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Annual quantitative survey about user acceptance towards ADAS and vehicle automation

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Summary

One of the main objectives of the L3Pilot was the large-scale piloting of Automated Driving Functions (ADFs) with a focus on level 3 functions. Since the development of ADFs, especially at SAE L3, is fairly well progressed, the aim was to pilot the functions, and to study user preferences, reactions and willingness to use vehicles equipped with AD applications. To this purpose, a large-scale L3Pilot Global User Acceptance Survey was administered to 27,970 respondents from 17 countries to provide a comprehensive picture of user acceptance, and identify major challenges related to L3 automation in this field. This study represents the first long-term and global study on user acceptance, attitudes and expectations around automated driving, with a focus on L3 technology.

The main objective, user acceptance was studied in more detail through these specific objectives:

- Explore user needs and preferences in order to design L3 technologies that promote acceptance and successful market implementations.
- Identify cross-national differences in knowledge, attitudes and expectations towards SAE Level 3 automation
- Predict user uptake by identifying key factors of user acceptance and expectations about L3 automation.
- Provide the necessary input to the impact assessment study conducted in L3Pilot complementing input from the pilots.
- Contribute to societal discourse about automated driving through the development of strategic recommendations for decision-makers.

The L3Pilot Global User Acceptance Survey is expected to have impact in three areas:

- Knowledge impact I - Scientific publications: The survey addresses several project-relevant research questions in a number of scientific publications in order to contribute and shape the scientific discourse in this research field. Therefore, a comprehensive publication strategy was developed.
- Knowledge impact II - Open access to research data: Release of the data of the L3Pilot Global User Acceptance Survey is made available via the L3Pilot Open Data Hub. Everyone interested in the data behind attitudes towards, and acceptance of L3 automation can use this data.
- Societal impact I - Recommendations and dialogue with decision-makers: The findings of the L3Pilot Global User Acceptance Survey and derived recommendations will be discussed with key stakeholders to establish a long-term dialogue. The main purpose is to collect feedback from stakeholders, e.g., by making the necessary laws or initiating pilots enabling this technology.

Therefore, the nature of the "products" that originate from the L3Pilot Global User Acceptance Survey are threefold:

1. Results to the research questions set for L3Pilot
2. Open data
3. Key findings as a slide set that will be distributed among key stakeholders. This slide set includes country dashboards with summary statistics per country, and a longer public slide set that presents the results of other relevant variables not covered in the country dashboards, and that show the results of the scientific publications in an easy-to-understand and accessible manner.

The L3Pilot Global User Acceptance Survey was performed among 27,970 respondents from 17 countries in two phases and three data collection waves. Respondents did not physically experience L3 cars. Descriptive statistics, analysis of variance and t-tests and multivariate statistical techniques (e.g., principal component analysis, cluster analysis, probit and ordered probit regressions, structural equation modelling and latent profile analysis) were conducted to analyse the data.

The results of the survey showed that respondents were generally willing to use L3 cars: Around 60% of respondents reported an intention to use L3 cars (based on the description of L3 cars respondents received prior to the questionnaire; see Section 3.1.1.) assuming that they had access to these cars. The proportion of respondents planning to buy a L3 car was smaller, with only 28% of respondents indicating that they would be willing to buy a L3 car. This apparent contradiction may be possibly explained by the lack of respondents' physical exposure to L3 cars, or because respondents can't or don't want to afford a L3 or generally a new car.

A comparison of the intention to use L3 cars across different automated driving functions has shown that although the intention to use L3 cars was high across all functions, it was highest in parking situations. It was also found that the perceived usefulness of L3 cars was associated with their perceived comfort and safety. 49% of respondents considered L3 cars safe, while around 58% of respondents indicated that L3 cars would increase their travel comfort.

Participants also believed that L3 cars would be easy to use, that they would be able to obtain knowledge about how to use them, and that they would be fun and useful. With regards to the factors predicting the acceptance of L3 automation, it was found that hedonic motivation (perceived enjoyment), performance expectancy (perceived usefulness), and social influence (social pressure) were the strongest predictors of the acceptance of L3 cars. Age and gender were weak predictors of the acceptance of L3 cars.

In terms of where people receive information about automated cars, it was found that respondents received most information from online communities, websites about IT, cars, or motoring, and social media, and least information from car dealers, suppliers and manufacturers. This finding is not surprising given that L3 cars have not been made available for the commercial market yet. Finally, we found that giving respondents information about the system limits of L3 cars does not have a strong impact on respondents' overall willingness to use these cars. Overall, these results show that internet sources are a good way to promote engagement with these new technologies,

One of the often-promoted benefits of automated vehicles is the opportunity for drivers to make better use of their travel time. However, our results show that only 42% of respondents indicated that they would like to use the time the L3 car is driving for other non-driving related activities. The most popular activities were talking to fellow passengers, surfing the internet, watching videos or TV shows, and observing the landscape, with 45%, 44% and 42% of respondents favouring these types of activities, respectively. The three least popular activities selected by respondents were reading a book, taking care of children, and playing games, with only 15%, 14% and 10% of respondents selecting this activity. We also investigated respondents' envisioned frequency of engaging in non-driving related activities, and here it was revealed that monitoring how the car is functioning was picked as the most popular activity by respondents.

These results suggest that 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. An alternative explanation is that respondents could not fully envision their interaction with L3 cars due to their lack of actual physical experience with these cars, which may have made it difficult for them to accurately understand the function and the benefits offered by this technology. More research providing users with experience of these vehicles is needed in order to understand if these beliefs impact actual behaviour during L3 driving.

Major findings

In sum, the present L3Pilot Global User Acceptance Survey investigated the acceptance of and attitudes towards conditionally automated cars among a large sample of car drivers from various European and non-European countries. It has shown which acceptance factors were most influential in predicting the acceptance of conditional automation, which reveals important implications for key decision-makers. The following major findings could be derived:

- People reported to receive most information about automated cars from online communities, websites about IT, cars or motoring & social media, followed by radio, TV, newspapers & magazines, friends, family and colleagues. People received the least information from car dealers, manufacturers, and suppliers.
- A negative correlation was found between a country's developmental status and the overall intention to use conditionally automated driving functions, with respondents from higher-GDP countries being more neutral towards conditionally automated cars than respondents from lower GDP countries.
- There was a positive correlation between a country's estimated number of road deaths per 100,000 population and the intention to use conditionally automated driving functions, with countries with a higher number of death rates having higher overall intentions to use conditionally automated driving functions.

- The intention to use conditionally automated cars was higher than the purchase intention: Only 28% plan to buy a conditionally automated car, while around 60% intend to use conditionally automated cars once they are on the market. This apparent contradiction can possibly be explained by respondents' lack of physical exposure to L3 cars. Furthermore, respondents may not be able to afford a L3 car or generally a new car, probably because they just bought a new car.
- The average willingness for not wanting to pay extra for conditionally automated cars on urban roads, motorways, traffic jams, and an in parking was 28%, 29%, 32% and 26%, respectively. The willingness to pay for parking, urban and motorway was slightly higher than traffic jam ADF. In general, the majority of respondents were willing to pay extra in order to equip their cars with ADFs for driving on urban roads, motorways, in traffic jam situations and for parking.
- Intention to use conditionally automated cars across the four environments (motorway, traffic jam, urban, and parking) was high; the highest intention to use was found for using conditionally automated cars in parking.
- The strongest effect on the acceptance and use of conditionally automated cars was perceived enjoyment, i.e., the extent to which conditionally automated cars would be considered enjoyable.
- The effect of age and gender on the acceptance and use of conditionally automated was generally small. Males had higher intentions to use conditionally automated cars in all four environments (i.e., on urban roads, motorways, in parking, traffic jams). People aged between 30-39 had the highest intention to use, followed by people aged between 18 and 29. People aged +60 had the lowest intention to use scores across all four environments.
- People who currently use Adaptive Cruise Control in their cars were more likely to have a higher intention to use conditionally automated cars. People currently using self-parking assist systems were more likely to intend to use conditionally automated cars.
- There was a significant negative correlation between a country's developmental status (GDP per capita) and the overall intention to use ADFs, suggesting that respondents from lower-GDP countries expressed a higher intention to use L3 cars than higher-GDP countries. Respondents from India, Turkey, and Indonesia expressed the highest intention to use L3 cars, while respondents from Sweden, Germany, and Finland reported the lowest intention to use L3 cars. In Russia, Japan, Hungary, and Spain, there were the largest proportion of Neutrals (i.e., people who reported that they were undecided / neutral towards using L3 cars), while in Brazil, Indonesia, Turkey, and India had the lowest proportion of Neutrals.
- This pattern was similar when considering the ADFs separately, where there was a significant negative correlation between GDP and Intention to use Motorway, Traffic Jam, Urban Roads, and Parking ADFs.

- There was also a significant positive correlation between a country's estimated number of road deaths per 100,000 population and the overall intention to use ADFs, where countries with higher estimated road deaths tended to have higher Intention to use scores.
- The intention to use conditionally automated cars was associated with a decreased intention to use public transport, active travel modes, and multimodality.
- People who received only positive information about conditionally automated cars (i.e., information about capabilities) were slightly more likely to intend to use conditionally automated cars in parking and less likely to use conditionally automated cars on motorways than people who also received information about the limitations of conditionally automated cars.
- The willingness to engage in secondary eyes-off road activities was moderate, with people reporting to engage in less resource-intensive and more familiar activities (e.g., talking to fellow travellers, surfing the internet, watching videos or TV shows, observing the landscape, monitoring how the car is functioning).

1 Introduction

1.1 Motivation for the L3Pilot Project

Over the past decades, numerous projects have paved the way for automated driving (AD). Significant progress has been made, but AD is not yet ready for the market introduction. However, the technology is rapidly advancing and has reached a stage that justifies automated driving tests in large-scale pilots. Consequently, the L3Pilot project was taking the last steps before the introduction of automated cars in daily traffic.

The uptake of automated systems was not solved simply by integrating more and better technology. Above all, this topic needs a focus on user acceptance, attitudes and behaviour. User acceptance is a key to the success of automated driving systems on the market. These questions can be best answered both on piloting automated systems on normal road traffic and acquire a deeper understanding on what the general public knows and feels about automated driving and its potential.

1.2 L3Pilot objectives

1.2.1 Overall goals

The objective of the L3Pilot project was to test and study the viability of automated driving as a safe and efficient means of transportation, explore and promote new service concepts to provide inclusive mobility.

Recent work indicates how driver assistance systems and AD functions can be best validated by means of extensive road tests with a sufficiently long operation time to allow extensive interaction with the driver and testable functions. The project used large-scale testing and piloting of AD with different users exposed to developed SAE Level 3 (L3) functions (Figure 1.1) in mixed traffic environments, including conventional vehicles and vulnerable road users (VRUs) and along different road networks. Some level 4 (L4) functions were also assessed.

The work addressed four major technical and scientific objectives listed below:

- Create a standardised Europe-wide piloting environment for automated driving.
- Coordinate activities across the piloting community to acquire the required data.
- Pilot, test and evaluate automated driving functions and connected automation.
- Innovate and promote AD for wider awareness and market introduction.

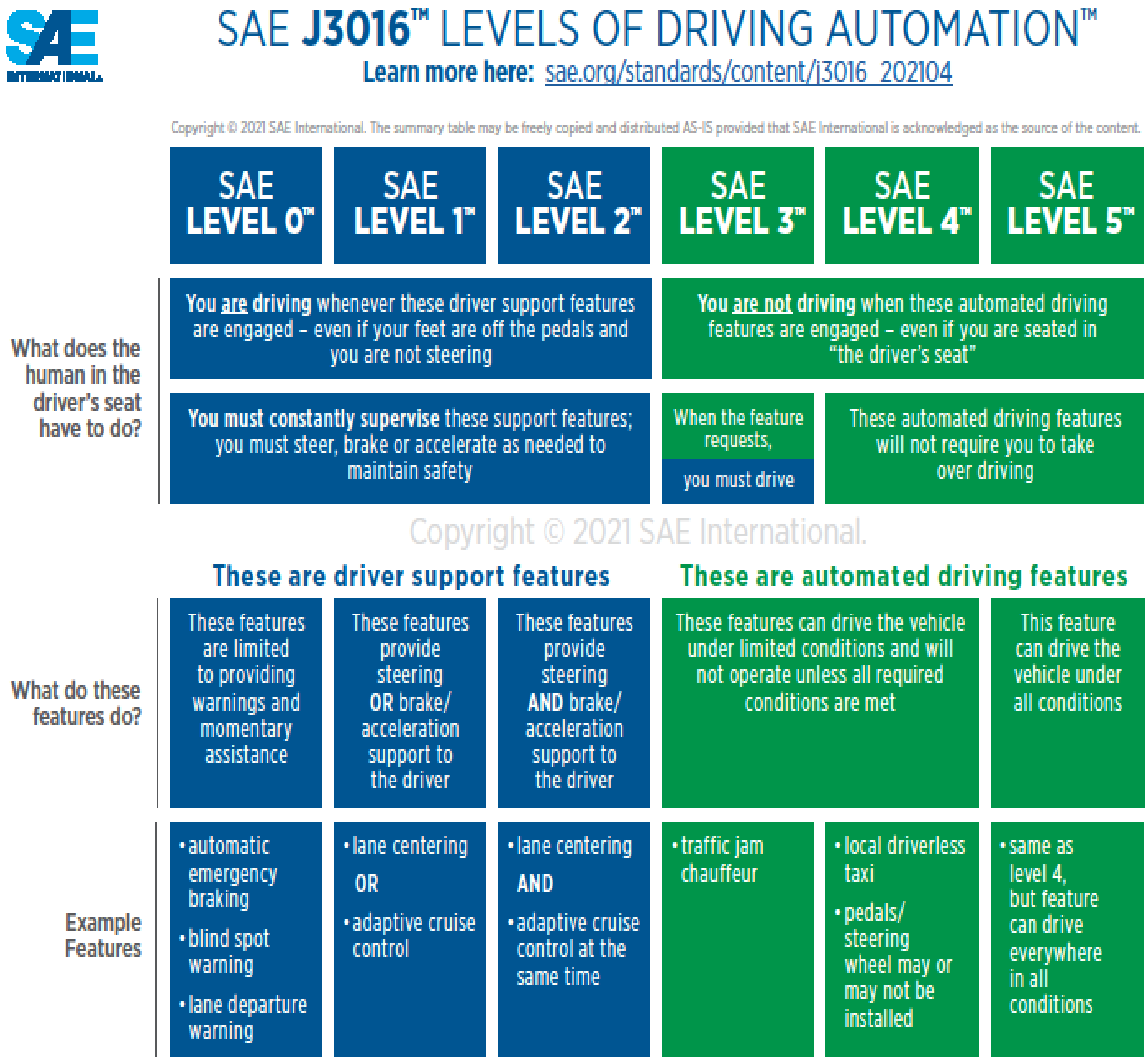

Figure 1.1: SAE Levels of Driving Automation J3016 (Copyright 2021 SAE International).

1.2.2 Global user survey supporting L3Pilot goals

In addition to the actual piloting on open road conditions, the project carried out several activities to complement the data obtained from the road tests. These activities comprised of promoting L3Pilot work through effective dissemination & communication, studying business models of AD for the market introduction, creating Code of Practise (CoP) for the development of automated driving functions as well as studying users' attitudes and willingness to pay for automated driving applications, especially SAE level 3 functions for passenger cars.

The project carried out a large-scale global user acceptance survey in different phases. The aim of the global survey was to create a comprehensive image of attitudes towards and acceptance of

SAE L3 systems globally and its evolution over time. Despite numerous user acceptance studies, this knowledge was still missing and did not allow to build the further deployment work on global user acceptance. The sporadic information on previous studies (e.g., European Commission, 2020; Kyriakidis et al., 2015; Moody et al., 2020) suggested that automated driving market and willingness to use AD systems vary a lot globally.

1.3 Approach and scope

The L3Pilot project focused on large-scale piloting of ADFs, primarily L3 functions, with additional assessment of some L4 functions. The key in testing was to ensure that the functionality of the systems used is exposed to variable conditions, and performance is consistent, reliable, predictable and accepted by the users. This would enhance a successful experience for the users (Figure 1.2). A good experience of using AD would accelerate acceptance and adoption of the technology and improve the business case to deploy AD.

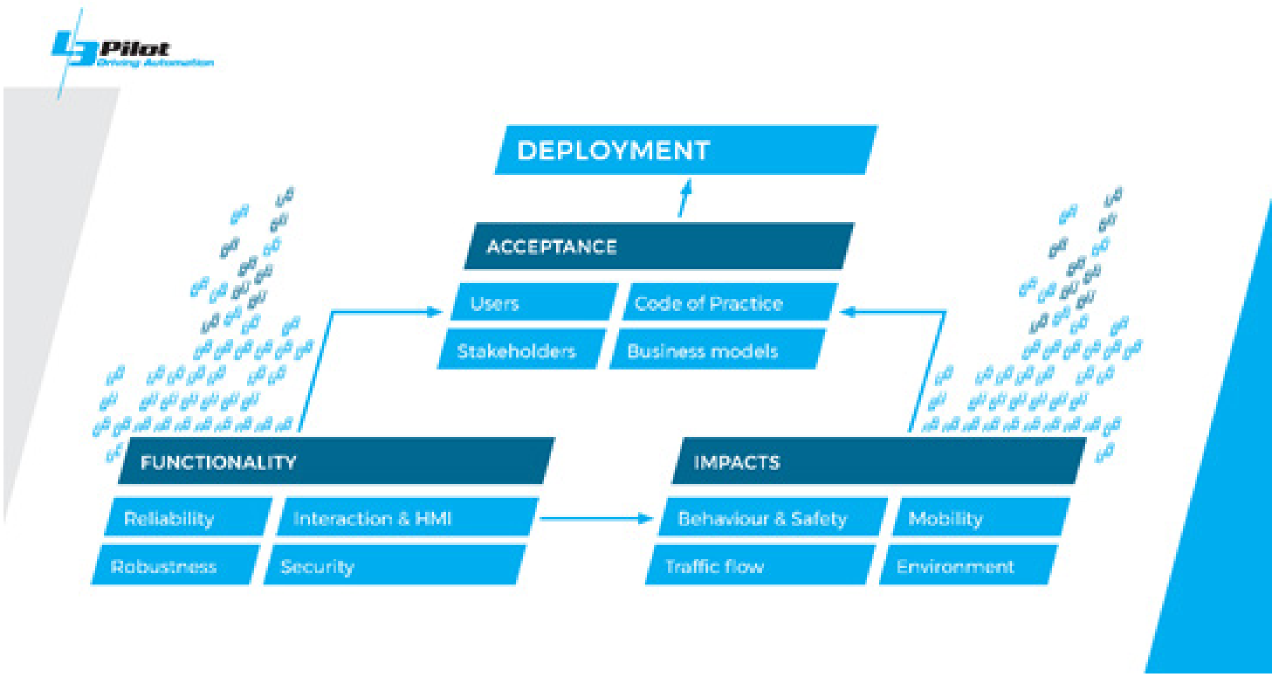

Figure 1.2: L3Pilot approach and the mechanism for deployment.

The consortium brought together stakeholders from the whole value chain including OEMs, suppliers, academic institutes, research institutes, infrastructure operators, governmental agencies, the insurance sector and user groups. 750 users tested 70 cars across Europe with bases in seven European countries including: Belgium, France, Germany, Italy, Luxembourg, Sweden, and the United Kingdom (Andreone et al., 2021), as shown in Figure 1.3. A number of supplementary studies, including the survey reported in this deliverable, were performed. The project lasted for 50 months and included 18 months of road tests.

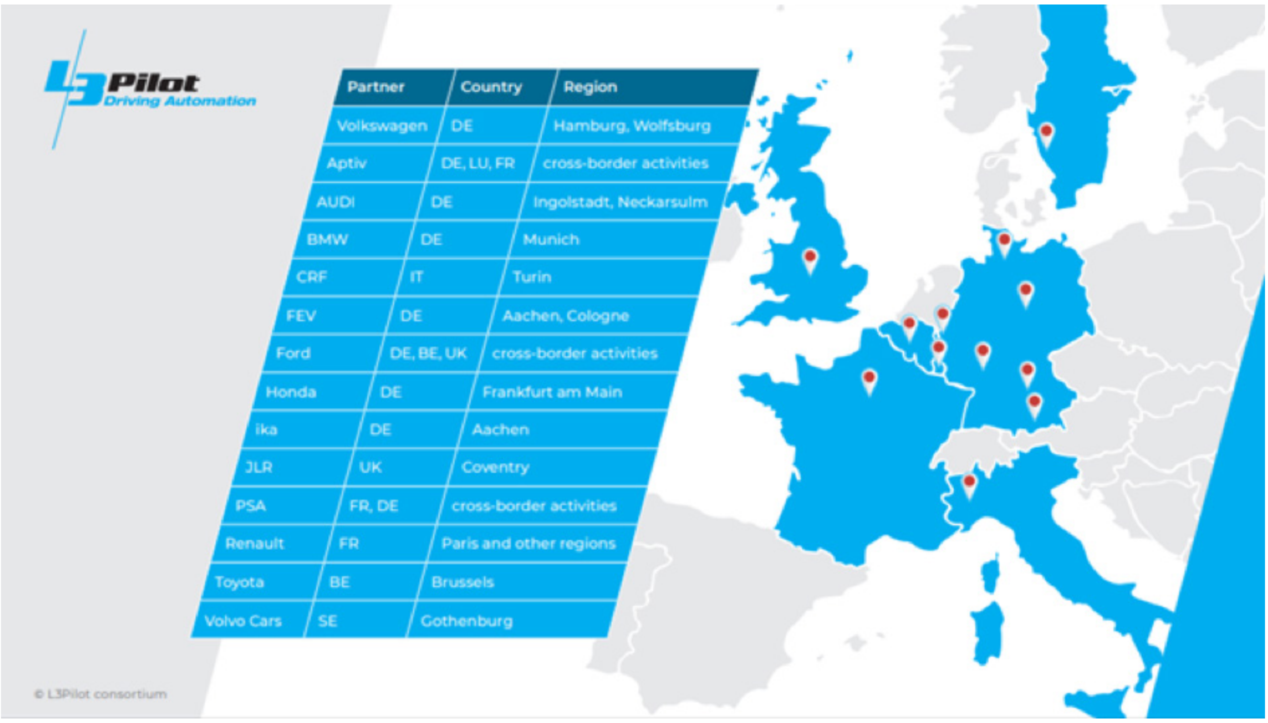

Figure 1.3: L3Pilot testing areas and cross-borders.

