDP and road death rate.
- **Lack of robust understanding of L3 functionality exists.**
  - Solid understanding about less complex SAE level 3 functions.
  - Confused understanding or assumptions of more complex capabilities of L3 cars.
  - Difficulties also among people with experience of road vehicle automation.

Short summary of results

- **Widespread awareness of automated cars across countries and cultures.**
  - Awareness is reflected in frequency of use of information sources.
  - Online channels are the most frequent means to receive information.
- **Relevant impacts of using CACs expected.**
  - High expectations about increases in the productive use of travel time and travel comfort. Moderate expectations regarding decreases in traffic congestion and accident numbers.
  - Emerging economies with higher expections regarding the impacts of CACs on people‘s personal mobility compared to European countries.
- **Large variation among countries about willingness to engage in other activities.**
  - Respondents value engagement in familiar and traditional activities they perform in cars and public transport that demand less attentional resources.

Short summary of results

- **Driving enjoyment is strongest influencing factor for L3 aceptance.**
  - The perceived benefits, pleasure and reliance on social networks / social pressure are key factors of acceptance.
  - Gender and age are weak predictors of the acceptance of L3 cars.
  - Effort expectancy and facilitating conditions did not predict L3 acceptance.
- **Impact of L3 cars on public transport and active travel may depend on attitudes and current travel behaviour**
  - Enthusiasts were more often expecting to decrease the use of public transport and active travel modes.
  - High multimodal individuals were more often expecting changes in either direction.

Limitations

Overview of limitations regarding the scope of data

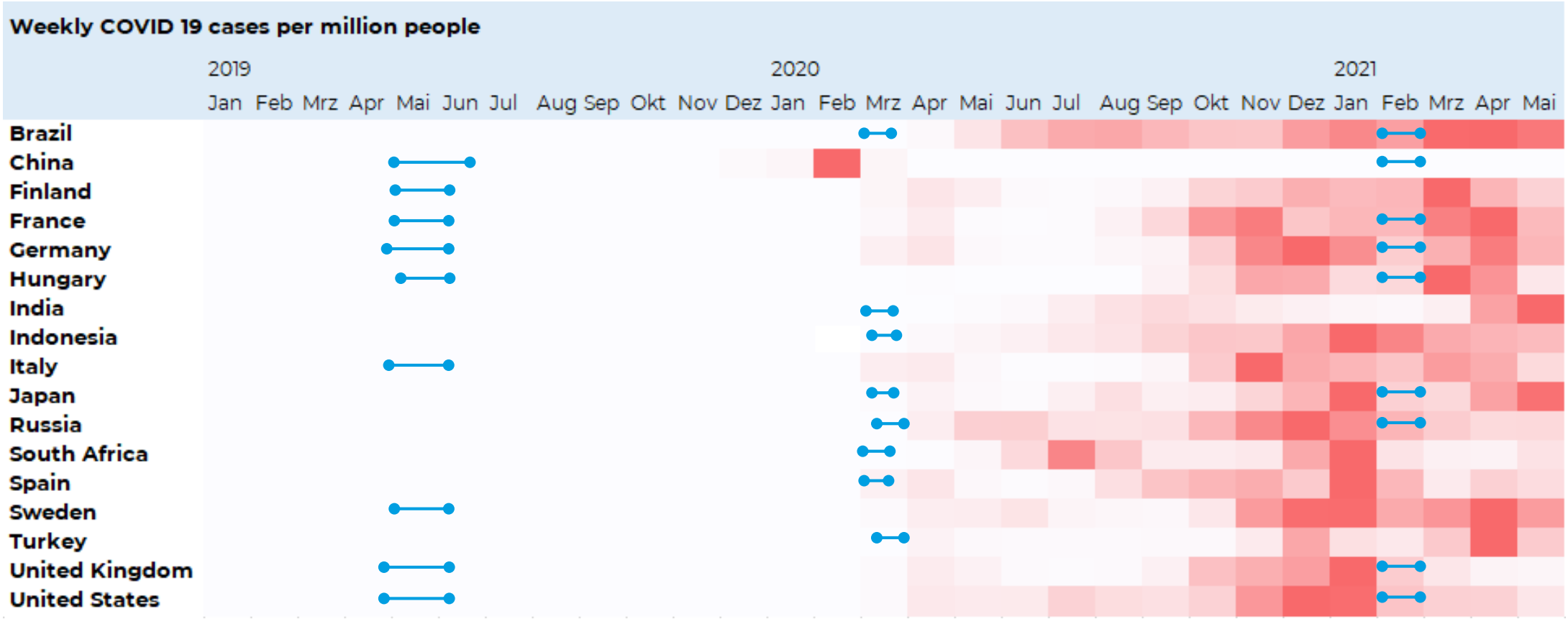
Mode of data collection

- The selected survey design, an online-survey, implies that only the population, that has access to the internet, was able to participate in the survey.
- For many of the participating countries, that is the great majority of the population. But for some countries the selected survey design leads to a restriction of the surveyed population, that affects the outcome.
- There is a large proportion of the general population of elderly people in particular that are not being accessed, due to the mode of data collection and the survey design.

Field period of data collection 2020, 2021: progressive spreading of the Corona pandemic

- During the field period of the second and third wave of the survey, the corona pandemic took a far-reaching development across several countries. We see a possible impact of the pandemic on questions regarding the intention to buy a new car as well as on questions regarding the actual usage of different mobility modes, e.g. public transport.
- The corona pandemic itself, as well as accompanying mitigation actions imposed by several governments affected the financial situation of many countries, markets and with that many individuals.

Field periods in comparison with the COVID 19 pandemic



Sources of COVID Stats: https://github.com/CSSEGISandData/COVID-19 COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University;
M. Roser, H. Ritchie, E. Ortiz-Ospina and J. Hasell (2020) - "Coronavirus Pandemic (COVID-19)". Retrieved from: https://ourworldindata.org/coronavirus [Online Resource]

Thank you for your kind attention.

Publications, further descriptive analyses and shared datasets can be found on the following websites:

https://l3pilot.eu/data
https://l3pilot.eu/downloads

Contact: user-survey@eict.de

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