1.4 Structure of the document

This deliverable presents the motivation for conducting the L3Pilot Global User Acceptance Survey, its methodology as well as the results from this survey with associated background information. The work presented is divided into five main chapters.

Chapter 1 “Introduction” includes the introductory chapters to the work and an overall description of the project.

Chapter 2 “L3Pilot Global User Acceptance Survey” motivates the need for the L3Pilot Global User Acceptance Survey (Section 2.1), including objectives (Section 2.2), research gaps (Section 2.3), and research questions (Section 2.4).

Chapter 3 presents the methodology for conducting the survey, including the data collection method (Section 3.1), instrument (Section 3.2), the questionnaire changes between phases 1 & 2 (Section 3.3), procedure (Section 3.4), and data evaluation and analysis (Section 3.5).

Chapter 4 presents the results of the survey, with Section 4.1 outlining the profile of study respondents, and Section 4.2 presenting the results of the survey mapped on the research questions addressed by the survey. Section 4.3 presents the format for releasing the survey data to the public.

Chapter 5 presents the conclusions, key recommendations for decision-makers and an outlook to the future.

2 Global User Acceptance Survey

2.1 Need for Global User Acceptance Survey

Several Human Factors specialists have voiced concerns about the challenges of L3 automation, which *"is to verify that the human drivers are aware of the AV's limitations, in order to resume control when required, whilst also remaining free to engage in other activities, beyond driving", expressing "serious doubt as for the handing over of the driving task associated with SAE Level 3" as "it is human nature that a driver, who is relieved even briefly from their driving task, will engage to other distracting tasks"* (Kyriakidis et al., 2019, p. 14 & 16).

Studies have also pointed to the public's skepticism towards, and fear of, automated cars (Etzioni et al., 2020; European Commission, 2020; Haboucha et al., 2017; Medina & Jenkins, 2017; Schrauth et al., 2020; Tennant et al., 2019; TNS Opinion & Social, 2015). This is a concern because if L3 conditionally automated cars are not accepted and used as intended by their designers, their potential to realise the benefits of road vehicle automation, such as increased traffic efficiency and safety, are not fulfilled. The huge number of studies published about user acceptance provides valuable insights into factors influencing user acceptance. However, most studies are one-off surveys that highlight snapshots of the population, focus on a rather small selection of countries, and do not exactly differentiate between the different levels of vehicle automation, their potential benefits, and limitations.

Furthermore, a *global scope* for the analysis of acceptance is needed, since the mobility market is global but not uniform with regional and country-specific differences. Finally, there is a need to draw reliable and precise conclusions from user acceptance of AD, a differentiated *analysis of attitudes and expectation* towards AD in general and L3 in particular, as it will enter the market in a foreseeable future. The L3Pilot Global User Acceptance Survey is situated within the multifaceted three-level approach for the user and acceptance evaluation in L3Pilot as exemplified by the pyramid in Figure 2.1.

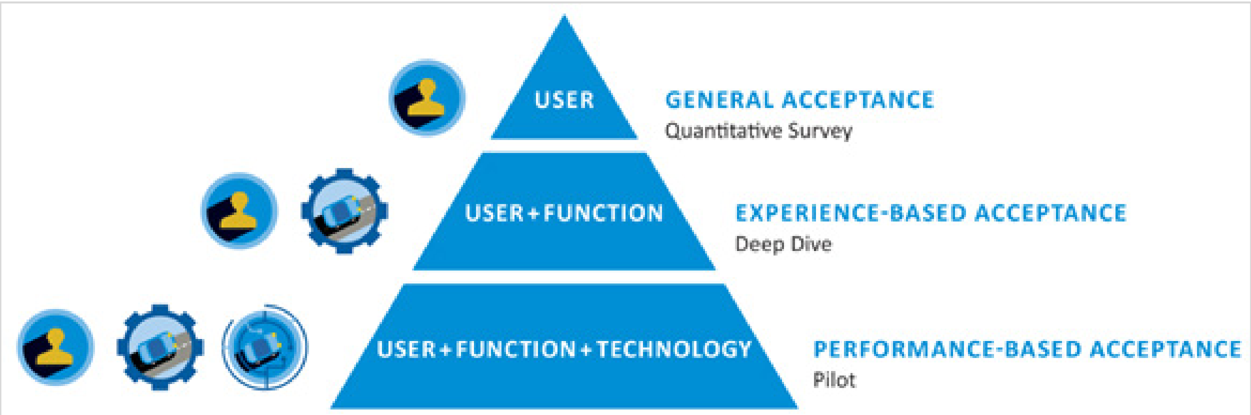

Figure 2.1: Three-level approach for user and acceptance evaluation.

In L3Pilot, the on-road piloting with extensive data collection, simulator, and Wizard-of-Oz studies performed at the bottom and middle of the pyramid collected data from individuals who experienced conditionally automated cars. The L3Pilot Global User Acceptance Survey reported in this deliverable collected data from individuals who have not experienced conditionally automated cars. Therefore, both types of studies have focused on the examination of acceptance: The on-road pilots, simulator and Wizard-of-Oz studies investigated acceptance after usage, while the L3Pilot Global User Acceptance Survey examined acceptance before usage. The former studies provided a key advantage as the knowledge obtained by these studies will help to improve the technical performance of the functions and their usability. Furthermore, the knowledge obtained by these studies might give insights into how to increase the usage / acceptance of conditionally automated cars. The present L3Pilot Global User Acceptance Survey adopted a global view on attitudes and acceptance of conditionally automated cars among a large sample from various European and non-European countries, helping to make the target population of users aware of both the capabilities and limitations of conditionally automated cars in order to promote positive attitudes prior to usage. In this sense, both approaches complement each other, giving a holistic overview of the factors affecting the acceptance of conditionally automated cars.

The on-road studies did not address *global differences* in attitudes towards and expectations of conditional automation. It is vital for the industry to know their different markets as well as understand differences in users' opinions and willingness to purchase AD applications. It is critical to promote positive attitudes towards AD, educating the public about the capabilities and limitations of ADFs in order to reduce misunderstandings and create a realistic and differentiated image of ADFs. All this knowledge lays the foundation for information and precise tailoring of their products according to market needs.

To respond to these needs, the L3Pilot Global User Acceptance Survey represents a *global study* to analyse user acceptance, attitudes, expectations towards, and representation of AD with a particular *focus on L3 technology*.

2.2 Objectives

Vehicle automation has been mainly treated as a lump called such as self-driving vehicles, automated driving, driverless cars or autonomous vehicles to name a few. This study focused precisely on SAE Level 3 automation for passenger cars to find out what the general public knew and understood about automation and what are possible needs for information and education campaigns as well as targeted marketing of automated vehicles' features.

The main objective of the L3Pilot Global User Acceptance Survey was divided into the following technical objectives:

- Explore user needs and preferences in order to design L3 technologies that promote acceptance and successful market implementations.
- Identify cross-national differences in attitudes and expectations towards SAE Level 3 automation.

- Predict user uptake by identifying key factors of user acceptance and expectations about L3 automation. As shown by Table 2.2, acceptance was measured by the Unified Theory of Acceptance and Use of Technology (UTAUT) acceptance construct 'behavioral intention' (see Section 2.3.2). Behavioral intention captured the intention to use conditionally automated cars rather than their actual use as these cars are not yet on the road. Behavioral intention was also operationalized by the indicator 'willingness to pay' as willingness to pay was defined as important determinant of acceptance (see Section 2.3.3). Conditionally automated cars will first operate in dedicated operational design domains such as on motorways, congested motorways, on urban roads, and in parking situations. Therefore, the L3Pilot Global User Acceptance Survey also examined the acceptance of using conditionally automated cars in these four environments, named automated driving functions (ADFs) in the present document. Whenever the term ADFs is used in this document, it refers to the ADFs or the use of conditionally automated cars on a function-specific level. Whenever we referred to conditionally automated cars, we did not refer to the function-specific level but to the use of conditionally automated cars in all of these four conditions.
- Provide the necessary input to the impact assessment study conducted in L3Pilot complementing input from the pilots.
- Contribute to societal discourse about automated driving through the development of strategic recommendations for public and private decision-makers.
- Laying the foundation for a long-term study on the acceptance of conditional automation and higher levels of vehicle automation, which will be continued and advanced in the project Hi-Drive.

2.3 Research gaps

2.3.1 Attitudes towards SAE L3 conditionally automated cars

First, there is little knowledge on the attitudes of the public towards conditionally automated cars, as well as the factors that drive their attitudes and acceptance. Automated driving and its impact on future mobility is a societal issue with implications for nearly everyone. However, SAE Level 3 automation is a new and still unknown technology for the general public as it has not been commercialized yet. The first 'automated-like' vehicles on the market are those equipped with SAE L2 automation that still requires an active participation of the driver.

Many studies have examined the acceptance of private passenger cars and public / shared pod-like automated vehicles such as automated shuttles serving as feeders in transport systems. However, they have not examined attitudes towards, nor modelled acceptance of, conditionally automated cars. In fact, the examination of the acceptance of conditional automation has been underrepresented by the literature on automated vehicle acceptance, with only 3 out of 124 studies (Buckley et al., 2018; Xu et al.; Zhang et al., 2019) being devoted to the study of conditional automation (Nordhoff et al., 2019). This is a concern, because if we do not know how the public thinks and feels about conditionally automated cars and why they would use them, we risk not being able to successfully market and sell these cars to the public. Furthermore, we risk not controlling the attitudes towards conditionally automated cars.

2.3.2 Acceptance of SAE L3 conditionally automated cars and the factors predicting acceptance

Second, in many of these studies, the acceptance of automated vehicles was examined by using technology acceptance models such as the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT) (Kaur and Rampersad, 2018; Kaye et al., 2019; Madigan et al., 2016; Madigan et al., 2017; Rahman et al., 2017; Xu et al., 2018; Zhang et al., 2019). However, these studies have not applied UTAUT2 to explain and predict the acceptance of conditionally automated cars. This is a pitfall because UTAUT2 is one of the most comprehensive technology acceptance models as it integrates eight of the most influential technology acceptance models such as the TPB (Ajzen, 1985) and the TAM (Venkatesh & Davis, 2000). Second, UTAUT2 has been tailored to the consumer context, explaining a larger portion of the variance in behavioural intention than the TAM, TPB, and UTAUT (Buckley et al., 2018; Madigan et al., 2016; Xu et al., 2018). UTAUT2 assumes that the acceptance of a technology by an individual is influenced by e.g. performance and effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit. UTAUT2 further assumes that the relationships between performance and effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit are moderated by age, gender and experience. The L3Pilot Global User Acceptance Survey makes use of UTAUT2 to understand the factors explaining and predicting driver's acceptance of ADFs. Conditionally automated cars are just now about to be commercially available. Therefore, it is impossible that respondents could have made habitual use of them. Consequently, the L3Pilot Global User Acceptance Survey did not examine the influence of the UTAUT2 constructs price value or habit on behavioural intention. Table 2.1 provides an overview of the UTAUT2 constructs, its definitions, and the questions being administered in phase I and phase II of the L3Pilot Global User Acceptance Survey.

Table 2.1: UTAUT2 (Unified Theory of Acceptance and Use of Technology) constructs, definitions, and questions representing the UTAUT2 constructs administered in phase I and II of the L3Pilot Global User Acceptance Survey.

Construct	Definition (Venkatesh et al., 2003; 2012)	Questions administered in L3Pilot Global User Acceptance Survey	
		Phase I	Phase II
Performance expectancy (PE)	The degree to which the technology is perceived to be useful	PE1: I would use the time during which a conditionally automated car is driving for other activities.	PE1: Using a conditionally automated car would help me reach my destination more safely.
		PE2: I expect that a conditionally automated car would be useful in meeting my daily mobility needs.	PE2: Using a conditionally automated car would help me reach my destination more comfortably.
		PE3: Using a conditionally automated car would help me reach my destination more safely.	PE3: The cost of the conditionally automated car would be the most important thing I would consider before purchasing one.
		PE4: Using a conditionally automated car would help me reach my destination more comfortably.	PE4: The benefits of using a conditionally automated car would be the most important thing I would consider before purchasing one.
		PE5: I assume that a conditionally automated car would be useful in my daily life.	PE5: Using a conditionally automated car would help me to reach my destination faster.
Effort expectancy (EE)	The degree to which using the technology is perceived to be easy to use	EE1: Learning how to use a conditionally automated car would be easy for me.	Removed due to lack of significance in phase I and the difficulty to ask respondents to evaluate the perceived use of conditionally automated cars without physical exposure to these cars.
		EE2: I expect that a conditionally automated car would be easy to use.	
		EE3: It would be easy for me to become skilful at using a conditionally automated car.	

Construct	Definition (Venkatesh et al., 2003; 2012)	Questions administered in L3Pilot Global User Acceptance Survey	
Social influence (SI)	The degree to which using the technology is appreciated in the social network important to the individual	SI1: I assume that people whose opinions I value would prefer that I use a conditionally automated car.	SI1: I assume that people whose opinions I value would prefer that I use a conditionally automated car.
		SI2: I expect that people who influence my behaviour think that I should use a conditionally automated car.	SI2: Using a conditionally automated car would give me status and prestige among people important to me.
		SI3: I expect that people who are important to me think that I should use a conditionally automated car.	SI3: It would make me proud to own a conditionally automated car.
		SI4: I would recommend a conditionally automated car to others.	
Facilitating conditions (FC)	The degree to which the individual believes to be in possession of the resources to use the technology	FC1: I could acquire the necessary knowledge to use a conditionally automated car.	FC1: I could acquire the necessary knowledge to use a conditionally automated car.
		FC2: I would expect the use of a conditionally automated car to be compatible with other digital devices I use.	FC2: I would be able to get help from my friends and/or family when I have difficulties using a conditionally automated car.
		FC3: I would expect to have the necessary knowledge to use a conditionally automated car.	FC3: I would not be able to get help from car dealers when I have difficulties using a conditionally automated car.
		FC4: I would be able to get help from others when I have difficulties using a conditionally automated car.	
Hedonic motivation (HM)	The degree to which the technology is perceived to be enjoyable	HM1: Using a conditionally automated car would be fun.	HMI1: Using a conditionally automated car would be enjoyable.
		HM2: Using a conditionally automated car would be entertaining.	HMI2: I find it important that the conditionally automated car has a sleek and cool design.

Construct	Definition (Venkatesh et al., 2003; 2012)	Questions administered in L3Pilot Global User Acceptance Survey	
		HM3: Using a conditionally automated car would be enjoyable.	HMI3:The brand of the conditionally automated car would be the most important thing I would consider before purchasing one.
Behavioral intention (BI)	The degree to which the individual intends to use the technology in the future	BI1: I intend to use a conditionally automated car in the future.	BI1: I intend to use a conditionally automated car in the future.
		BI2: Assuming that I had access to a conditionally automated car, I predict that I would use it.	BI2: The next car I buy will be a conditionally automated car, if it is available.
		BI3: I plan to use a conditionally automated car in adverse weather conditions such as during heavy rain or fog, and in darkness.	BI3: I plan to use a conditionally automated car once it becomes available.
		BI4: I would use a conditionally automated car during my everyday trips.	
		BI5: I plan to buy a conditionally automated car once it is available.	
Price value	The cognitive trade-off between perceived benefits and monetary costs of technology usage	Not addressed due to lack of commercialization of L3 cars and the resulting difficulty to accurately rate the price value of and habit with conditionally automated cars	
Habit	The passage of time from the initial technology usage		

Figure 2.2 shows the adapted version of the UTAUT2 model that was used as the baseline model for the formulation of the questions addressed by the L3Pilot Global User Acceptance Survey. The model provides an overview of the constructs and relationships between the constructs that were addressed by the L3Pilot Global User Acceptance Survey.

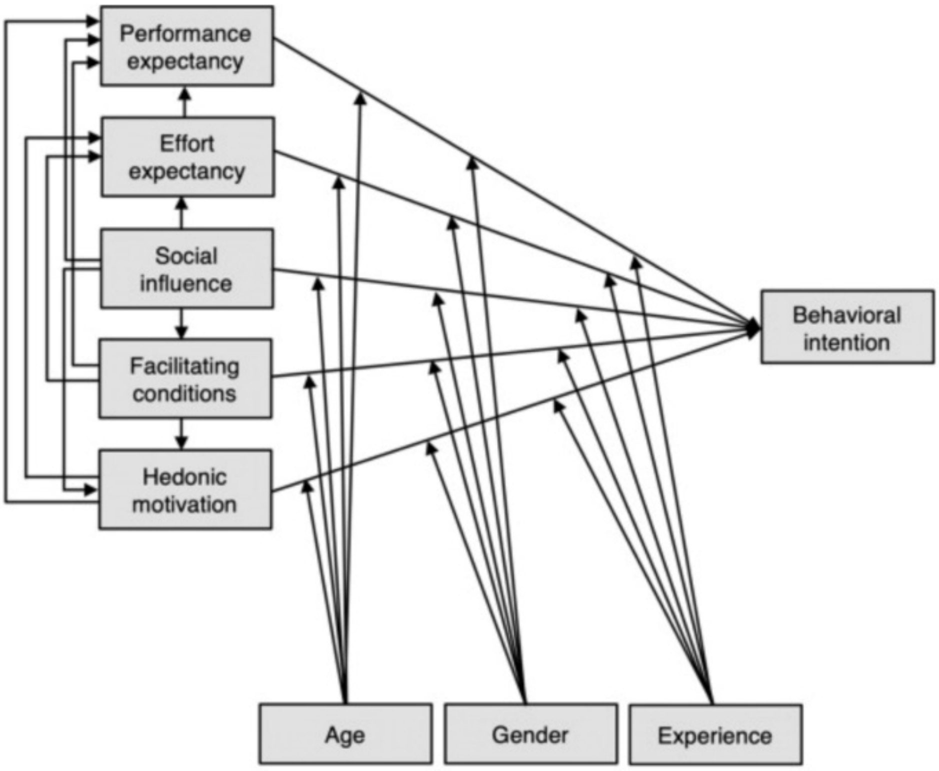

Figure 2.2: Adjusted UTAUT2 model based on the model by Venkatesh et al. (2012).

2.3.3 Differences between countries in attitudes and acceptance of conditionally automated cars

Third, there is limited knowledge on how attitudes and acceptance of conditionally automated cars differ across countries. Most of previous studies have not recruited large European samples that are representative of gender, age, and different regions, but were conducted among smaller samples (≤ 300) from China and the U.S. Large sample sizes are needed to increase the statistical power of our analyses and detect significant correlations (Hair et al., 2014).

Gaining an understanding of how attitudes towards and acceptance of conditionally automated cars yields important practical recommendations for the OEMs, which can then more effectively market their advertising and communication campaigns over the right channels. In particular, in countries with a lower motorization, less traffic flow efficiency and higher road death rate and environmental pollution, automated cars have a huge potential to realize the benefits of automation and increase the quality of life of the people living in these countries (Thomas & Trost, 2017).

There are various studies that have shown differences between countries in the awareness of and attitudes towards automated cars, perceived comfort with riding in an autonomous car, willingness to pay, and acceptance of the decisions of automated cars. For example, Moody et al. (2020) revealed that country-level awareness of automated driving was positively related to GDP per capita, suggesting that more economically developed countries were more aware of automated cars than others. A report of the European Commission (2020) has shown that respondents from the Netherlands, Sweden, and Denmark were most aware of automated cars, while respondents from Poland, Romania, and Bulgaria were the least aware. Schrauth et al. (2020) revealed that respondents from Spain, Sweden and Slovenia regarded the introduction of conditionally automated cars most beneficial, while the assessment of the benefits of the introduction of conditionally automated cars was lowest among respondents from Germany, France, and the U.S. Respondents from Germany, the U.S. and Australia were most concerned about the introduction of conditionally automated cars, while respondents from Slovenia, Spain, and Sweden were the least concerned. The authors have further shown that respondents from Spain and Slovenia had a higher level of acceptance of conditionally automated cars, while respondents from Australia and the U.S. did not differ significantly from the reference group France. In Ansys's (2019) Global Autonomous Vehicle Report, respondents from India were most comfortable with riding in an automated car today, while respondents from China, U.K., and Japan were the least comfortable. In Deloitte's (2017) Global Automotive Consumer Study, respondents from China, India, and the U. S. were the least likely to believe that self-driving vehicles will not be safe and respondents from Japan and South Korea the most likely. In the Eurobarometer survey (European Commission, 2020) respondents from higher-GDP European countries (e.g., France, Germany, Luxembourg) were more likely to feel not comfortable with travelling in a fully automated vehicle without human supervision than respondents from lower-GDP European countries (e.g., Romania, Poland, Portugal).

2.3.4 Information consumption behaviour

Fourth, there is a lack of knowledge on how the frequency of using various sources to receive information about automated cars influences attitudes towards and acceptance of conditionally automated cars. Previous studies have acknowledged the importance of knowledge and information on the perceptions of automated cars (Anania et al., 2018; Fraedrich & Lenz, 2016; Sanbonmatsu et al., 2018). Zhu et al. (2020) found a positive influence of receiving information about automated cars from mass media on the perceived usefulness and perceived risks of automated cars. Receiving information from social media had no influence on the perceived usefulness but increased the perceived risks of automated cars.

2.4 Research questions

2.4.1 Supporting L3Pilot methodology

The aim of the L3Pilot Global User Acceptance Survey was to answer the central research question:

What are the attitudes towards, and acceptance of, conditionally automated cars, and what are the factors influencing attitudes and acceptance of conditionally automated cars?

This central research question was based on the L3Pilot-relevant research questions for user and acceptance evaluation (Table 2.2). The survey also addressed additional research questions that were considered important to contribute to the project objectives as well as the scientific discourse on the acceptance of automated vehicles. The process for the generation of these research questions is described in full detail in the L3Pilot Deliverable D3.4 (Innamaa et al. 2020) and are briefly outlined here. An overview of the process is given in Figure 2.3.

The process started with a review of the literature to identify the state of the art and research gaps. The results of the desk research were then discussed and aligned through workshops and expert discussions in the exploration phase. Through this process, specific research questions were developed to contribute to the objectives of the project, and the scientific discourse on the acceptance of automated vehicles. Furthermore, the exploration phase led to the identification of the Unified Theory of Acceptance and Use of Technology (UTAUT2), that was used as theoretical framework and baseline model for the design of the L3Pilot Global User Acceptance Survey.

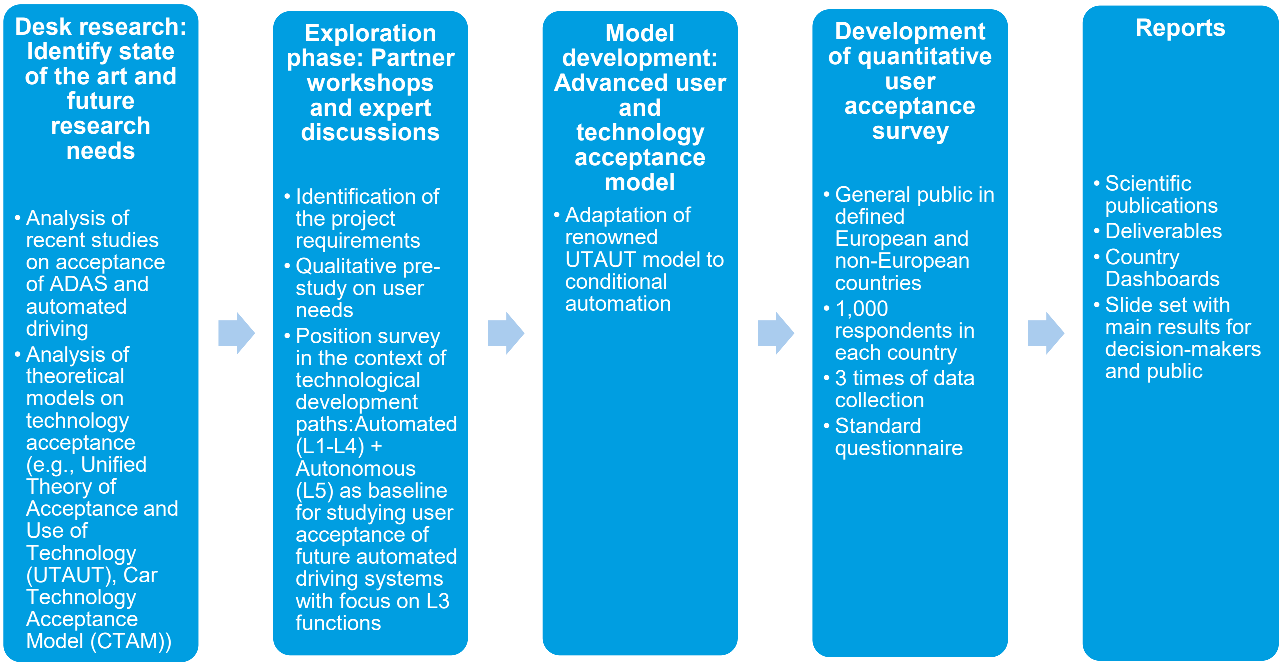

Figure 2.3: Process behind development of L3Pilot Global User Acceptance Survey.

The list of research questions was first based on the established literature and the input of the project members based on their experience in previous projects. This top-down approach to generate research questions was followed by a bottom-up approach, that included checking the feasibility of the research questions based on the availability of the data, and evaluation of methods and tools. In workshops held with experts of the consortium, these general research questions were translated into specific questions that formed the basis of the L3Pilot Global User Acceptance Survey. The L3Pilot Global User Acceptance Survey only addressed questions for user & acceptance evaluation and impact assessment, neglecting the evaluation area technical & traffic evaluation. The Level 1 research questions were organized around the evaluation area “user & acceptance” as one of the four L3Pilot evaluation areas. The Level 2 research questions captured more detailed aspects of the Level 1 research questions. The Level 3 research questions specified even more detailed questions about related attributes of the Level 2 research questions. The L3Pilot Global User Acceptance Survey did not address those research questions that addressed the ADFs’ impact on driver state, situation awareness, motion sickness nor takeovers as these required exposure to AD and were addressed by the Pilot Site Questionnaire (Weber & Hiller, 2021). An overview of the research questions is given in Table 2.2. In addition to these research questions in Table 2.2, the L3Pilot Global User Acceptance Survey addressed these additional research questions:

- What are the factors explaining and predicting the user acceptance of conditionally automated cars?
- What is the influence of drivers’ mobility behaviour on the acceptance of conditionally automated cars?
- To what extent does increased knowledge of specific ADFs affect trust and intentions to use these functionalities?
- What are the differences between the countries in the acceptance of conditionally automated cars and their expectations about changes in their personal mobility due to conditionally automated cars?

Table 2.2: Overview of main research questions for user & acceptance evaluation addressed by L3Pilot Global User Acceptance Survey

RQ-ID	RQ Level 1	RQ Level 2	RQ Level 3
RQ-U1	What is the impact on user acceptance & awareness?	Are drivers willing to use an ADF?	
RQ-U2		How much are drivers willing to pay for the ADF?	
RQ-U3		What is the user acceptance of the ADF?	What is the perceived safety of the ADF?
RQ-U4			What is the perceived comfort of the ADF?
			What is the perceived usefulness of the ADF?
			What is the perceived trust of the ADF?
			How does user acceptance differ between ADF types?
		What are drivers' expectations regarding system features?	What is the drivers' overall impression of the system?

RQ-ID	RQ Level 1	RQ Level 2	RQ Level 3
RQ-U9		What is drivers' secondary task engagement during ADF use?	What secondary tasks do or would drivers engage in during ADF use?
			What is the frequency and duration of drivers' secondary task engagement during ADF use?

2.4.2 From L3Pilot Global User Acceptance Survey to Impact Assessment Survey

One of the aims of the L3Pilot project was to perform an impact assessment of conditionally ADFs, the results of which are reported in L3Pilot Deliverable D7.4 (Björnvatn et al. 2021). Data representing the views of the general public was required to conduct the socio-economic and mobility impact assessment. Information on the general public's willingness to pay for conditionally automated cars was required for the socio-economic assessment of conditionally automated cars, while information on potential changes in travel behaviour once conditionally automated cars are available was important for the mobility impact assessment. Willingness to pay for ADFs and expected changes in the personal mobility are both naturally related to respondents' acceptance and willingness to use and were therefore included in the L3 Pilot Global User Acceptance Survey.

As will be mentioned in Section 3.1, the L3Pilot Global User Acceptance Survey was performed in three data collection waves. The first two waves addressed the needs of the impact assessment by providing data on the willingness to pay for different ADFs, and questions regarding the current travel behaviour and expected impacts of conditionally automated cars on personal mobility. These analyses were complemented with links to user acceptance and behavioural intention to use conditionally automated cars, representing core elements of the L3Pilot Global User Acceptance Survey.

However, during the data analysis of the first and second data collection waves, it became evident that some further clarifying questions and more data to properly conduct the socio-economic and mobility impact assessment were needed. Because the number of questions needed to address all the project-relevant research questions pertaining to impact assessment was too large for a single survey, it was decided that for the third wave, the willingness to pay questions and mobility impact assessment questions would be moved to a separate survey called the Impact Assessment Survey. The core of the Impact Assessment Survey was built on the questions already used in the first and second data collection waves of the L3Pilot Global User Acceptance Survey. Experience with the L3Pilot Global User Acceptance Survey and its response data helped to refine the questions and add some further clarifying questions that were needed for the performance of the impact assessment analyses. The results of the Impact Assessment Survey are reported in the L3Pilot Deliverable D7.4. (Björnvatn et al. 2021).

3 Methodology

3.1 Data collection

The questionnaire was implemented in two phases and three data-collection waves. The first wave took place in May / June 2019, the second wave in February / March 2020, and the third wave in January / February 2021. In total, around 27,970 respondents were surveyed.

In the first wave, data was collected among a representative sample of ordinary car drivers from European countries, including Finland, France, Germany, Italy, Sweden, Hungary, the U.K., and two non-European countries, China and the U.S.

In the second wave, data was collected among a representative sample (in terms of age, gender, and income) of Spain, Brazil, Russia, India, Indonesia, Japan, Russia, South Africa, and Turkey.

In the third wave, data was collected among a smaller set of countries that were also surveyed in waves 1 & 2, including Brazil, China, Germany, France, Hungary, Japan, Russia, U.K., and the U.S.

The countries were selected based on their car market size and a geographical representation. An overview of all countries surveyed in phases I and II is provided in Table 3.1.

Figure 3.1 presents an overview of the countries and the number of respondents surveyed in the three data collection waves. The countries coloured in cyan represent the countries that were surveyed, while the countries coloured in dark blue represent the countries that were not surveyed by the L3Pilot Global User Acceptance Survey.

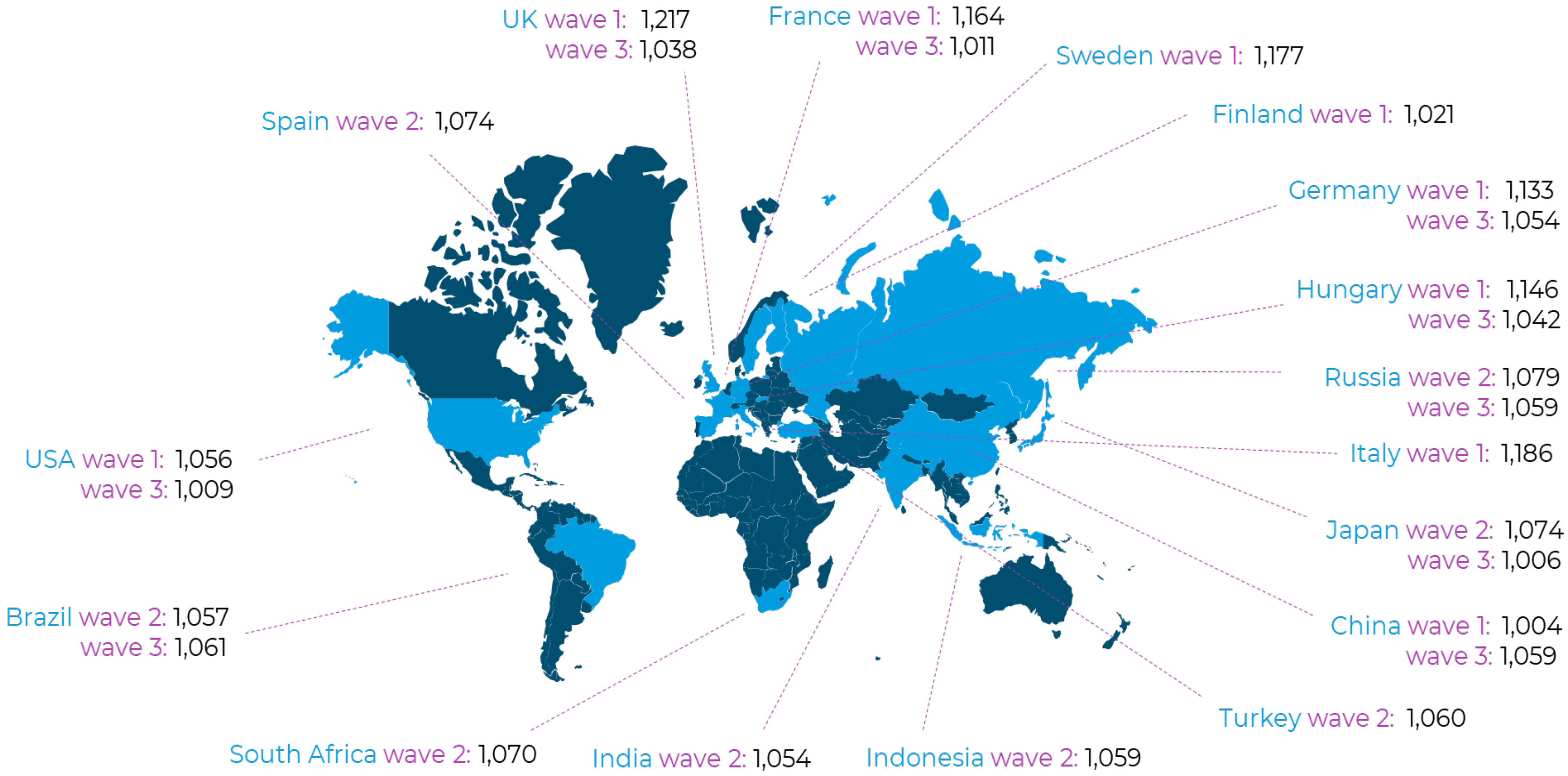

Figure 3.1: World map; countries coloured in cyan represent the countries surveyed by the L3Pilot User Acceptance Study and countries coloured in dark blue represent the countries not addressed by the survey. Values next to the countries represent the number of respondents surveyed in data collection waves 1–3.

Table 3.1: Overview of countries surveyed in phase I and II and motivation for country selection.

Country	Phase I: Focus on EU and non-EU forerunners in AD development				Phase II : Focus on EU and non-EU	
	CN	• Leader in AD development • Size of car market (current and future)	BR	• Size of car market (future) • Representation of South America	BR	• Size of car market (future) • Representation of South America
	DE	• (Political) relevance as OEM market	ES	• Representation of Southern Europe	CN	• Leader in AD development • High L3 acceptance • Size of car market (current and future)
	FI	• Representation of Northern Europe	ID	• Size of car market (future)	DE	• (Political) relevance as OEM market
	FR	• (Political) relevance as OEM market • Representation of Central Europe	IN	• Representation of South Asia • Size of car market (future)	FR	• (Political) relevance as OEM market • Representation of Central Europe
	HU	• Representation of Eastern Europe • Size of car market (future)	JP	• Leadership in AD development • Size of car market (current & future)	HU	• Representation of Eastern Europe • Size of car market (future)
	IT	• Representation of Southern Europe • Size of car market (future)	RU	• Size of car market (current & future)	JP	• Leadership in AD development • Size of car market (current & future)
	SE	• (Political) relevance as OEM market • Representation of Northern Europe	TR	• Representation of Southern Europe	RU	• Size of car market (current & future)
	UK	• (Political) relevance as OEM market • Representation of North West Europe	ZA	• Representation of Africa • Size of car market (current & future)	UK	• (Political) relevance as OEM market • Representation of North West Europe
	US	• Leader in AD development (testing) • Car-centric mobility culture	–	–	US	• Leader in AD development (testing) • Car-centric mobility culture

3.2 Instrument

3.2.1 First phase

The topics covered in the first and second waves of data collection are shown in Figure 3.2. Access to the full questionnaire of the first phase is provided in Section 7.1. Respondents were first presented with instructions about conditionally automated 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.*
>
> ***The questionnaire is executed as part of the research project L3Pilot (www.l3pilot.eu).***
>
> ***It will take around 20 minutes and your responses will be treated anonymously.***
>
> ***Thank you very much for your participation."***

After the instructions, respondents were asked to answer questions about their socio-demographic profile (age, gender, income) and travel behaviour. Next, respondents were asked to respond to a series of questions testing how well they had understood the descriptions of the functionality of conditionally automated cars, based on the introduction to these cars respondents received at the beginning of the questionnaire. Next, they were asked to answer questions measuring their awareness of automated cars, and the frequency with which they receive information about automated cars from various sources. In the next questions, respondents were asked to report their attitudes towards conditional automation and willingness to pay for using conditionally automated cars in different operational design domains including trust, secondary task engagement, and constructs from the technology acceptance model UTAUT. Finally, respondents were asked to answer questions about the expected impact of conditionally automated cars on their personal mobility, their experiences with several advanced driver assistance systems (ADAS), as well as further information about their socio-demographic profile. The full questionnaire is provided in Section 7.1 in the appendix.

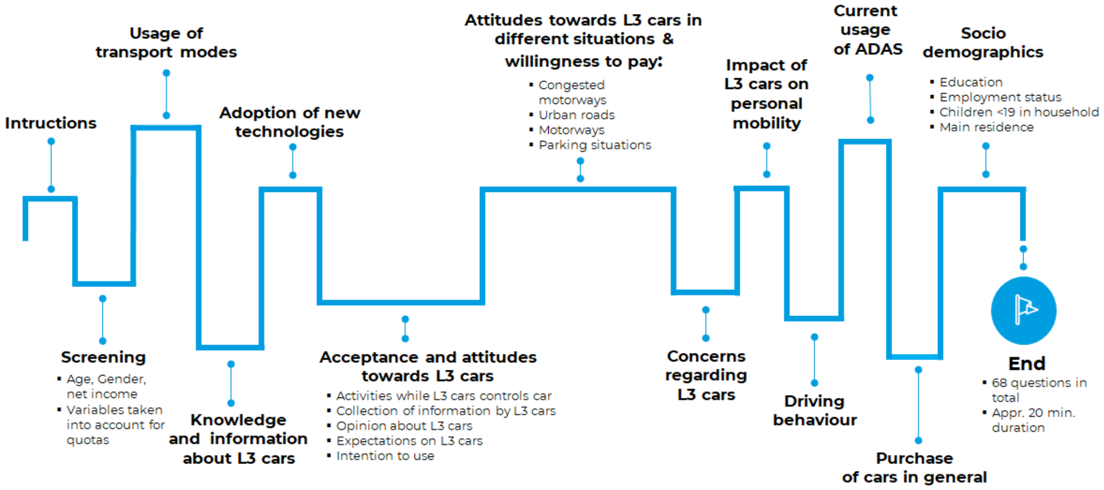

Figure 3.2: Overview of questionnaire topics of phase I (data collection waves 1 & 2) presented in the order in which they were asked.

3.2.2 Second phase

In the second phase, data was collected from a smaller set of European and non-European countries using an adjusted version of the phase I questionnaire. These countries were selected because they represented current and future car markets and were / are expected to be leaders in AD development. The topics of this questionnaire are shown in Figure 3.3. Access to the full questionnaire of the first phase is provided in Section 7.2. First, respondents received instructions about the functionality of conditionally automated cars and survey instructions to ensure sufficient understanding. The instructions were written out as follows:

> *"With this questionnaire, we would like to get your opinion* ***on conditionally automated cars.*** *Conditionally automated cars can drive on* ***motorways, congested motorways, in urban traffic, and parking situations.*** *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 except for sleeping. However, the car might ask you to resume control at any time, in which case you will have to stop what you are doing and resume control of the driving task.*
>
> ***The questionnaire is executed as part of the research project L3Pilot (www.l3pilot.eu).***
>
> ***It will take around 20 minutes and your responses will be treated anonymously.***
>
> ***Thank you very much for your participation."***

After the instructions, respondents were asked to provide information about their personal information (age, gender, income, highest level of education, and number of children). Next, respondents were asked to provide information about their personality and driving behavior. After these questions, respondents provided information about their awareness of, and frequency of receiving information about automated cars. After these questions, the sample was divided into two groups. One group received information about both the capabilities and limitations of L3 cars, while the second group only received information only about the capabilities of conditionally automated cars. After this section, respondents were asked questions measuring their acceptance of, and general attitudes towards conditionally automated cars including trust, secondary task engagement, and constructs from the technology acceptance model UTAUT. In the next section, respondents were asked to answer questions about their attitudes towards using conditionally automated cars in different settings. In the final section, they provided information about their current use of ADAS, along with socio-demographic information.

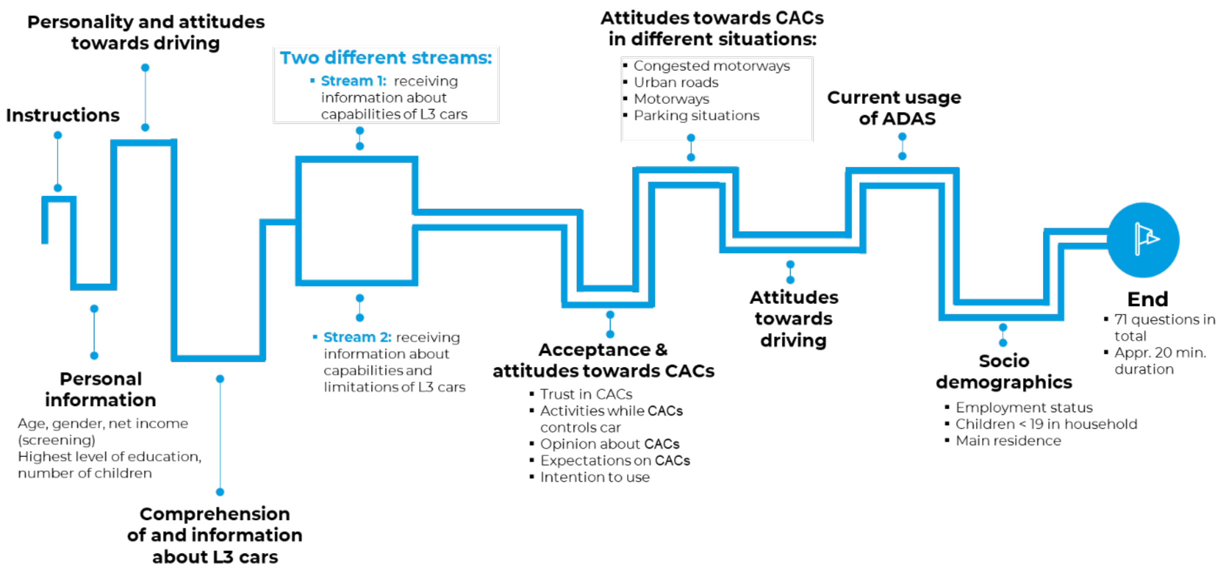

Figure 3.3: Overview of questionnaire topics of phase II (data collection wave 3) in the presented order in which they were asked.

3.2.3 Questionnaire changes between the first and second phase

First, the questions that were needed for the socio-economic and mobility impact assessment were migrated to a separate Impact Assessment Survey in phase II to include more questions that were related to these topics in order to provide the input needed for the impact assessment as mentioned in Section 2.4.2.

Second, the questions measuring general attitudes towards, and acceptance of, conditionally automated cars in terms of the UTAUT2 constructs were adjusted to make them more applicable to the context of conditional automation. The original constructs are usually expressed in very generic and theoretical terms. For example, the UTAUT2 question measuring performance expectancy *"I* *assume that a conditionally automated car would be useful in my daily life"* provides valuable information about the perceived usefulness of conditionally automated cars. However, it provides little information about the specific aspects that respondents associate with the perceived usefulness of conditionally automated cars.

Third, constructs that proved to be of limited theoretical and practical relevance were removed in the third data collection wave (e.g., technology readiness, willingness to share data) because the data in phase I produced enough input to provide answers to the research questions.

Fourth, new constructs were adopted. For example, to examine the influence of increased knowledge of how conditionally automated cars work in different situations, the sample was split into two sub-samples: one sample getting information on both capabilities and limitations while the other sample only received information on the capabilities of conditionally automated cars.

Fifth, personality and driving style measures were included, to study the influence of a person's personality and driving style as these have been previously linked to attitudes towards and acceptance of AVs and have been neglected so far (Ajzen & Fishbein, 1980; Devaraj et al., 2008; Kraus et al., 2020; Kyriakidis et al., 2015; Wang et al., 2018). For example, the study by Kyriakidis et al. (2015) found that neurotic individuals were less comfortable with data transmitting, while individuals who were high on agreeableness were more comfortable with it, and considered automation less silly. In the study of Charness et al. (2018) the effects of extraversion, agreeableness and openness on concerns with automated vehicles were not significant. The relationship between extraversion, agreeableness and eagerness to adopt automated vehicles was also not significant. Openness did influence eagerness to adopt automated vehicles. The effect of agreeableness, conscientiousness on the willingness to relinquish driving control was not significant, while extraversion and openness showed significant effects.

Table 3.2: An overview of the main differences between phases I and II.

<table>
<tr><th>Structure</th><th>Phase I (data collection waves 1 & 2)</th><th>Phase II (data collection wave 3)</th></tr>
<tr><td colspan="3">Fixed: Examining attitudes towards and acceptance of conditional automation</td></tr>
<tr><td rowspan="4"></td><td colspan="2">Socio-demographics, mobility behaviour, experience with ADAS</td></tr>
<tr><td colspan="2">Instructions about functionality of conditionally automated cars</td></tr>
<tr><td colspan="2">Task engagement</td></tr>
<tr><td>General attitudes towards conditionally automated cars and acceptance</td><td>More specific attitudes towards conditionally automated cars and acceptance</td></tr>
<tr><td colspan="3">Variable: Addressing new research questions from the project and scientific community</td></tr>
<tr><td rowspan="3"></td><td>Knowledge & awareness of conditionally automated cars</td><td>Influence of type of information on attitudes and acceptance and awareness</td></tr>
<tr><td>Technology readiness</td><td>–</td></tr>
<tr><td>Data sharing</td><td>–</td></tr>
</table>

Structure	Phase I (data collection waves 1 & 2)		Phase II (data collection wave 3)
	Function-specifics (Willingness to pay and intention to use, safety & trust)	Function-specifics (Willingness to pay and intention to use, safety & trust)	Willingness to pay questions were migrated to Impact Assessment Survey; questions measuring general trust in conditionally automated cars were adopted
	Expected mobility impacts of conditionally automated cars		Moved to Impact Assessment Survey
	Intended trips with conditionally automated cars		Moved to Impact Assessment Survey
	–		Personality
	–		Driving style

3.3 Procedure

The surveys were administered by the German market research institute INNOFACT AG (innofact.com) using the questionnaire tool EXAVO (https://www.exavo.de/surveytainment/). The Finnish data in phase I was collected by Taloustutkimus Oy (https://www.taloustutkimus.fi/in-english.html) among their nationally representative Internet panel, using their proprietary questionnaire tool.

The invitation to participate in the survey study was sent via email by online panels who had access to a large number of respondents. Once a representative sample per country was obtained, the questionnaire was closed, and participation was no longer possible.

Due to the reliance on online panels for the recruitment of respondents, the profile of respondents varied across the three data collection points / waves. Furthermore, the market research institute used several technologies to enhance data quality, ensuring that respondents were human (i.e., no bot), without suspect proxies or email addresses, and that participants did not take the same survey more than once – e.g., via multiple email or panel accounts from the same computer.

Respondents were financially compensated for their participation in the questionnaire. In Germany, each respondent received 1.00 euro for completing the whole questionnaire. The other respondents received points that were worth between 0.80 and 1.00 euro per respondent, which could be redeemed as vouchers. The Finnish respondents had a chance to win prizes by being a member of the panel and participating in surveys.

Before the questionnaire was programmed and launched by INNOFACT AG, it was pre-tested in several iteration rounds, to ensure clarity in terms of a common understanding of the flow of the questionnaire (e.g., order of items) and the content of the questionnaire (i.e., the meaning of items). This also encompassed ensuring that the questionnaire was correctly translated into the different languages. In addition, INNOFACT AG performed a soft launch of the questionnaire, with approximately thirty respondents, to resolve any implementation or wording errors. To ensure that responses were not influenced by the order in which questionnaire items were presented, those that did not follow a specific logic were presented in a random order across respondents.

3.4 Data evaluation and analysis

Several types of analyses were performed, which are now introduced in the following sections.

Descriptive statistics

For every questionnaire item, descriptive statistics (i.e., frequencies, means (M), standard deviations (SD)) were calculated.

Comparison of means - Analysis of variance and t-tests

T-tests and Analysis of variance (ANOVA) were performed to explore differences between the intention to use scores of different groups, including gender, age, cross country, and ADF comparisons in all three questionnaires.

Spearman correlation coefficients

Spearman rank-order correlation coefficients were computed between the intention to use conditionally automated cars and selected variables such as the expected benefits of conditionally automated cars.

Principal component analysis

A principal component analysis was conducted to explore correlations between the questionnaire items and their underlying components. A principal component analysis is an explorative data-reduction technique that assigns questionnaire items to their underlying components based on their correlations with the underlying component and with other questionnaire items. Questionnaire items with a loading lower than 0.40 were deleted from the analysis, i.e., not assigned to a component.

Cluster analysis

A hierarchical cluster analysis was run on questionnaire items in order to form homogenous, mutually exclusive groups or clusters of respondents. To assess the similarity between the groups, Euclidean distance was applied. Ward's method was used to form the groups. The dendrogram was used to find the most optimal cluster solution. To characterize the clusters and detect significant differences between the groups, Pearson's chi-squared tests were performed.

Discrete choice regression models

Probit and ordered probit regression models were used to examine respondents' willingness to pay for each of the four L3 automated driving functions.

Multinomial logistic regression model

Multinomial logistic regression was used investigate the expectation to increase or decrease the use of public transport and active travel. Multinomial logistic regression was used become the outcome variable was best represented in three categories (decrease, no change, increase) and the assumptions of the ordered regression were not fully met.

Structural equation modelling

For the examination and prediction of conditionally automated cars, it is necessary to study the relationships between the factors influencing the acceptance of conditionally automated cars. Therefore, structural equation modelling was performed in two steps in line with Anderson & Gerbing (1998).

In the first step, a confirmatory factor analysis was conducted to evaluate the measurement relationships between the latent and observed variables. Latent variables are the theoretical, unobserved factors. Observed variables are the variables that can be directly measured / observed. These are the questionnaire items that are given to respondents so that they can rate them. 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. To determine the reliability and validity of the measurement model, indicator reliability, internal consistency reliability, convergent validity and discriminant validity were examined.

The second step of the analysis involved estimating the structural model consisting of the path relationships between the latent variables. 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 standardised 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.

4 Results

The survey results are presented with regards to the research questions. More details on the results can be found in the corresponding studies in the appendix in Section 7.

4.1 Respondents

An overview of respondents' profile for each of the two phases is given in Table 4.1 and Table 4.2, respectively. The respondents were representative of age, gender, and income of their respective country populations. In order to recruit a representative sample of a country population, the market institute applied specific quoting criteria according to which respondents were selected into the national samples.

Table 4.1: Respondents' profile based on information collected in first and second wave (n = 18,631)

Question	Mean (*M*)	Standard deviation (SD)	Response categories	*n*
Age	3.69	0.96	18–29 (1)	12%
			30–39 (2)	29%
			40–49 (3)	40%
			50–59 (4)	17%
			60–69 (5)	2%
Gender	0.50	0.50	Male (1)	50%
			Female (2)	50%
Number of children under 19 years old in household	1.76	0.94	None (1)	4%
			1 (2)	45%
			2 (3)	27%
			3 (4)	18%
			≥ 4 (5)	6%
Annual mileage	3.26	1.43	< 1.000 (1)	11%
			1,000 – 3.000 (2)	15%
			3,000 – 6.000 (3)	20%
			6,000 – 9.000 (4)	19%
			9,000 – 12.000 (5)	15%
			12,000 – 30.000 (6)	14%
			> 30.000 (7)	6%

Table 4.2: Respondents' profile based on information collected in the third wave (n = 9,339)

Question	*M*	SD	Response categories	*n*
Age	2.73	1.34	18–29 (1)	23%
			30–39 (2)	24%
			40–49 (3)	22%
			50–59 (4)	18%
			60–69 (5)	13%
Gender	1.52	0.50	Male (1)	48%
			Female (2)	52%
Education	3.67	1.13	High school diploma without apprenticeship / professional training (1)	3%
			High school diploma with apprenticeship / professional training (2)	13%
			College (no degree) (3)	25%
			College degree (no finished studies) (4)	29%
			Finished studies (5)	29%
Number of children under 19 years old in household	1.76	0.94	None (1)	52%
			1 (2)	28%
			2 (3)	16%
			3 (4)	4%
			4 (5)	0%
			> 4 (6)	0%
Impact of COVID19 on monthly mileage	3.52	1.60	Yes, I drive more (1)	16%
			Yes, I drive less (2)	78%
			No, no change (3)	6%

Question	*M*	SD	Response categories	*n*
Age of car (in years)	1.90	1.18	< 2 (1)	52%
			2–5 (2)	23%
			5 –10 (3)	13%
			11 –15 (4)	5%
			>15 (5)	6%
Annual mileage (outside of the coronavirus pandemic) (in miles)	3.26	1.43	< 1.000 (1)	14%
			1,000 – 3.000 (2)	19%
			3,000 – 6.000 (3)	23%
			6,000 – 9.000 (4)	19%
			9,000 – 12.000 (5)	23%
			12,000 – 30.000 (6)	3%
			> 30.000 (7)	3%

4.2 What are drivers' expectations regarding system features?

4.2.1 What is drivers' overall impression of the system?

In order to investigate the overall impression of the system, we conducted simple descriptive statistics, analysing the frequencies, means, and standard deviations of questionnaire items using data from the first data collection wave (Table 4.3). Overall, the impression of the system was very positive. The highest mean ratings were obtained for questions measuring the perceived ease of use of conditionally automated cars. The highest mean rating (i.e., the strongest agreement provided by respondents) was obtained for respondents' belief that a conditionally automated car would be easy to use (***M*** = 3.80, SD = 0.97, on a scale from strongly disagree (1) to strongly agree (5)), and that they could acquire the necessary knowledge to use a conditionally automated car (***M*** = 3.79, SD = 1.00). The third-highest mean rating was obtained for respondents' belief that learning how to use a conditionally automated car would be easy for them (***M*** = 3.74, SD = 0.98).

One of the lowest means ratings were obtained for the questions measuring the social influence. One of the second mean ratings were obtained for respondents' belief that people who are important to them think that they should use a conditionally automated car (***M*** = 3.02, SD = 1.12). The third-lowest rating was obtained for respondents' belief that people who influence their behaviour think that they should use a conditionally automated car (***M*** = 3.06, SD = 1.12). For more details on the results see the study of Nordhoff et al. (2020).

Table 4.3: Descriptive statistics (i.e., means (M), standard deviations (SD), relative frequencies). Questions are presented in descending order according to their means in order to identify high, moderate, and low mean ratings. The questions were measured on a scale from strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5).

Question	*M*	SD	*n*	Relative frequencies				
				1	2	3	4	5
I expect that a conditionally automated car would be easy to use.	3.80	0.97	9044	4%	5%	20%	49%	22%
I could acquire the necessary knowledge to use a conditionally automated car.	3.79	1.00	9029	5%	5%	20%	47%	23%
Learning how to use a conditionally automated car would be easy for me.	3.74	0.98	9038	4%	6%	24%	46%	21%
I would expect to have the necessary knowledge to use a conditionally automated car.	3.65	1.05	9019	6%	7%	23%	44%	20%
It would be easy for me to become skillful at using a conditionally automated car.	3.60	1.03	9027	5%	7%	27%	43%	18%
I would expect the use of a conditionally automated car to be compatible with other digital devices I use.	3.54	1.08	9006	7%	8%	27%	41%	17%
Using a conditionally automated car would help me reach my destination more comfortably.	3.52	1.10	9044	7 %	9%	26%	41%	17%
Using a conditionally automated car would be fun.	3.42	1.14	9034	9%	10%	28%	37%	16%
I assume that a conditionally automated car would be useful in my daily life.	3.39	1.15	8996	9 %	11%	27%	38%	15%
Using a conditionally automated car would be enjoyable.	3.38	1.16	9018	10%	10%	27%	37%	15%
I would be able to get help from others when I have difficulties using a conditionally automated car.	3.37	1.05	8961	7%	11%	32%	39%	12%
I would use a conditionally automated car during my everyday trips.	3.37	1.18	9029	10%	12%	25%	38%	16%
Assuming that I had access to a conditionally automated car, I predict that I would use it.	3.36	1.18	9038	9%	8%	22%	41%	19%

Question	*M*	SD	*n*	Relative frequencies				
				1	2	3	4	5
I expect that a conditionally automated car would be useful in meeting my daily mobility needs.	3.36	1.18	9038	10%	12%	25%	38%	15%
Using a conditionally automated car would be entertaining.	3.36	1.14	8996	9%	11%	29%	37%	14%
Using a conditionally automated car would help me reach my destination more safely.	3.35	1.11	9033	8%	11%	32%	35%	14%
I intend to use a conditionally automated car in the future.	3.22	1.17	8995	12%	11%	32%	31%	13%
I would recommend a conditionally automated car to others.	3.20	1.14	8955	11%	11%	35%	30%	12%
I plan to use a conditionally automated car in adverse weather conditions such as during heavy rain or fog, and in darkness.	3.16	1.21	9022	13%	16%	28%	31%	13%
I would use the time during which a conditionally automated car is driving for other activities.	3.09	1.15	9010	11%	20%	27%	32%	9%
I assume that people whose opinions I value would prefer that I use a conditionally automated car.	3.08	1.10	8987	11%	15%	39%	26%	9%
I expect that people who influence my behaviour think that I should use a conditionally automated car.	3.06	1.12	8985	11%	16%	37%	26%	9%
I expect that people who are important to me think that I should use a conditionally automated car.	3.02	1.12	8974	12%	16%	37%	26%	8%
I plan to buy a conditionally automated car once it is available.	2.77	1.20	8980	20%	19%	33%	21%	8%

4.3 What is drivers' secondary task engagement during the ADF use?

The analysis of descriptive statistics of data collected in the first data collection wave revealed moderate mean ratings for using the time the conditionally automated car is driving for other activities (***M*** = 3.09, SD = 1.15, question measured on a scale from strongly disagree (1) to strongly agree (5)). 42% of respondents indicated that they would like to spend the time for secondary activities during conditionally automated driving. The three most preferred activities included talking to fellow passengers; surfing the internet, watching videos or TV shows; and observing the landscape, with 45%, 44%, and 42% of respondents favouring these types of activities, respectively. The three-least favoured activities were reading a book, taking care of children, and playing games, with 15%, 13%, and 10% of respondents favouring these types of activities, respectively. See Figure 4.1 for an overview of the types of activities respondents reported to engage in during conditionally automated driving ordered from the most favourite to the least favourite activities. For more details on the results see the study of Nordhoff et al. (2020).

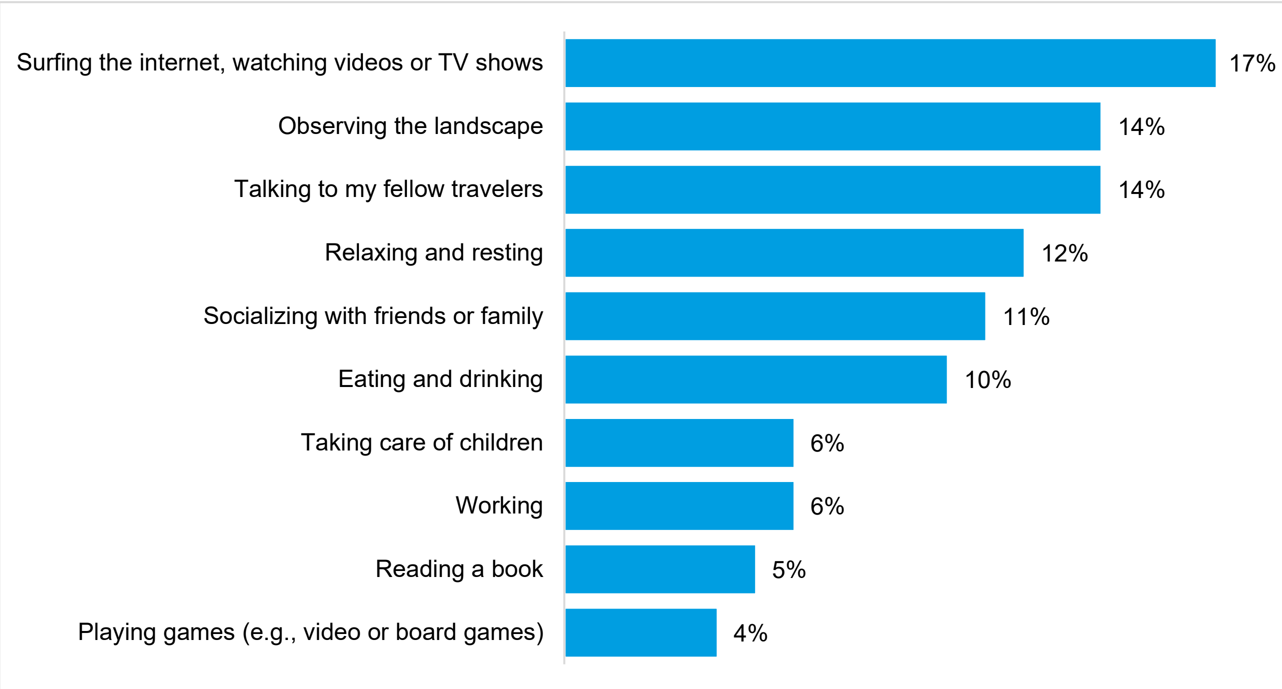

Figure 4.1: Types of activities respondents preferred to do in conditionally automated cars. Note that respondents were asked to select three activities they would engage in during conditionally automated driving.

These results suggest that people may not be fully comfortable engaging in secondary tasks during automation and may not trust the system enough. It is interesting to note that participants appear to want to use this time for leisure rather than work-related activities. For more details of the results see the study of Nordhoff et al. (in preparation).

4.4 Are drivers willing to use an ADF?

An analysis of data of the first data collection wave suggested that willingness to use conditionally automated cars was measured using two questionnaire items: the intention to use and buy a conditionally automated car. Adescriptive analysis of the questionnaire items revealed that the lowest mean rating was obtained for respondents' willingness to buy a conditionally automated car (***M*** = 2.77, SD = 1.20, question was measured on a scale from 1 = strongly disagree to 5 = strongly agree). Only 28% of respondents agreed with the statement capturing their intention to buy a conditionally automated car. The intention to use a conditionally automated car was higher: 60% of respondents agreed with the item that they predict they would use a conditionally automated car assuming that they had access to it. This suggests that although drivers may be willing to use automated systems if their vehicles were fitted with them, they may not be willing to pay extra for them in the immediate future. The relatively small proportion of respondents who could imagine buying a conditionally automated car may also be explained by their lack of physical exposure to conditionally automated cars, which may make it difficult for them to accurately envision their interaction with these cars. Furthermore, the wording of the questionnaire item ('I plan to buy a conditionally automated car once it is available') measuring the intention to purchase a conditionally automated car may have produced biased responses by encouraging respondents to disagree with this item, possibly because they just bought a new car, or because they can't afford buying a conditionally automated car, or generally a new car. In other words, a disagreement with this item does not necessarily imply that people are generally unwilling to consider the purchase of a conditionally automated car, or that respondents who intend to use conditionally automated cars will immediately consider purchasing one. For more details of the results see the study of Nordhoff et al. (2020).

A comparison of ADFs based on the third data collection wave shows that participants gave relatively high intention to use scores for each of the four ADF's evaluated (motorway, traffic jam, urban, and parking), although there are significant differences between the ADFs. Intention to use ratings were highest for the Parking ADF, and lowest for the Urban ADF (see Figure 4.2 below). As the parking ADF is used in slow moving and low risk situations, this result is perhaps unsurprising. For more details of the results see the study of Madigan et al. (in preparation).

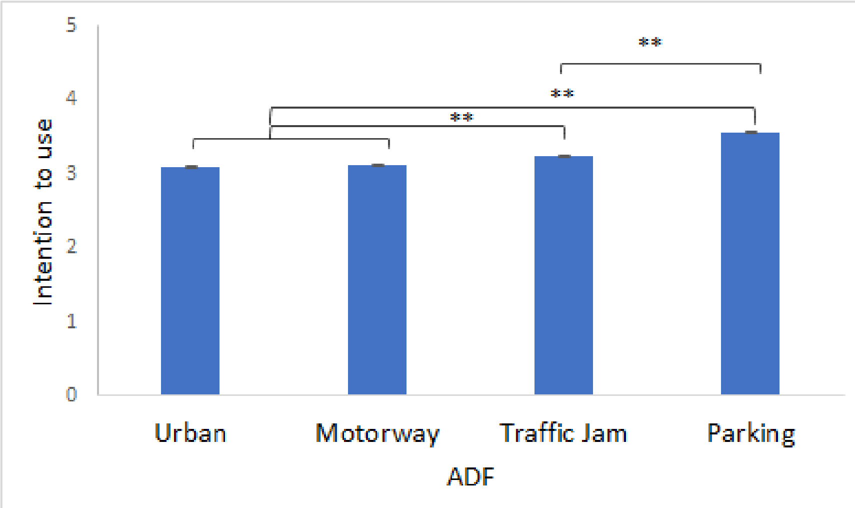

Figure 4.2: Mean intention to use different ADFs from the third wave of data collection.

4.5 How much are drivers willing to pay for ADFs?

To measure the willingness to pay for L3 ADFs, respondents were asked to indicate how much *extra* they would be willing to pay in addition to the price of a car for equipping their car with an ADF. For each ADF, respondents were given several price options to choose from, including 0 if they were unwilling to pay any extra amount.

The results in this section are reported for the first data collection wave using data from respondents from eight European countries. The analysis included respondents who indicated that they were willing to use a conditionally automated car once it would become available in the market. Figure 4.3 illustrates willingness to pay in each country and across all countries.

Figure 4.3: Willingness to pay per ADF, by country and across all countries.

As shown by Figure 4.3, there are differences in the willingness to pay for ADFs in each country and also across all countries. The share of respondents who were not willing to pay any extra amount for automated driving systems on urban roads, motorways, traffic jam and parking was 28%, 29%, 32% and 26%, respectively. In all countries, willingness to pay for ADFs decreased with increases in prices.

The impact of individuals' socio-demographic characteristics and their perception of benefits in terms of safety and performing activities while driving on willingness to pay for each level 3 ADFs was investigated by means of regression analyses. *Probit* and *ordered probit* regression models were performed in order to investigate the determinants of willingness to pay for different ADFs. The results indicated that age was negatively associated with willingness to pay across all ADFs. Respondents with higher income were also more likely to pay for ADFs. Perception of safety was significantly positive for all ADFs. Performing activities during driving had positive effects on willingness to pay for the majority of the activities during driving (e.g., taking care of children, observing the landscape). For more details of the results see the study of Björnvatn et al. (in preparation).

4.6 What is the user acceptance of the ADFs and what are the factors explaining and predicting it?

The results of this section are based on data from the first data collection wave. In order to measure the perceived usefulness of conditionally automated cars, which is often regarded the strongest predictor of automated vehicle acceptance as well as user acceptance itself, a confirmatory factor analysis was applied. The results of the confirmatory factor analysis are shown in Table 4.4. Model fit parameters were acceptable for all latent variables with the exception of the chi-square statistic, which has exceeded the recommended threshold of 3. However, the chi-square statistic is sensitive to sample size, implying that a value larger than 3 is usually expected with larger sample sizes (Hair et al., 2014). The items PE3–PE4, EE1–EE2, HM1 and HM3, SI1–SI2, FC1 and FC3, BI1 and BI5 were maintained in the analysis as their loadings exceeded the threshold of 0.70. The remaining items were omitted from the analysis due to factor loadings that were lower than 0.70, and high inter-construct correlations. The constructs demonstrated sufficient internal consistency reliability as shown by the Cronbach's alpha and composite reliability values, which were both higher than 0.70. Average variance extracted values (AVE) were higher than 0.50 for all latent variables except for willingness to pay. Discriminant validity was acceptable for all latent variables: The Pearson correlation coefficients between two constructs do not exceed the square root of the AVE, are smaller than 0.80, and the variance inflation factors (VIF) for all constructs are below the recommended cut-off value of 3, suggesting the absence of substantial multicollinearity (Garson, 2012; Hair et al., 2014).

As shown by Table 4.4, performance expectancy (i.e., perceived usefulness) was measured by two out of five indicators as valid and reliable indicators of perceived usefulness. These were the items *PE3: Using a conditionally automated car would help me reach my destination more safely*, and *PE4: Using a conditionally automated car would help me reach my destination more comfortably*. Thus, the perceived usefulness of conditionally automated cars was associated with its perceived comfort and safety. An analysis of descriptive statistics revealed that moderate mean ratings were found for these two items. For perceived safety, the mean rating was 3.35, with 49% of respondents considering conditionally automated cars safe. For perceived comfort, the mean rating was 3.52 (with the question measured on a scale from 1 = strongly disagree to 5 = strongly agree), with 58% of respondents believing that conditionally automated cars would help them reach their destination more comfortably. The confirmatory factor analysis further revealed that user acceptance of ADFs was measured by the intention to use and buy conditionally automated cars (Table 4.4).

Table 4.4: Results of confirmatory factor analysis.

Latent variable	Observed variable	λ	α	CR	AVE
Performance expectancy (PE)			0.82	0.82	0.70
	PE1: I would use the time during which a conditionally automated car is driving for other activities (Q17).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	PE2: I expect that a conditionally automated car would be useful in meeting my daily mobility needs (Q22).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	PE3: Using a conditionally automated car would help me reach my destination more safely (Q23).	0.83			
	PE4: Using a conditionally automated car would help me reach my destination more comfortably (Q26).	0.85			
	PE5: I assume that a conditionally automated car would be useful in my daily life (Q43).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
Effort expectancy (EE)			0.76	0.77	0.62
	EE1: Learning how to use a conditionally automated car would be easy for me (Q24).	0.75			
	EE2: I expect that a conditionally automated car would be easy to use (Q25).	0.83			
	EE3: It would be easy for me to become skillful at using a conditionally automated car. (Q27).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
Social influence (SI)			0.79	0.79	0.66
	SI1: I assume that people whose opinions I value would prefer that I use a conditionally automated car (Q29).	0.86			
	SI2: I expect that people who influence my behaviour think that I should use a conditionally automated car (Q39).	0.76			

Latent variable	Observed variable	λ	α	CR	AVE
	SI3: I expect that people who are important to me think that I should use a conditionally automated car (Q41).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	SI4: I would recommend a conditionally automated car to others (Q42).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
Facilitating conditions (FC)			0.77	0.79	0.66
	FC1: I could acquire the necessary knowledge to use a conditionally automated car (Q34).	0.82			
	FC2: I would expect the use of a conditionally automated car to be compatible with other digital devices I use (Q36).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	FC3: I would expect to have the necessary knowledge to use a conditionally automated car (Q38).	0.77			
	FC4: I would be able to get help from others when I have difficulties using a conditionally automated car (Q40).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
Hedonic motivation (HM)			0.80	0.80	0.67
	HM1: Using a conditionally automated car would be fun (Q28).	0.78			
	HM2: Using a conditionally automated car would be entertaining (Q30).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	HM3: Using a conditionally automated car would be enjoyable (Q32).	0.86			
Behavioural intention (BI)			0.82	0.82	0.70
	BI1: I intend to use a conditionally automated car in the future (Q31).	0.88			
	BI2: Assuming that I had access to a conditionally automated car, I predict that I would use it (Q33).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			

Latent variable	Observed variable	ƛ	α	CR	AVE
	BI3: I plan to use a conditionally automated car in adverse weather conditions such as during heavy rain or fog, and in darkness (Q35).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	BI4: I would use a conditionally automated car during my everyday trips (Q37).	Omitted from analysis due to factor loadings < 0.70 and high inter-construct correlations			
	BI5: I plan to buy a conditionally automated car once it is available (Q44).	0.80			
CFI	0.98				
RMSEA	0.06				
SRMR	0.02				
x^2	30.04				

Note: Measurement of the UTAUT2 constructs were used from Xu et al. (2018) and Venkatesh et al. (2012) and adjusted to the context of this study.

ƛ = Lambda, factor loading; **α** = Cronbach's alpha, internal consistency measure; CR = Construct reliability, internal consistency measure; AVE = average variance extracted, summary measure of convergence among observed variables representing a latent variable (Hair et al., 2014)

Structural equation modelling was performed in order to identify the factors explaining and predicting the acceptance and use of conditionally automated cars as shown by Table 4.5. The input factors (i.e., factors predicting acceptance) were the UTAUT2 constructs performance and effort expectancy, facilitating conditions, social influence, and hedonic motivation. The factor that was to be predicted was intention to use conditionally automated cars as proxy for the acceptance and use of conditionally automated cars. Hedonic motivation (i.e., perceived enjoyment) had the strongest influence on acceptance. The second-strongest influence on the acceptance of conditionally automated cars was social influence. Perceived usefulness / performance expectancy had the third-strongest influence on the acceptance of conditionally automated cars.

We also investigated the influence of age and gender on the intention to use conditionally automated cars. We found small negative effects of age and gender ($r < 0.10$). This suggests that elderly people were less likely than younger people to intend to use conditionally automated cars. Small positive effects of gender (Males = 1) were found on behavioural intention ($r < 0.05$), with Males being more likely than Females to intend to use conditionally automated cars. These findings mirror the literature on automated vehicle acceptance in two substantial ways. First, they correspond with the studies, which have shown significant, yet small, effects of age and gender on the factors predicting automated vehicle acceptance, as well as the acceptance construct itself (Kettles & Van Belle, 2019; Kyriakidis et al., 2015; Nordhoff et al., 2018). Second, the findings corroborate the more positive attitudes of Males than Females, which reflect a relatively consistent pattern across studies on automated vehicle acceptance (Rahman et al., 2019; Rice & Winter, 2019). These findings suggest that age and gender are weak predictors of the acceptance of conditionally automated cars. It is plausible that the effect of age and gender will be stronger when interacting with other psycho-social variables.

We also investigated the effects of experience with advanced driver assistance systems on the intention to use conditionally automated cars. Again the strength of this relationship was small ($r < 0.10$). Individuals who currently have Adaptive Cruise Control in their cars were more likely to intend to use conditionally automated cars. Furthermore, it was found that individuals whose cars are equipped with Parking Assist systems were less likely to use conditionally automated cars. This could be explained with regards to driver difficulties with using Parking Assist systems (Trösterer et al., 2014). The positive relationship between the experience with Self-Parking Assist systems and the intention to use conditionally automated cars can possibly be explained with regards to the perceived difficulty of parking, especially among elderly drivers (Baldock et al., 2006), and the added value of Self-Parking Assist systems in decreasing the difficulties associated with parking. For more details of the results see the study of Nordhoff et al. (2020).

Table 4.5: Results of structural equation modelling; significant structural path relations between latent variables, socio-demographics and experience with advanced driver assistance systems (β), variance explained (R^2), and model fit parameters.

Hypothetical path			Model 1	Model 2
Hypothesis	**Independent variable**	**Dependent variable**	**Effect *β* & significance level**	**Effect *β* & significance level**
H1	Performance expectancy	Behavioural intention	0.107*	0.135**
H2	Effort expectancy		0.082, *n.s.*	0.051, *n.s.*
H3	Social influence		0.393***	0.404***
H4	Facilitating conditions		-0.095, *n.s.*	-0.062, *n.s.*
H5	Hedonic motivation		0.496***	0.462***
H6	Age		–	-0.082***
	Gender		–	0.026***
	Experience with Automated Emergency Braking (AEB)		–	0.003, *n.s.*
	Experience with Forward Collision Warning (FCW)		–	-0.007, *n.s.*
	Experience with Blind Spot Monitoring (BSM)		–	-0.004, *n.s.*
	Experience with Drowsy Driver Detection (DDD)		–	0.003, *n.s.*
	Experience with Lane Departure Warning (LDW)		–	0.002, *n.s.*
	Experience with Lane Keeping Assistance (LKA)		–	0.012, *n.s.*
	Experience with Adaptive Cruise Control (ACC)		–	0.035**
	Experience with Parking Assist (PA)		–	-0.029**
	Experience with Self-parking Assist System (SPA)		–	0.051***
H7	Effort expectancy	Performance expectancy	-0.009, *n.s.*	-0.009, *n.s.*

Hypothetical path			Model 1	Model 2
Hypothesis	**Independent variable**	**Dependent variable**	**Effect *β* & significance level**	**Effect *β* & significance level**
H8	Social influence	Performance expectancy	0.209***	0.207***
H9	Social influence	Effort expectancy	0.059**	0.057**
H10	Social influence	Facilitating conditions	0.560***	0.562***
H11	Social influence	Hedonic motivation	0.561***	0.566***
H12	Facilitating conditions	Performance expectancy	0.125, *n.s.*	0.125, *n.s.*
H13	Facilitating conditions	Effort expectancy	0.845 ***	0.845***
H14	Facilitating conditions	Hedonic motivation	0.406***	0.402***
H15	Hedonic motivation	Performance expectancy	0.677***	0.679***
H16	Hedonic motivation	Effort expectancy	0.103***	0.105***
Assessment of model fit				
CFI			0.982	0.85
RMSEA			0.059	0.048
SRMR			0.021	0.045
χ^2/df			28.37	20.68
R^2 of BI			0.877	0.883
R^2 of PE			0.879	0.879
R^2 of EE			0.919	0.919
R^2 of HM			0.734	0.738
R^2 of FC			0.314	0.316

In order to understand the effects of participant demographics on intention to use each of the specific ADFs, we compared the effect of age group (18-29, 30-39, 40-49, 50-59, 60+) and gender (Male, Female) on intention to use scores for the Motorway, Urban, Traffic Jam, and Parking systems. For this analysis, we used the data from the first two data collection waves. As shown in Table 4.5 and Table 4.6, there was a significant effect of Age group on Intention to use scores across all four ADFs, where the intention to use ADFs tends to decrease with increasing age. Across all ADFs, the 30-39 age group had the highest mean intention to use score, followed by the 18-29 age group. By contrast, the 60+ age group had the lowest mean Intention to use score across all ADFs. There was also a significant effect of gender on intentions to use some ADFs (Table 4.6), where males had higher Intention to use scores for Motorway, Traffic Jam and Urban

ADFs. However, there was no difference for the Parking ADF. For more details of the results see the study of Louw et al. (in preparation).

*Table 4.6: Mean (M), standard deviation (SD), and ANOVA test results for Intention to use different ADFs, by Age group and Gender. ***p < .001.*

		Motorways		Traffic Jam		Urban		Parking	
		M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Age	**18-29**	3.63	1.1	3.52	1.12	3.58	1.11	3.82	1.01
	30-39	3.7	1.08	3.61	1.15	3.63	1.12	3.89	0.99
	40-49	3.43	1.17	3.43	1.16	3.39	1.15	3.66	1.1
	50-59	3.18	1.2	3.21	1.15	3.12	1.19	3.52	1.16
	60+	2.89	1.25	2.92	1.23	2.91	1.26	3.28	1.22
	Welch's F	$F(4,1992.71) = 59.946$, $\omega^2 = .04$***		$F(4,2001.20) = 38.649$, $\omega^2 = .03$***		$F(4,1999.64) = 50.886$, $\omega^2 = .03$***		$F(4,1924.19) = 34.244$, $\omega^2 = .03$***	
Gender	**Male**	3.51	1.15	3.49	1.14	3.44	1.17	3.7	1.09
	Female	3.38	1.2	3.31	1.2	3.35	1.19	3.7	1.1
	Welch's F	$F(4,4608.97) = 14.154$, $\omega^2 < .01$***		$F(1,4595.34) = 25.739$, $\omega^2 < .01$***		$F(1,4621) = 6.322$, $\omega^2 < .01$**		$F(1,4625.772) = 0.014$, $\omega^2 < .01$	

*Table 4.7: Post Hoc Results for Intention to use scores by Age group and ADF. **p < .01.*

	18-29	30-39	40-49	50-59	60+
18-29	x				
30-39	ns	x			
40-49	M** U** P**	M** T** U** P**	x		
50-59	M** T** U** P**	M** T** U** P**	M** T** U** P**	x	
60+	M** T** U** P**	M** T** U** P**	M** T** U** P**	M** T** U** P**	x
M: Motorway, T: Traffic Jam, U: Urban, P: Parking, ns: not significant					

4.7 What is the influence of drivers' mobility behaviour on the acceptance of L3 cars?

The user acceptance of conditionally automated cars reflects on the willingness to use them for personal mobility. Furthermore, intention to use conditionally automated cars may have implications for the use of other travel modes. A European subset of the first and the second waves of the survey was used to investigate how the respondents expected conditionally automated cars to change their use of public transport and active travel modes. It was expected that high intention to use conditionally automated cars could also predict willingness to replace trips travelled by other modes by conditionally automated cars. In addition, it was expected that multimodal travellers (i.e., those who regularly use many travel modes) could be more will to change their travel behaviour. The respondents were divided in three groups by their intention to use conditionally automated cars, and independently by their level of multimodality.

The links between intention to use conditionally automated cars, multimodality, and expectation to increase or decrease the use of public transport and active travel modes were then examined. A majority of the respondents did not expect to change their use of public transport (62%) or active travel modes (67%). However, it was found that the intention to use conditionally automated cars predicted higher expectations to decrease their use. On the other hand, multimodality was associated with higher expectations to change the use of public transport and active travel (either increase or decrease). Intention to use conditionally automated cars and multimodality were also positively associated. Consequently, it appears that those travellers who are most willing to use conditionally automated cars are also typically multimodal travellers. This suggests that conditionally automated cars may have a substantial impact on the travel mode choices if the travellers end up replacing their public transport or active travel trips by trips traveller by conditionally automated cars. For more details of the results see the study of Lehtonen et al. (2021).

4.8 Does increased knowledge of specific ADF's affect trust and intentions to use these functionalities?

Respondents received most information from online communities, websites about IT, cars or motoring (Q12.1) & social media (Q12.2), followed by the radio, TV (Q12.3), newspapers, & magazines (not online) (Q12.6), and friends, family and colleagues (Q12.4 (Figure 4.4). Respondents received information from car dealers, manufacturers, and suppliers (Q12.5) the least frequently. This is not surprising given that L3 cars have not been commercialized yet. For more details on the results see Nordhoff, Madigan et al. (2021).

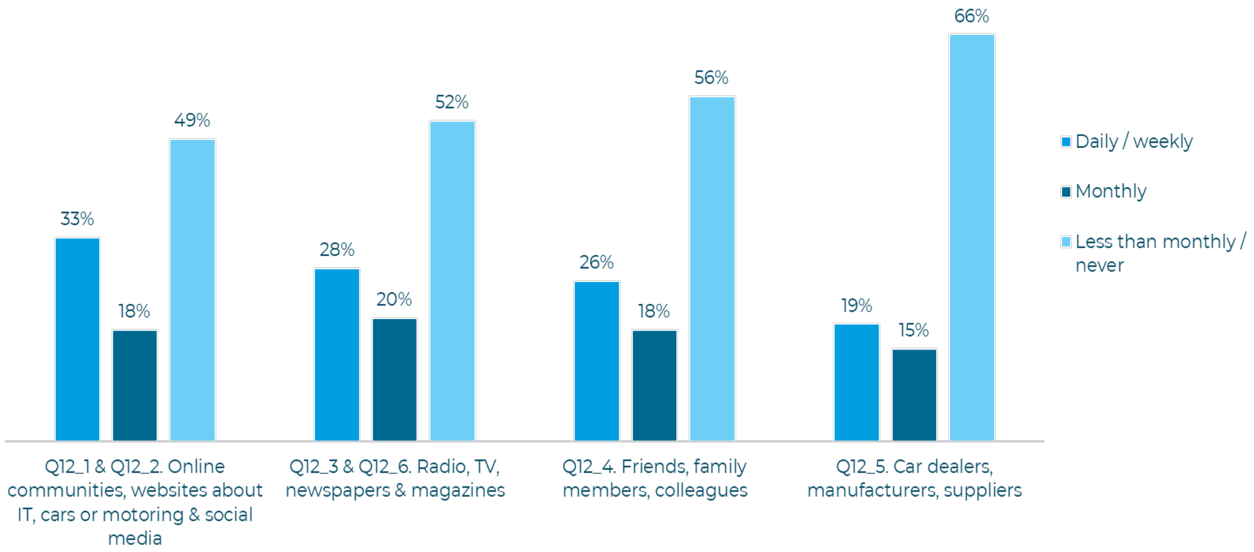

Figure 4.4: Frequency of receiving information about automated cars from various sources.

Previous research has highlighted the importance of knowledge and information on the perceptions of automated cars (Anania et al., 2018; Fraedrich & Lenz, 2016; Sanbonmatsu et al., 2018), with studies showing that the provision of an incorrect preliminary system description can lead to an incorrect mental model of how traffic situations will play out (Blömacher et al., 2018). Thus, in the third wave of the questionnaire, we aimed to establish how the level of information provided about each of the ADF's impacted on respondents' trust and acceptance of these systems. A between-subjects intervention was designed, whereby half of the participants were provided with statements about the *system capabilities* of the motorway, traffic jam, urban, and parking ADFs followed by questions on trust and intention to use, and the other half were provided with statements incorporating information on the *system capabilities and driver responsibilities* for the ADFs. The capabilities included descriptions of the situations where the ADF could be activated, and the elements of vehicle control supported by the system. The driver responsibilities statements included information on the manoeuvres not supported by the ADF, based on the pilot vehicle descriptions in D7.4 (Björnvatn et al. 2021). An example of the statements are as follows:

System Capabilities: The Motorway System can be activated by the driver on free-flowing motorways up to 130 km/h. When it is on, the car will do all of the steering, accelerating and braking, and you will not be required to monitor the road ahead. It will maintain a safe distance to the vehicle in front, changing lane to overtake traffic if required.

System Capabilities and Driver Responsibilities: The Motorway System can be activated by the driver on free-flowing motorways up to 130 km/h. When it is on, the car will do all of the steering, accelerating and braking, and you will not be required to monitor the road ahead. It will maintain a safe distance to the vehicle in front, changing lane to overtake traffic if required. The car requires visible lanes and road markings, so may ask the driver to re-take control if, for example, there are roadworks where lane markings have been removed, or a situation where there are poor weather conditions, including heavy rain, snow, or surface water. The driver will also be asked to re-take control when the vehicle is leaving the motorway.

Results indicated that there was a high level of *overall willingness to use* an ADF, with no significant differences between the two description groups ($F(1, 9337) = 0.219$, $p = 0.64$). However, respondents in the system capabilities description group provided slightly higher ratings of intentions to use the Parking ADF, and slightly lower intentions to use the Motorway ADF, than participants who also received information on the driver responsibilities ($F(3, 28011) = 970.69$, $p < 0.001$, $\eta p^2 = 0.094$). There was also a significant, albeit small, effect of system description (Capabilities vs Capabilities and Driver Responsibilities) on *ratings of trust* in the ADFs ($F(1, 9337) = 6.63$, $p < 0.05$, $\eta p^2 = 0.001$), with participants providing slightly higher ratings of trust when presented with information focused on the capabilities of the L3 systems compared to information on the capabilities and driver responsibilities. Finally, there was a significant interaction between ADF and system description ($F(3, 28011) = 18.57$, $p < 0.001$, $\eta p^2 = 0.002$), with participants providing lower ratings of trust in the Motorway and Urban ADFs than the Traffic Jam and Parking ADFs. For more details on the results see the study of Madigan et al. (under preparation).

4.9 What are the differences between countries?

4.9.1 What are the expectations about changes in personal mobility?

Using data collected in the first and second data collection wave, we also investigated differences between the countries in terms of their expectation as to how conditionally automated cars change their personal mobility in terms of the productive use of travel time, travel comfort, and the number of accidents. Again, these country differences were analysed for three different user groups, respectively, named Enthusiasts, Neutrals, and Sceptics. Table 4.8 provides an overview of the means, standard deviations and Spearman correlation coefficients of the questions measuring respondents' expectations in personal mobility associated with the introduction of conditionally automated cars.

Enthusiasts (58%) were more likely to expect an increase in the productive use of travel time than Neutrals (48%) and Sceptics (36%) Figure 4.5 (left). The correlation between the expected changes in the productive use of travel time and the intention to use conditionally automated cars was positive ($r = \leq 0.40$) yet not significant in Hungary and Russia.

Enthusiasts (67%) were more likely to expect an increase in travel comfort than Neutrals (58%) and Sceptics (38%) Figure 4.5 (middle). The correlation between the expected change in travel comfort and the intention to use conditionally automated cars was positive and significant in all countries ($r = < 0.55$).
Enthusiasts (57%) were more likely to expect a decrease in the number of accidents than Neutrals (41%), and Sceptics (19%) Figure 4.5 (right). The correlation between the expected change in the number of accidents and the intention to use conditionally automated cars was negative and significant in all countries ($r = < -0.50$) yet not significant in China and India. For more details on the results see the study of Nordhoff et al. (2021).

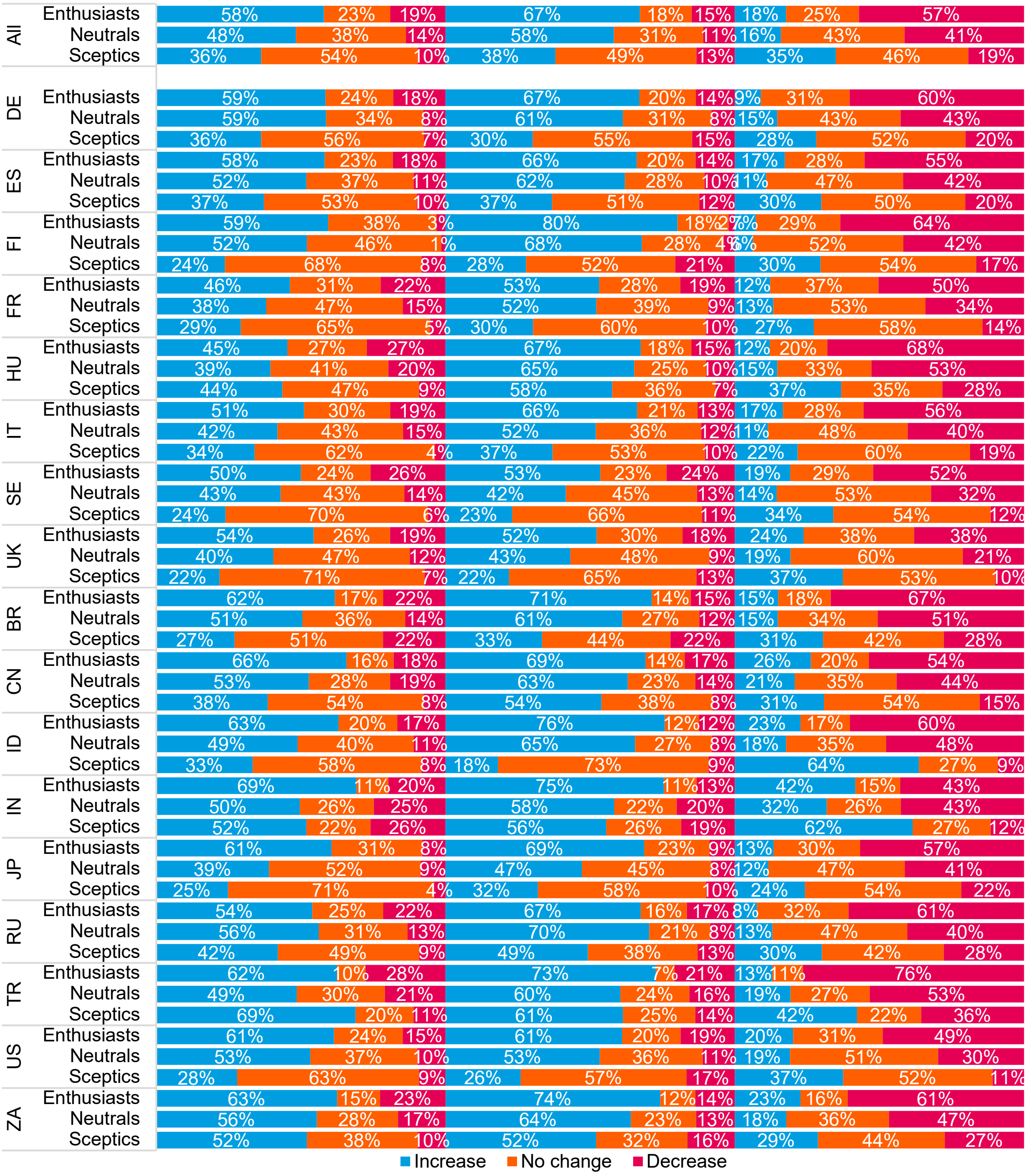

Figure 4.5: Percentage values of Enthusiasts, Neutrals, and Sceptics

Figure 4.5 shows the percentage values of Enthusiasts, Neutrals, and Sceptics differing in their expectation about the changes in:

- the productive use of travel time due to conditionally automated cars (Q21.1, left)
- travel comfort due to conditionally automated cars (Q21.2, middle)
- the number of traffic accidents due to conditionally automated cars (Q21.3, right)

Table 4.8: Spearman rank-order correlation matrix. Note that the correlations were multiplied by 100.

Question	Intention to use conditionally automated cars																
	DE	ES	FI	FR	HU	IT	SE	UK	BR	CN	ID	IN	JP	RU	TR	US	ZA
Q21.1. Change in productive use of travel time due to conditionally automated cars (1 = Never, 2 = Less than monthly, 3 = Monthly, 4 = Weekly, 5 = Daily)	18 ***	14 ***	40 ***	5, *n.s.*	-4, *n.s.*	10 ***	11 ***	16 ***	21 ***	16 ***	21 ***	20 ***	24 ***	2, *n.s.*	8 *	24 ***	8 *
M	3.59	3.53	3.47	3.31	3.27	3.43	3.33	3.35	3.57	3.63	3.60	3.73	3.41	3.57	3.59	3.50	3.62
SD	0.97	1.02	0.84	0.91	1.03	0.99	0.97	0.92	1.20	1.17	1.05	1.30	0.77	1.17	1.43	0.99	1.27
Q21.2. Change in travel comfort due to conditionally automated cars (1 = Never, 2 = Less than monthly, 3 = Monthly, 4 = Weekly, 5 = Daily)	33 ***	22 ***	53 ***	18 ***	11 ***	23 ***	18 ***	20 ***	29 ***	15 ***	25 ***	23 ***	29 ***	15 ***	16 ***	24 ***	26 ***
M	3.59	3.66	3.52	3.46	3.76	3.63	3.33	3.36	3.80	3.81	3.88	3.95	3.49	3.86	3.89	3.45	3.88
SD	1.02	1.06	0.96	0.98	1.07	1.02	0.97	0.93	1.17	1.18	1.04	1.22	0.82	1.12	1.39	1.06	1.20
Q21.3. Change in number of accidents due to conditionally automated cars (1 = Never, 2 = Less than monthly, 3 = Monthly, 4 = Weekly, 5 = Daily)	-33 ***	-26 ***	-47 ***	-32 ***	-32 ***	-23 ***	-33 ***	-23 ***	-29 ***	-5, *n.s.*	-10 ***	-4, *n.s*	-27 ***	-30 ***	-34 ***	-29 ***	-20 ***
M	2.70	2.61	2.78	2.75	2.50	2.59	2.87	3.03	2.34	2.62	2.56	2.99	2.66	2.51	2.08	2.93	2.48
SD	1.04	1.02	1	0.98	1.07	1.03	1.01	0.97	1.15	1.16	1.18	1.44	0.89	1.07	1.25	1.04	1.25

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, *n.s.* = not significant.
The scales of the questions Q12.1–Q12.6 and Q21.1–Q21.3 were reverse-coded. The questions Q6–Q11 were dummy coded.
DE = Germany, ES = Spain, FI = Finland, HU = Hungary, IT = Italy, SE = Sweden, UK = United Kingdom, BR = Brazil, CN = China, ID = Indonesia, IN = India, JP = Japan, RU = Russia, TR = Turkey, US = United States of America, ZA = South Africa

4.9.2 What is the intention to use conditionally automated cars?

For the analysis of differences between countries, we calculated Spearman rank-order correlation coefficients (ρ) between the country's GDP per capita (World Health Organization, 2018) and the mean intention to use score of participants from that country using data from the first and second data collection wave. We conducted a similar calculation of the correlation between the country's estimated number of road deaths per 100,000 population (World Health Organization, 2018) and its mean Intention to use score. There was a significant negative correlation between a country's developmental status (GDP per capita) and the overall intention to use ADFs (Figure 4.6). On average, respondents from higher-GDP countries were more neutral regarding their intention to use ADFs, compared to those from lower-GDP countries, who tended to have higher Intention to use scores. This pattern was similar when considering the ADFs separately, where there was a significant negative correlation between GDP and Intention to use Motorway, Traffic Jam, Urban Roads, and Parking ADFs. There was a significant positive correlation between a country's estimated number of road deaths per 100,000 population and the overall intention to use ADFs, where countries with higher estimated road deaths tended to have higher Intention to use scores. As with GDP, this pattern was similar for the different ADFs. There were significant positive correlations for the Motorway, Traffic Jam, Urban Roads, and Parking ADFs.

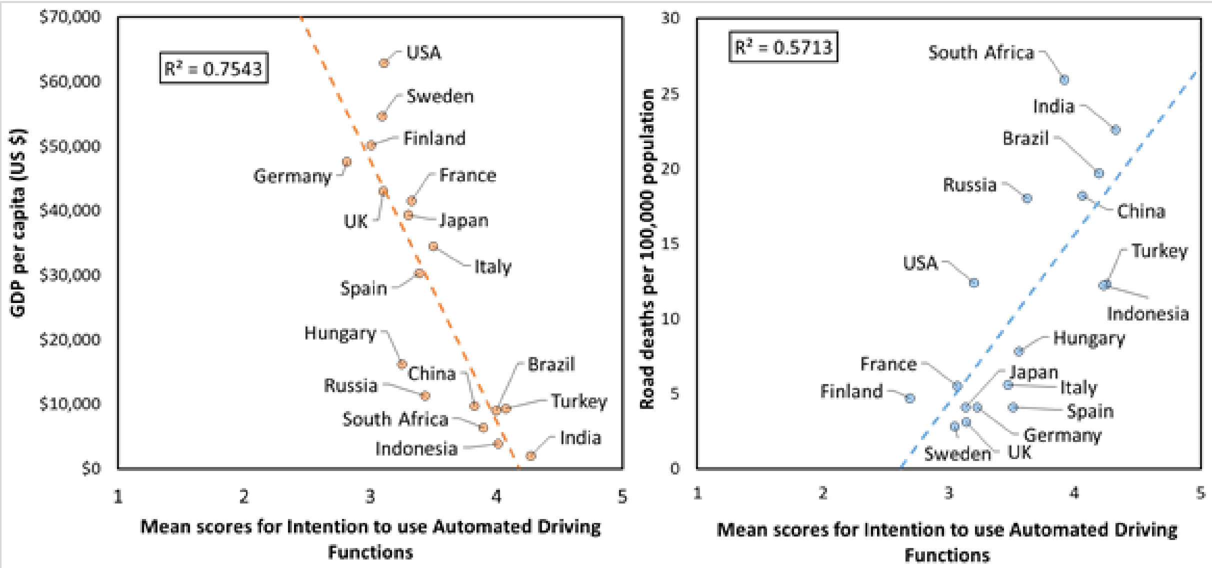

Figure 4.6: Mean scores for intention to use ADFs.

As shown by Figure 4.7, respondents from the European countries were less enthusiastic about using conditionally automated cars than respondents from non-European countries. India, Indonesia, and Turkey had the highest proportion of Enthusiasts (i.e., individuals who provided their agreement with the questions measuring intention to use). The European nations Sweden, Germany, and Finland had the lowest proportion of people who were enthusiastic towards using conditionally automated cars. Russia, Japan, Hungary, and Spain had the highest proportion of people who were neutral towards using conditionally automated cars, while Brazil, Indonesia, and India the lowest. Finland, Germany, and Sweden had the highest proportion of people who were sceptical towards using conditionally automated cars, while China and Indonesia had the lowest. For more details of the results see the study of Nordhoff et al. (2021).

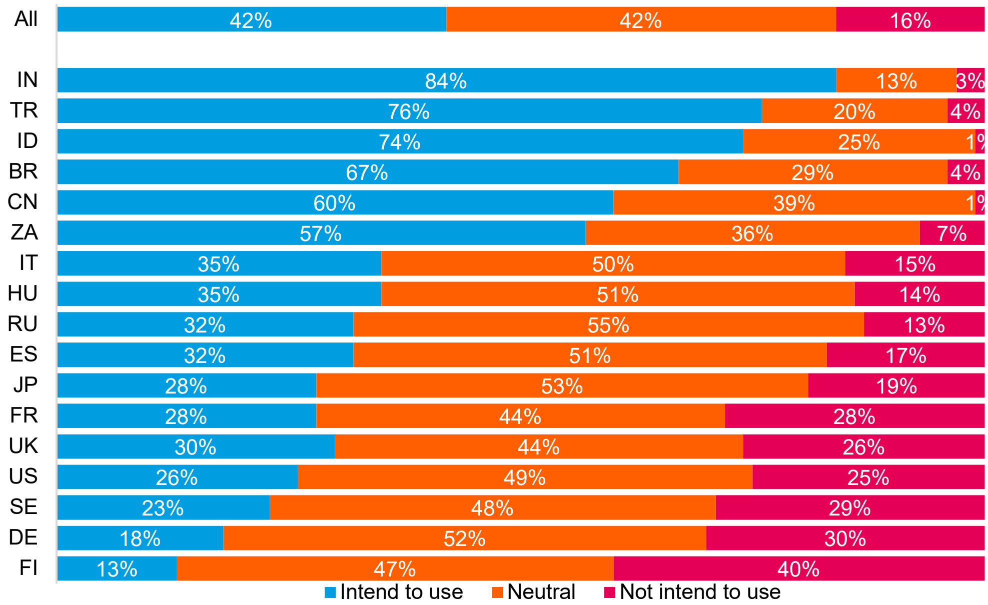

Figure 4.7: Proportions of Enthusiasts, Neutrals, and Sceptics towards conditionally automated cars (M = 3.38, SD = 1.09, n = 18,054)

4.10 Open access to survey data

The survey data collected is made open access. The data from the waves one and two is published before the end of the project, expect for the willingness to pay questions which will be embargoed until November 2022. The data from the third wave will be likewise embargoed until November 2022. During the embargo period, the research team will have time to review and publish the main results and their interpretation and possible limitations. This will ensure that the users of the open access data will know how to utilize and interpret the data correctly.

The data is stored at Zenodo repository. Zenode was created 2013 by EU funded OpenAIRE project and CERN to be an all-purpose open research repository. The dataset has a digital object identified (DOI) which acts as a way to refer to the data. The data is also presented and links are provided at the L3Pilot Open Data Hub providing an overview of the open data produced by L3Pilot project. Together with the data, detailed instructions are provided for external users in the form of a README file to ensure that the data can be correctly used and interpreted by those sharing or publishing the data. The README file will contain the following information:

- Title of the dataset: L3Pilot Global User Acceptance Survey, First Phase Data.
- Short description of what the dataset contains.
- Contact information in case users have questions about the data.
- Short methodological description for collecting and analysing the data with links to the current deliverable.

- Data-specific information including full names and definitions of the headings of the columns (i.e., variable names).
- Measurement units.
- Definitions for codes to represent missing data.
- Sharing and access information: License / restrictions placed on the data to regulate the use of the data.

5 Conclusions and outlook

5.1 What are drivers' expectations regarding system features?

Overall, respondents of L3Pilot Global User Acceptance Survey were very positive about the idea of conditionally automated cars as exemplified by high ratings of perceived comfort, safety, usefulness, ease of use and enjoyment. The highest mean rating was obtained for the questionnaire item pertaining to the perceived ease of use of conditionally automated cars (in theoretical terms, perceived ease of use was defined as effort expectancy). Conditionally automated driving may pose excessive demands on the abilities of human drivers to safely, comfortably and efficiently take back control from a conditionally automated car. Therefore, it is plausible that the positivity of our respondents may be explained by their lack of physical exposure to conditionally automated cars, which may make it difficult for them to correctly envision their interaction as drivers with conditionally automated cars. Furthermore, it has to be taken into account that the specific questionnaire items measuring the perceived ease of use of conditionally automated cars did not address the specific take-over situation and interaction with a conditionally automated car but were phrased generically. We recommend future research to adjust the operationalisation of effort expectancy to the context of conditionally automated driving.

To conclude the above: respondents were generally very positive about the idea of conditionally automated cars as shown by a strong agreement with questionnaire items measuring the safety, usefulness, enjoyment, and ease of use. They were most positive about the perceived ease of use of conditionally automated cars.

5.2 What is drivers' secondary task engagement during the ADF use?

Furthermore, we found that 42% of respondents indicated to be willing to engage in secondary activities during conditionally automated driving. This percentage can be considered as relatively low given that the engagement in secondary eyes-off road activities was advertised as one of the main benefits of automated driving. Among these 42% respondents, the most preferred activities were talking to fellow passengers (45%), surfing the internet, watching TV shows or videos (44%), and observing the landscape (42%). Working was preferred only by 17%. The preference to engage in activities that require less attentional resources, and that can be performed in traditional transport modes mirrors the literature (Cunningham et al., 2019a; Cunningham et al., 2019b; Cyganski et al., 2015; Pfleging et al., 2016). This could imply that the possibility to relax and perform lighter activities is preferred in conditionally automated driving, and that the car interior should to be adjusted to accommodate these activities (Pfleging et al., 2016).

An alternative explanation for the low preference to engage in secondary activities may be related to concerns around discomfort by having the eyes off the road. Such concerns may be remedied only if automation driving styles and interiors are demonstrated to result in high comfort levels even when taking the eyes off the road, and when such benefits are effectively communicated to potential users. Finally, the limited intention to take the eyes off the road could be explained by the particular nature of conditional automation, which places considerable demands on the sensory, motoric and cognitive state of the human driver (Louw et al., 2017; Naujoks et al., 2018). Conditionally automated cars that will be commercialised will have to enable a safe, comfortable and efficient take-over situation, without jeopardising the added benefits that this level of automation entails. If this is achieved, human drivers will not have to divide their attentional resources between the driving environment, while also supervising the performance of the automated system, and managing their own activity all at the same time. To be safe, useable and acceptable, the systems that will enter the market have to enable the driver to comfortably and safely engage in non-driving related activities and provide sufficient time for a request to intervene and take over control of the automated system.

To conclude the above: without having a direct experience on conditional automation, a small majority would use the system and subsequently a minority of the respondents would engage in a secondary task while the system is activated even though the purpose of conditional automation is to allow temporary engagement in tasks other than driving.

5.3 Are drivers willing to use an ADF?

Respondents reported a high intention to use conditionally automated cars: 60% of respondents indicated that they intend to use a conditionally automated cars assuming that they had access to it. However, the lowest mean rating was obtained for purchasing a conditionally automated car once available. Only 28% of respondents planned to buy a conditionally automated car once it is available. This finding corresponds to some extent with Power (2012) who surveyed 17,400 vehicle owners and found that only 37% of respondents would definitely or probably be interested in purchasing automated driving technology, and according to Pfleging, Rang, and Broy (2016) who revealed that 44% of their respondents could imagine buying a highly automated car. The relatively small proportion of respondents who could imagine buying a conditionally automated car may also be explained by their lack of physical exposure to conditionally automated cars, which may make it difficult for them to accurately envision their interaction with these cars. Furthermore, the wording of the questionnaire item measuring the intention to purchase a conditionally automated car may have produced biased responses by encouraging respondents to disagree with this item, possibly because they just bought a new car, or because they can’t afford buying a conditionally automated car, or generally a new car. In other words, a disagreement with this item does not necessarily imply that people are generally unwilling to consider the purchase of a conditionally automated car, or that respondents who intend to use conditionally automated cars will immediately consider purchasing one.

To conclude the above: even though respondents had a positive representation of conditional automation, there was, however, a low willingness to purchase an automated car. However, the results indicated that the majority of respondents were willing to use conditionally automated cars.

5.4 How much are drivers willing to pay for ADFs?

Our results have shown that the proportion of respondents who were unwilling to pay any extra for using conditionally automated cars in the four environments (i.e., urban roads, motorways, congested motorways, and parking) was 28%, 29%, 32% and 26%, respectively. The results showed that the willingness to pay for parking, urban and motorway was slightly higher than the willingness to pay for traffic jam ADF. The results suggest that the majority of respondents were willing to pay for ADFs. In all countries, willingness to pay for ADFs decreased with increases in prices. Furthermore, it was found that age was a negative predictor of willingness to pay, which means that elderly people were less willing to pay for ADFs than younger people. This corresponds with research, which has shown that elderly people had more negative attitudes towards automated cars and were less accepting of these (see Section 6.5). Furthermore, it was found that income was a positive predictor of willingness to pay, suggesting that higher-income people were more willing to pay for ADFs. Safety was also positively related to willingness to pay, implying that people who consider ADFs as safe were more willing to pay for ADFs. Being willing to engage in secondary activities during the ride with ADFs was also positively correlated to ADFs, meaning that those individuals with a preference to engage in secondary eyes-off road activities were more willing to pay for ADFs.

To conclude the above: respondents who were unwilling to pay for using conditionally automated cars on urban roads, motorways, congested motorways, and in parking situations was 28%, 29%, 32%, and 26%. The willingness to pay for parking was higher than the willingness to pay for using conditionally automated cars in traffic jams. Elderly people were less willing and higher-income people were more willing to pay for the four functions. Safety and the willingness to engage in secondary activities were positive predictors of the willingness to pay for ADFs.

5.5 What is the user acceptance of the ADFs and what are the factors explaining and predicting it?

One of the main objectives of the L3Pilot Global User Acceptance Survey was also to examine and predict the acceptance of conditional automation. Therefore, one of the most comprehensive technology acceptance models was applied, i.e., the Unified Theory of Acceptance and Use of Technology (UTAUT2). It was found that hedonic motivation was the strongest predictor of individuals' behavioural intention, implying that individuals who consider conditionally automated cars enjoyable are more likely to intend to use them.

The second-strongest predictor of behavioural intention was social influence (social pressure) implying that individuals who believe that people important to them in their social network appreciate their use of conditionally automated cars are more likely to intend to use them. Performance expectancy – the third-strongest predictor of the acceptance and use of conditionally automated cars – was predicted by the factors perceived safety and expected comfort. This means that individuals who consider conditionally automated cars safe and comfortable are more likely to form positive *intentions to use these cars.* In our study, performance expectancy was the third-strongest predictor of the behavioural intention to use conditionally automated cars, while in previous research performance expectancy was the strongest predictor (Madigan et al., 2016; Panagiotopoulos & Dimitrakopoulos, 2018). One plausible explanation for this finding could be that there is a strong correlation between performance expectancy and hedonic motivation. Consequently, hedonic motivation may capture some of the effects of performance expectancy on behavioural intention, probably also since the factor comfort included in performance expectancy is conceptually related to hedonic motivation. The positive effects of hedonic motivation, social influence, and performance expectancy on the intention to use conditionally automated cars suggest that the benefits of conditionally automated cars must be clearly demonstrated and promoted by the public (e.g., media, policy-makers) and private decision-makers (e.g., manufacturers) via established communication channels and in social networks. The results also suggest that automated cars could be more effectively promoted via car dealers in order to increase the level of awareness of and knowledge about automated cars.

To conclude the above: the factors predicting best the acceptance of SAE conditional automation in this order: perceived enjoyment (hedonic motivation), social esteem (social pressure) and safety and comfort of use. Age and gender only had a very weak influence on the acceptance of conditionally automated cars. Males were slightly more likely than Females to accept and use conditionally automated cars.

The effects of age and gender on the acceptance and use of conditionally automated cars were small (beta coefficient as measure for the strength of the relationship between age, gender, and acceptance was below 0.10). This suggests that age and gender may not be relevant predictors of the acceptance of conditional automation or is captured through other predictors. The correlation between age and behavioural intention was negative. This implies that elderly people were less likely to use conditionally automated cars. These findings mirror the literature on automated vehicle acceptance in two substantial ways. First, they correspond with the studies which have shown significant, yet small, effects of age and gender on the factors predicting automated vehicle acceptance, as well as the acceptance construct itself (Kettles and Van Belle, 2019; Kyriakidis et al., 2015; Nordhoff et al., 2018). Second, the findings corroborate the more positive attitudes, higher ratings of the perceived usefulness, social norms, and trust of automated vehicles of males than females, which reflect a relatively consistent pattern across studies on automated vehicle acceptance (Rahman et al., 2019; Rice and Winter, 2019).

To conclude the above: the acceptance of conditionally automated cars is determined by complicated relationships of factors and may not be strongly explained or at all by age and gender. However, Males had a higher intention to use conditionally automated cars than Females.

Small positive effects of experience with advanced driver assistance systems (ADAS) were found on behavioural intention ($r < 0.10$). Individuals who currently have Adaptive Cruise Control in their cars were more likely to intend to use conditionally automated cars. This corresponds with Kyriakidis et al. (2015) who reported that people who currently use Adaptive Cruise Control would be willing to pay more for automated vehicles and are more comfortable about driving without a steering wheel. Furthermore, it was found that individuals whose cars are equipped with

Parking Assist systems were less likely to use conditionally automated cars. This could be explained with regards to driver difficulties with using Parking Assist systems (Trösterer et al., 2014). The positive relationship between the experience with Self-Parking Assist systems and the intention to use conditionally automated cars can possibly be explained with regards to the perceived difficulty of parking, especially among elderly drivers (Baldock et al., 2006), and the added value of Self-Parking Assist systems in decreasing the difficulties associated with parking. Future research should examine more closely the effect of experience with advanced driver assistance systems differing in their functionality on the intention to use conditionally automated cars. It is plausible that respondents' limited experience with advanced driver assistance systems accounts for the small effect on intention to use conditionally automated cars as shown by the present Deliverable.

To conclude the above: Those having positive experience on ADAS, were more likely to show more intention to use conditionally automated driving applications that those with less experience.

5.6 Does increased knowledge of specific ADF's affect trust and intentions to use these functionalities?

It was found that respondents who received information about the capabilities of conditionally automated cars provided higher ratings of the intention to use the Parking ADF and lower intention to use the Motorway ADF than respondents who received information about the responsibilities of the driver. Furthermore, we found that the system description about conditionally automated cars (capabilities vs Capabilities and Driver Responsibilities) had a small positive effect on *ratings of trust* in the ADFs, with participants providing slightly higher ratings of trust when presented with information focused on the capabilities of the conditionally automated driving systems compared to information on the capabilities and driver responsibilities. Finally, we also found a significant interaction between ADF and system description, with participants providing lower ratings of trust in the Motorway and Urban ADFs than the Traffic Jam and Parking ADFs. Overall, it appears that providing more detailed information about system boundaries and driver responsibilities does not have a strong impact on respondents' intentions to use L3 systems; but does have a small impact on users' trust in these systems.

5.7 What is the influence of drivers' mobility behaviour on the acceptance of L3 cars?

It was found that the intention to use conditionally automated cars was related to intention to use public transport and active travel less once the conditionally automated cars are available. This suggests that automated driving is attractive to the users to the extent that they are willing to change their daily travel behaviour. Note that this might also change in case automated mobility (e.g., shuttles, robot taxis) as an additional offer, increasing the number of mobility options and public transport comfort (e.g., more supply, less waiting time). However, it is important to note that benefits of automated driving to an individual traveller may have led into challenges at the systems level. If a large number of travellers choose cars over public transport, for example, traffic congestion may become worse. Ironically, the gains of automated driving such as more time to engage in other activities than driving can be decreased by increased travel times. At the system level, transport policy measures are needed to make sure that the benefits of the automated cars are not lost. Understanding who are willing to use conditionally automated cars and why can inform policy makers in their efforts to create a sustainable transportation system.

To conclude: Based on the survey, conditionally automated driving may influence to switch more from public transportation to automated vehicles. Note that this assumption holds for a situation in which the supply of public transport options is constant.

We also investigated how the acceptance of conditionally automated cars differed between countries. It was found that respondents from non-European, lower-GDP countries (except for Japan) were more accepting of conditionally automated cars than respondents from European, higher-GDP countries (e.g., Sweden, Germany, and Finland). Russia, Japan, Hungary, and Spain had the highest proportion of Neutrals, Brazil, Indonesia, and India the lowest. This corresponds with the study of Schoettle and Sivak (2014), which has shown that respondents from China and Japan had the most positive attitudes towards automated cars with more than half of their study respondents from Japan being neutral towards automated cars. In Ansys's (2019) Global Autonomous Vehicle Report, respondents from India were most comfortable with riding in an automated car today, while respondents from China, U.K., and Japan were the least comfortable. In Nordhoff et al. (2018) respondents from lower GDP-countries were more accepting of driverless automated shuttles than respondents from higher-GDP countries.

A plausible explanation for a higher acceptance of conditionally automated cars among respondents from non-European, lower-GDP countries may reflect the dissatisfaction with transport solutions in these countries and the expectation that automated cars will lead to a substantial improvement in personal mobility (KPMG, 2019; Nordhoff et al., 2018). A second plausible explanation is that these respondents may be more comfortable with and enthusiastic about new technologies (see Nordhoff et al., 2018), probably because they are less concerned or simply less aware of so-called "higher-order needs" (Maslow, 1954) (e.g., cybersecurity, liability and privacy), which some see threatened by the introduction of automated cars. Furthermore, the countries which represent the "classical automobile nations" (i.e., Germany, Italy, France, Sweden) had the lowest proportion of Enthusiasts and the highest proportion of Sceptics. A plausible explanation may be rooted in the expected loss of driving enjoyment due to more automation and connectivity in passenger cars. Alternatively, these respondents may have a higher awareness of the limitations of conditionally automated cars. We recommend future research to investigate the reasons for the differences in the acceptance of conditionally automated cars between countries.

These results may suggest that the development and deployment strategies for conditionally automated cars may need to be tailored to different markets to ensure uptake and safe use. For example, in markets where intention to use conditionally automated cars is low (countries with high GDP and low road casualty rate), more emphasis should be placed on communicating the safety benefits of the technology, especially to older cohorts. On the other hand, in markets where intention to use conditionally automated car is high (countries with low GDP and high road casualty rate), it may be necessary to make using and / or owning conditionally automated cars affordable, thus preventing cost to be the barrier to adoption (e.g., government-funded grants, vis-à-vis electric vehicles). Finally, given the enthusiastic view of conditionally automated car in these countries, it may be prudent to communicate the realities of the limitations of the technologies to avoid potential misuse due to inflated expectations, especially amongst younger cohorts.

To conclude the above: Classical European automotive and higher GDP countries had the lowest proportion of Enthusiasts for conditionally automated driving. Respondents from non-European, lower-GDP countries were more accepting of conditionally automated cars than others.

5.8 Dialogue with decision-makers

The recommendations derived from the survey to start the dialogue with private and public decision-makers will be released in the form of a slide set that summarises the key results for key decision makers. The built-up of the slides is consistent across topics in order to increase readability. First, the topic is introduced by an introductory slide. Next, the key results of a topic are presented by a bar diagram for the whole sample (left) and then showing the cross-national differences. After presenting the main results, the results will be interpreted. Finally, implications for decision-makers will be derived in order to inform the decisions by key stakeholders.

Furthermore, a second slide set consists of country dashboards that provide a visual representation of the results of the L3Pilot Global User Acceptance Survey. The “Country Dashboards” present key variables that pertain to the profile of respondents (top) and key factors that were considered pivotal for the acceptance and use of conditionally automated cars (bottom).

The top of the country dashboard presents key variables related to socio-demographic profile and travel behaviour of the respondents (i.e., age, gender, income, car usage, experience with ADAS). This was done to give readers and listeners an idea of the profile of respondents surveyed in the L3Pilot Global User Acceptance Survey. Furthermore, the favourite activities in conditionally automated cars are shown as the engagement in secondary, eyes-off road activities is considered one of the main benefits of automated cars.

The bottom of the Dashboards presents the key factors that were considered pivotal for the acceptance and use of conditionally automated cars. These include the expected benefits of conditionally automated cars (i.e., productive use of travel time, travel comfort, number of accidents, and traffic congestion), the proportion of Enthusiasts, Neutrals, and Sceptics in these countries, as well as respondents’ intention to use and buy conditionally automated cars.

The slide sets will be available after the final events in October on the L3Pilot websites so that it can be downloaded by the public.

5.9 Limitations and implications for future research

A number of recommendations for future research can be derived based on the lessons learned gained in the present survey.

First, as conditionally automated cars do not yet exist in the market, our respondents have not physically experienced them but were asked to imagine the use of such cars, depending on their representation about what these cars are. This makes it difficult for them to accurately envision their interaction with these cars. Thus, it is possible that our respondents had overly positive attitudes towards automated cars. Furthermore, it is likely that respondents gave socially desirable responses due to the novelty, hype around automated cars, and influence of the media in marketing automated cars. In sum, these factors may have contributed to biases in their responses. To increase the internal validity of our study findings, respondents who replied to all knowledge questions on conditionally automated cars with ‘I don’t know’ were omitted from the analysis, ensuring that all respondents had sufficient understanding of the functionalities of conditionally automated cars. Nevertheless, respondents may overestimate the capabilities of these cars. The limitation of this study that pertains to asking respondents to imagine rather than directly exposing respondents to conditionally automated cars has been addressed by work conducted in L3Pilot, exposing over 800 individuals to conditionally automated cars. A comparison of the attitudes of experienced versus less experienced individuals (see L3Pilot Deliverable D7.3 by Weber & Hiller (2021)) will allow a deeper understanding of how much overlap there is between expectations and experiences with L3 cars.

Second, the technology acceptance constructs were measured in very generic terms. This leaves ample room for respondents to attach different meaning to them. It should also be assessed whether the questions pertaining to the UTAUT2 constructs have the same meaning across countries. We therefore recommend performing qualitative research (e.g., interviews, focus groups) with respondents from different countries to explore respondents’ associations with the UTAUT2 constructs.

Third, the samples recruited in the three different data collection waves are representative of the online population of their respective countries in terms of age, gender, and income. Due to limited internet access, it was difficult to find a representative sample of the general (also offline) population in some countries (e.g., Brazil, China, India, Indonesia). This makes direct overall country-wise comparison problematic. Furthermore, people with relatively newer cars were recruited. We recommend future research to recruit representative samples of the general population of car drivers.

5.10 Recommendations for practitioners

The following recommendations can be derived for practitioners.

First, to make the general public familiar with these cars, it is important to create more opportunities to come in touch with L3 and higher levels of automation on an everyday basis when the technology is ready enough for such activities, e.g., through living labs or as test drivers / customers. In the context of these campaigns, the public can be exposed to conditionally automated cars and their safe and reliable operation but also encounter their limitations.

Second, communication strategies should be more experience-oriented. Furthermore, communication and marketing campaigns should create a realistic image of the capabilities and limitations of conditionally automated cars, educating the public about conditionally automated cars. Therefore, user education programs should be harmonized to educate the general public but also politicians and legislators about the potentials and limitations of different automation levels. As part of these education and communication programs, the complex SAEJ3016 taxonomy, which is the leading automation taxonomy to data, should be translated into a simpler taxonomy with easy-to-read and understand guidelines for users.

Third, the lack of matured, close to development prototypes should be overcome, and extensive demonstrations boosted in order to showcase the benefits of automated cars. We recommend to conduct more user research once the technology is mature enough to allow ordinary drivers testing the technology in daily life. This is necessary to confirm the findings from survey research with respondents without physical experience of ADFs with data from actual use. These deployment strategies could help to gain the trust of people being neutral and sceptical towards the use of conditionally automated cars.

Fourth, the role of car dealers / suppliers / manufacturers for selling automated cars should be carefully re-considered. It could be effective to promote automated driving more effectively via car dealers who could be better trained about system capabilities and limitations, e.g., by offering consumers the possibility to test conditionally automated driving functions in the context of test rides or on a longer-term basis (e.g., monthly subscription). Mandatory information about the conditions of use of the systems – How does the system work? What is the role of human drivers (in terms of supervision and intervention)? And what are system limitations? – should be provided in case of purchase / rent. The information offered by car dealers during the purchase process should meet minimum harmonization requirements (Tsapi et al., 2020). Furthermore, it could also be considered to digitalize the purchase of a car in order to reach a large audience more conveniently, which is especially relevant against the background of the current pandemic situation.

Fifth, given that social influence played a major role in influencing the acceptance and use of conditionally automated cars, social networks (both online and offline) could play a more important role in promoting the benefits of conditionally automated cars as friends, family, and colleagues represent an important and trusted source of information. Marketing could establish a “bring a friend/relative campaign” or focus on recommendations by friends/relatives in order to leverage the potential of trustful social relationships.

Sixth, in order to encourage engagement in eyes-off road activities, a comfortable driving experience should be provided focusing on the design of smooth, efficient, and clear driver-vehicle interactions. These driving strategies should focus on overcoming potential discomfort (e.g., urge to take over control from the automated car) and reducing motion sickness Furthermore, it is recommended to design the vehicle interior around new opportunities and requirements for the driver.

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List of abbreviations and acronyms

Abbreviation / term	Meaning
ADAS	Advanced driver assistance system
ADF	Automated driving function
AV	Automated vehicle
AEB	Autonomous emergency braking
CAC	Connected automated car
DE	Germany
FIN	Finland
FOT	Field Operational Test
FR	France
GDP	Gross domestic product
ITA	Italy
HMI	Human-Machine Interface
HUN	Hungary
L0 – L5	SAE Level 0 - SAE Level 5
M	Mean
ODD	Operational Design Domain
OEM	Original Equipment Manufacturer
RQ	Research question
SAE	Society of Automotive Engineers
SD	Standard deviation
SP	Sub project
SWE	Sweden
T&T	Technical and traffic assessment
Q	Question
U&A	User and acceptance evaluation
U.K. / UK	United Kingdom
U.S. / US	United States
UTAUT	Unified Theory of Acceptance and Use of Technology
WP	Work Package
WTP	Willingness to pay

ANNEX 1: Questionnaires

Questionnaire: First phase

Below is shown the UK version of the questionnaire translated in English. Income and location related questions were adapted to each country.

1. How old are you?

2. What is your gender?

a. Male
b. Female
c. Other

3. Which of the following groups represents the monthly net income of your household (the income of all the members of your household together, after deduction of taxes, social contributions, etc.)?

a. less than 700 £

b. 700 £ to less than 1,000 £

c. 1,000 £ to less than 1,500 £

d. 1,500 £ to less than 2,500 £

e. 2,500 £ to less than 3,500 £

f. 3,500 £ and more

4. How often do you use the following transport modes?

	(almost) daily	4-5 days per week	1-3 days per week	1-3 days per month	less than once per month	(almost) never	I prefer not to respond
Walking for more than 500 meters/0.3 miles per trip	○	○	○	○	○	○	○
Private personal bike (including electric bikes)	○	○	○	○	○	○	○
Rental bike or bike-sharing (including electric bikes)	○	○	○	○	○	○	○
Motorcycle as a driver (all motorcycles, including (electric)	○	○	○	○	○	○	○

	(almost) daily	4-5 days per week	1-3 days per week	1-3 days per month	less than once per month	(almost) never	I prefer not to respond
scooter-sharing and rental motorcycles)							
Private car as driver (without car-sharing and rental cars)	○	○	○	○	○	○	○
Car as driver (only car-sharing and rental cars)	○	○	○	○	○	○	○
Car as passenger (all cars, including taxis and carpools)	○	○	○	○	○	○	○
Public transport for trips of less than 50 km per direction/30 miles (regional trains, subways, trams, busses, ferries)	○	○	○	○	○	○	○
Public transport for trips of more than 50 km/30 miles per direction	○	○	○	○	○	○	○
Airplane	○	○	○	○	○	○	○

5. **What mode of transport do you typically use for the following trip types? Choose 1-3 often used modes: 1 for the one most used, 2 for the second most used (if applicable), 3 for the third most used (if applicable). Exclude trips made by airplane.**

	Passenger car	Public transport	Taxi	Motorbike or scooter	Bicycle or walking	I don't take such trips
Commuting						
Business travel						
Leisure/social						
Errands (incl. groceries)						

Have you ever heard of automated cars?

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 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.

The questionnaire is executed as part of the research project L3Pilot (https://l3pilot.eu).
If you would like to receive more information on the project, please visit the website.

We encourage you to become a part of the project and participate in this online questionnaire. It will take around 20 minutes and your responses will be treated anonymously.

Thank you very much for your participation.

The first questions are about the information you just had the opportunity to read in the introduction.

6. A conditionally automated car can stay in the lane on its own. Is this correct?

a. Yes
b. No
c. I don't know

7. A conditionally automated car can overtake on its own. Is this correct?

a. Yes
b. No
c. I don't know

8. A conditionally automated car can operate in all conditions.

a. Yes
b. No
c. I don't know

9. A conditionally automated car can ask me to take over control anytime. Is this correct?

a. Yes
b. No
c. I don't know

10. **I as a driver of a conditionally automated car can pursue other activities. I am not allowed to sleep in the car. Is this correct?**

a. Yes
b. No
c. I don't know

11. **Have you ever heard of automated cars before taking part in the present questionnaire survey?**

a. Yes —> *Filter question: If yes, move to Q12*
b. No —> *Filter question: If no, move to Q13.*

12. **How often do you get information on automated cars from the following sources?**

	Daily	**Weekly**	**Monthly**	**Less than monthly**	**Never**
Online communities (e.g., blogs, forums), websites about IT, cars or motoring	○	○	○	○	○
Social media (e.g. Facebook, Instagram, Twitter, YouTube)	○	○	○	○	○
Radio, TV	○	○	○	○	○
Friends, family members, colleagues	○	○	○	○	○
Car dealers, car manufacturers, suppliers	○	○	○	○	○
Newspapers, magazines (not online)	○	○	○	○	○

Please indicate to what extent you agree with the following statements, which relate to the usage of new technologies.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**I prefer not to respond**

13. **Other people come to me for advice on new technologies.**

14. **In general, I am among the first in my circle of friends to acquire new technology when it appears.**

15. **I can usually figure out new high-tech products and services without help from others.**

16. **I keep up with the latest technological developments in my areas of interest.**

While driving in conditionally automated mode, you as driver will be allowed to engage in other activities. Please indicate to what extent you agree with the following statement, which relates to the activities you would like to perform in a conditionally automated car.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond
Please note: If respondents agree or strongly agree, respondents move to Q18.	○	○	○	○	○	○

17. I would use the time during which a conditionally automated car is driving for other activities.

18. Which activities would you like to perform in a conditionally automated car? Please select a maximum of three activities.

Taking care of children	
Talking to my fellow travelers	
Surfing the internet, watching videos or TV shows.	
Playing games (e.g., video or board games)	
Socializing with friends or family (e.g., write messages, make phone calls, use social media).	
Eating and drinking	
Observing the landscape	
Relaxing and resting	
Reading a book	

A conditionally automated car may collect some information about the way you drive. The car can also observe your behavior. For example, cameras inside the car interior can be used to detect your drowsiness by observing your eye movements (e.g., eyelid closure and blinking behaviour), face muscle activity, or head movements. Please indicate to what extent you agree with the following statements, which relate to privacy-related topics and conditionally automated cars.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

19. I would feel comfortable with a conditionally automated car collecting information about the way I drive to ensure I can manage a safe take-over.

20. I would feel comfortable with a conditionally automated car using information about the way I drive for other purposes (following my authorization). This may include information used by insurance companies to create an individual risk profile.

21. I would feel comfortable with a conditionally automated car monitoring my eye behaviour to issue warnings in case I become drowsy.

Now, we kindly ask you to give your opinion on conditionally automated cars. Please indicate to what extent you agree with the following statements.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

22. I expect that a conditionally automated car would be useful in meeting my daily mobility needs.
23. Using a conditionally automated car would help me reach my destination more safely.
24. I expect that a conditionally automated car would be easy to use.
25. Using a conditionally automated car would help me reach my destination more comfortably.
26. It would be easy for me to become skillful at using a conditionally automated car.
27. Using a conditionally automated car would be fun.
28. I assume that people whose opinions I value would prefer that I use a conditionally automated car.
29. Using a conditionally automated car would be entertaining.
30. I intend to use a conditionally automated car in the future.
31. Using a conditionally automated car would be enjoyable.
32. Assuming that I had access to a conditionally automated car, I predict that I would use it.
33. I could acquire the necessary knowledge to use a conditionally automated car.

34. **I plan to use a conditionally automated car in adverse weather conditions such as during heavy rain or fog, and in darkness.**
35. **I would expect the use of a conditionally automated car to be compatible with other digital devices I use.**
36. **I would use a conditionally automated car during my everyday trips.**
37. **I would expect to have the necessary knowledge to use a conditionally automated car.**
38. **I expect that people who influence my behaviour think that I should use a conditionally automated car.**
39. **I would be able to get help from others when I have difficulties using a conditionally automated car.**
40. **I expect that people who are important to me think that I should use a conditionally automated car.**
41. **I would recommend a conditionally automated car to others.**
42. **I assume that a conditionally automated car would be useful in my daily life.**
43. **I plan to buy a conditionally automated car once it is available.**

As you may recall from the introduction, a conditionally automated car can drive on its own under limited conditions such as on motorways, congested motorways, urban roads, and in parking situations.

Please indicate your intention to use and willingness to pay for driving in automated mode in one of these conditions.

On congested motorways: On congested motorways, a conditionally automated car takes over the driving in a traffic jam up to 60 km/h, identifies slower vehicles in front and changes the lane to overtake slower vehicles or to exit the motorway.

Please indicate to what extent you agree with the following statement.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

44. **I plan to use a conditionally automated car on congested motorways once it becomes available.**

Filter question -> If respondents agree, then they are moved to Q45.

45. **How much would you be willing to pay for being able to drive in automated mode on congested motorways?**

UK	0 £	less than 1,300 £	1,300-1,699 £	1,700-2,099 £	2,100-2,599 £	2,600-2,999 £	3,000-3,499 £	equal or over 3,500 £
€-countries	0	less than 1500€	1500-1999€	2000-2499€	2500-2999€	3000-3499€	3500-3999€	equal or over 4000€

Please indicate to what extent you agree with the following statements, which relate to your expectations if you were using a conditionally automated car on congested motorways.	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*	*I prefer not to respond*

46. **I would feel comfortable giving control to a conditionally automated car.**

47. **I would feel relaxed during the ride in a conditionally automated car.**

48. **I think I would monitor the car's performance the whole time to be sure I can safely take over control from the car when needed.**

49. **I would expect that a conditionally automated car acts appropriately in all situations.**

50. **I would feel safe using a conditionally automated car.**

51. **I would expect that a conditionally automated car is reliable.**

52. **I would be concerned about the general safety of a conditionally automated car.**

53. **I believe that the actions of a conditionally automated car would be predictable.**

54. **I think I would be more aware of the traffic environment in a conditionally automated car than when I would drive on my own.**

55. **I would be concerned that a failure or malfunctions of a conditionally automated car may cause accidents.**

56. **I would be concerned to take over control from a conditionally automated car after being engaged in activities other than driving (e.g., watching a movie, using social media).**

On urban roads: A conditionally automated car on urban roads follows the lane, accelerates and decelerates and identifies and overtakes other road users, including pedestrians and cyclists. It can also handle crossings and automatically turns right or left.

Please indicate to what extent you agree with the following statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**I prefer not to respond**
If strongly agree or agree, move to Q45. *If all other options, move to Q46.*	○	○	○	○	○	○

44. **I plan to use a conditionally automated car on urban roads once it becomes available.**

45. **How much would be willing to pay for being able to drive in automated mode on urban roads?**

UK	0 £	less than 1,300 £	1,300-2,199 £	2,200-2,999 £	3,000-3,799 £	3,800-4,699 £	4,700-5,599 £	equal or over 5,600 £
€-countries	0	less than 1500€	1500-2499€	2500-3499€	3500-4499€	4500-5499€	5500-6499€	equal or over 6500€

Please indicate to what extent you agree with the following statements, which relate to your expectations if you were using a conditionally automated car on urban roads.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

46. I would feel comfortable giving control to a conditionally automated car.

47. I would feel relaxed during the ride in a conditionally automated car.

48. I think I would monitor the car's performance the whole time to be sure I can safely take over control from the car when needed.

49. I would expect that a conditionally automated car acts appropriately in all situations.

50. I would feel safe using a conditionally automated car.

51. I would expect that a conditionally automated car is reliable.

52. I would be concerned about the general safety of a conditionally automated car.

53. I believe that the actions of a conditionally automated car would be predictable.

54. I think I would be more aware of the traffic environment in a conditionally automated car than when I would drive on my own.

55. I would be concerned that a failure or malfunctions of a conditionally automated car may cause accidents.

56. I would be concerned to take over control from a conditionally automated car after being engaged in activities other than driving (e.g., watching a movie, using social media).

On motorways: A conditionally automated car on motorways stays in the lane, follows the vehicle in front and overtakes slower vehicles at a maximum speed of up to 130 km/h.

Please indicate to what extent you agree with the following statement.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

If strongly agree or agree, move to Q45. *If all other options, move to Q46.*	○	○	○	○	○	○

44. I plan to use a conditionally automated car on motorways once it becomes available.

45. How much would be willing to pay for being able to drive in automated mode on motorways?

UK	0 £	less than 1,300 £	1,300-2,199 £	2,200-2,999 £	3,000-3,799 £	3,800-4,699 £	4,700-5,599 £	equal or over 5,600 £
€-countries	0	less than 1500€	1500-2499€	2500-3499€	3500-4499€	4500-5499€	5500-6499€	Equal or over 6500€

Please indicate to what extent you agree with the following statements, which relate to your expectations if you were using a conditionally automated car on motorways.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I prefer not to respond

46. I would feel comfortable giving control to a conditionally automated car.

47. I would feel relaxed during the ride in a conditionally automated car.

48. I think I would monitor the car's performance the whole time to be sure I can safely take over control from the car when needed.

49. I would expect that a conditionally automated car acts appropriately in all situations.

50. I would feel safe using a conditionally automated car.

51. I would expect that a conditionally automated car is reliable.

52. I would be concerned about the general safety of a conditionally automated car.

53. I believe that the actions of a conditionally automated car would be predictable.

54. I think I would be more aware of the traffic environment in a conditionally automated car than when I would drive on my own.

55. I would be concerned that a failure or malfunctions of a conditionally automated car may cause accidents.

56. I would be concerned to take over control from a conditionally automated car after being engaged in activities other than driving (e.g., watching a movie, using social media).

In parking situations: A conditionally automated car in parking situations overtakes the parking into and out of garages and driveways. The driver can either be inside or outside the vehicle. The parking maneuver does not have to be monitored by the driver.

Please indicate to what extent you agree with the following statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**I prefer not to respond**
If strongly agree or agree, move to Q45. *If all other options, move to Q46.*	○	○	○	○	○	○

44. I plan to use a conditionally automated car in parking situations once it becomes available.

45. How much would you be willing to pay for enabling your car to park in conditionally automated mode?

UK	0 £	less than 430 £	430-699 £	700-899 £	900-1,199 £	1,200-1,499 £	1,500-1,699 £	equal or over 1,700 £
€-countries	0	less than 500€	500-799€	800-1099€	1100-1399€	1400-1699€	1700-1999€	equal or over 2000€

Please indicate to what extent you agree with the following statements, which relate to your expectations if you were using a conditionally automated car in parking situations.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**I prefer not to respond**

46. I would feel comfortable giving control to a conditionally automated car.

47. I would feel relaxed during the ride in a conditionally automated car.

48. I think I would monitor the car's performance the whole time to be sure I can safely take over control from the car when needed.

49. I would expect that a conditionally automated car acts appropriately in all situations.

50. I would feel safe using a conditionally automated car.

51. I would expect that a conditionally automated car is reliable.

52. I would be concerned about the general safety of a conditionally automated car.

53. I believe that the actions of a conditionally automated car would be predictable.

54. I think I would be more aware of the traffic environment in a conditionally automated car than when I would drive on my own.

55. I would be concerned that a failure or malfunctions of a conditionally automated car may cause accidents.

56. I would be concerned to take over control from a conditionally automated car after being engaged in activities other than driving (e.g., watching a movie, using social media).

Please indicate to what extent you agree with the following statements, which relate to the types of trips you could use a conditionally automated car for. **57. I would use a conditionally automated car**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**I don't take such trips**	**I prefer not to respond**
for my daily commute to work/school/university/ training school	○	○	○	○	○	○	○
for business travel	○	○	○	○	○	○	○
to run errands (e.g., going to dentist, or post office, visits to authorities, grocery shopping)	○	○	○	○	○	○	○
for leisure activities (e.g. sport, concert, restaurant, meeting friends)	○	○	○	○	○	○	○
for vacation trips	○	○	○	○	○	○	○

58. How do you think conditionally automated cars will affect your personal mobility?	**Large increase**	**Small increase**	**No change**	**Small decrease**	**Large decrease**	**I prefer not to respond**
Productive use of travel time	○	○	○	○	○	○
Travel comfort	○	○	○	○	○	○
Number of accidents	○	○	○	○	○	○
Traffic congestion	○	○	○	○	○	○

58. How do you think conditionally automated cars will affect your personal mobility?	Large increase	Small increase	No change	Small decrease	Large decrease	I prefer not to respond
Personal (no automated) car use	○	○	○	○	○	○
Public transport use	○	○	○	○	○	○
Use of active travel modes (i.e., walking, cycling)	○	○	○	○	○	○
Overall weekly number of trips	○	○	○	○	○	○
Travel time per trip	○	○	○	○	○	○
Fuel consumption	○	○	○	○	○	○
Number of kilometers	○	○	○	○	○	○

With the last questions, we would like to ask you to provide some information on your mobility behaviour and your previous experience with road vehicle automation.

59. Do you have a valid driving license?

Yes -> Filter question: If yes, move to Q60

No -> Filter question: If no, move to Q66

60. Do you travel in kilometres or miles? Please select one option.

a) Kilometres
b) Miles

61. Approximately how many kilometres/miles did you drive in the last 12 months as a driver?

a	Less than 2,000 km	Less than 1,000 miles
b	2,000-5,000 km	1,000-3,000 miles
c	5,000-10,000 km	3,000-6,000 miles
d	10,000-15,000 km	6,000-9,000 miles
e	15,000-20,000 km	9,000-12,000miles

f	20,000-50,000 km	12,000-30,000miles
g	More than 50,000 km	More than 30,000 miles
h	I prefer not to respond	I prefer not to respond

62. Today's cars offer lots of technical equipment - known as driver assistance systems - intended to support the driver.Please indicate if you have the following driving assistance systems in the car(s) you use, if so, whether you use them.	**I have it and I use it**	**I have it but I don't use it**	**Don't know if I have it**	**I don't have it but I would use it**	**I don't have it and I would not use it**	**I prefer not to respond**
Automated Emergency Braking (AEB; A system that automatically brakes the vehicle when an impending collision is detected.)	○	○	○			○
Forward Collision Warning (FCW; A system that provides warnings for potential collisions with the vehicle in front.)	○	○	○	○	○	○
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).	○	○	○	○	○	○
Drowsy Driver Detection (A system that detects driver drowsiness).	○	○	○	○	○	○
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).	○	○	○	○	○	○
Lane Keeping Assistance (LKA; A system that helps the	○	○	○	○	○	○

driver to avoid inadvertently moving out of a lane).						
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).	○	○	○	○	○	○
Parking Assist (Radar -beeps-) or camera view). The driver is in the car during the parking maneuver.	○	○	○	○	○	○
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 maneuver.) The driver is in the car during the parking maneuver.	○	○	○	○	○	○

63. How often do you purchase or change your car?

Every year	2-5 years	6-10 years	> 10 years	Not sure, no clear habits	Not relevant to me	I prefer not to respond
○	○	○	○	○	○	○

64. What will your next car be?

Company purchased car	Own car, leased *->Move to Q65*	Own car, financed or directly paid *->Move to Q63*	Car sharing car	I don't know yet	I prefer not to respond
○	○	○	○	○	○

65. How much would you be willing to pay for your next car (By this we mean the costs of a manual, driver-controlled car that cannot drive in automated mode)?

UK	less than 13.000 £	13.000£-16.999 £	17.000£-21.999£	22.000 £-25.999£	26.000 £-29.999 £	30.000 £-34.999£	35.000 £-38.999 £	equal or over 39.000£
	○	○	○	○	○	○	○	○
€ countries	less than 15.000€	15.000-19.999€	20.000-24.999€	25.000-29.999€	30.000-34.999€	35.000-39.999€	40.000€-44.999 €	equal or over 45.000€
	○	○	○	○	○	○	○	○

66. What is the highest educational level you have completed or you are about to complete?

- o university degree
- o trade/technical/vocational training
- o none of those

67. What is your employment status?

a. Employed full-time
b. Employed part-time
c. Self-employed
d. Homemaker
e. Unemployed
f. Student
g. Retired

68. How many children under 19 years old live in your household?

a) None
b) 1
c) 2
d) 3
e) 4
f) more than 4
g) I prefer not to respond

69. Please indicate where your main residence is located.

a. East of England
b. London
c. Midlands
d. North East Yorkshire & the Humber
e. North West
f. Northern Ireland
g. Scotland
h. South East
i. South West
j. Wales

Questionnaire: Second phase

With this questionnaire, we would like to get your opinion **on conditionally automated cars.** Conditionally automated cars can drive on **motorways, congested motorways, in urban traffic, and parking situations.** 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 except for sleeping. However, the car might ask you to resume control at any time, in which case you will have to stop what you are doing and resume control of the driving task.

The questionnaire is executed as part of the research project L3Pilot (https://l3pilot.eu/).

It will take around 20 minutes and your responses will be treated anonymously.

Thank you very much for your participation.

Section A: Personal information (Q1 – Q5)

1. How old are you?

2. What is your gender?

   a. Male
   b. Female
   c. Other
   d. Prefer not to answer

3. Which of the following groups/categories represents the monthly net income of your household (the income of all the members of your household together, after deduction of taxes, social contributions, etc.)?

   a. less than 700 £
   b. £700 to less than £1,000 -
   c. £1,000 £ to less than £1,500
   d. £1,500 £ to less than £2,500
   e. £2,500 £ to less than £3,500
   f. £3,500 £ and more
   g. Prefer not to answer

4. What is the highest educational level you have completed or you are about to complete?
   - University degree
   - Trade/technical/vocational training
   - None of those

5. How many children under 19 years old live in your household?
   a. None
   b. 1
   c. 2
   d. 3
   e. 4
   f. More than 4

Section B: Personality and driving profile (Q6-Q20)

6. Do you have a valid driving license?

a. ☐Yes (please, move to Q5, please)

b. ☐No (move to end of questionnaire)

7. Approximately how many kilometres/miles did you drive in the last 12 months?		
	In kilometers	In miles
a	Less than 2,000 km	Less than 1,000 miles
b	2,000-5,000 km	1,000-3,000 miles
c	5,000-10,000 km	3,000-6,000 miles
d	10,000-15,000 km	6,000-9,000 miles
e	15,000-20,000 km	9,000-12,000 miles
f	20,000-50,000 km	12,000-30,000 miles
g	More than 50,000 km	More than 30,000 miles

Here are a number of characteristics that may or may not apply to you. Please indicate your level of agreement with the following statements.

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly agree (5)**

8. I see myself as someone who is reserved	○	○	○	○	○
9. I see myself as someone who is generally trusting	○	○	○	○	○
10. I see myself as someone who tends to be lazy	○	○	○	○	○
11. I see myself as someone who is relaxed, and handles stress well	○	○	○	○	○
12. I see myself as someone who has few artistic interests	○	○	○	○	○
13. I see myself as someone who is outgoing, sociable	○	○	○	○	○
14. I see myself as someone who tends to find fault with others	○	○	○	○	○
15. I see myself as someone who does a thorough job	○	○	○	○	○
16. I see myself as someone who gets nervous easily	○	○	○	○	○
17. I see myself as someone who has an active imagination	○	○	○	○	○

Please indicate your level of agreement with the following statements.

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly agree (5)**

18. I love driving					
19. I like to drive just for the fun					
20. I feel free and independent if I drive					

Section C: Awareness of automated vehicles (Q21-Q22)

21. Have you ever heard of automated vehicles or driverless cars?

c. ☐Yes (please, move to Q22, please)

☐No (move to Q23, please)

	Never	Rarely	Occasionally	Often
22. If yes, how often do you read / watch / listen to information about automated vehicles?	○	○	○	○

Section D: Attitudes towards conditionally automated cars (Q23-Q60).

Now please indicate your level of agreement with the following items. https://l3pilot.eu/

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
23. I would be suspicious of conditionally automated cars	○	○	○	○	○
24. I would trust conditionally automated cars	○	○	○	○	○
25. I would engage in other tasks while the conditionally	○	○	○	○	○

automated car is in control					
26. I would feel hesitant about using a conditionally automated car	○	○	○	○	○
27. I plan to use a conditionally automated car once it becomes available	○	○	○	○	○

When driving in automated mode, you can engage in other activities. The car may ask you to take back control if needed. How often would you engage in the following activities while the system is active?

1.	**Always**	**Very often**	**Sometimes**	**Rarely**	**Never**	**Not relevant to me**
28. Spending time with my fellow passengers (e.g., talking, playing games)	○	○	○	○	○	○
29. Entertaining/taking care of children	○	○	○	○	○	○
30. Messaging/calling friends or family	○	○	○	○	○	○
31. Listening to	○	○	○	○	○	○

music, radio or audiobooks						
32. Using digital media (e.g., browsing, watching videos, playing games)	○	○	○	○	○	○
33. Reading a book or magazine	○	○	○	○	○	○
34. Eating or drinking	○	○	○	○	○	○
35. Monitoring how the car is functioning	○	○	○	○	○	○
36. Observing the landscape or road ahead	○	○	○	○	○	○
37. Relaxing and/or resting	○	○	○	○	○	○

38. Working (e.g., phone calls, meetings, emails)	○	○	○	○	○	○

Now please rate the level of agreement with the following aspects pertaining to the use of a conditionally automated car.

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
39. Using a conditionally automated car would help me reach my destination more safely	○	○	○	○	○
40. Using a conditionally automated car would help me reach my destination more comfortably	○	○	○	○	○
41. The cost of the conditionally automated car would be the most important thing I would consider before purchasing one	○	○	○	○	○
42. The benefits of using a conditionally automated car would be the most important thing I would consider before purchasing one	○	○	○	○	○
43. Using a conditionally automated car would help me to reach my destination faster	○	○	○	○	○

44. I would accept that I might have to take over control from the conditionally automated car after having my eyes off the road for a prolonged period of time.	○	○	○	○	○
45. I would not want to monitor what the conditionally automated car is doing when it is in control	○	○	○	○	○
46. I would not want to stop the other activity I am doing to respond to requests from the car to take over control	○	○	○	○	○
47. I would want to remain engaged in the driving task, e.g., periodically touch the steering wheel, to be able to respond to requests from the car to take over control	○	○	○	○	○
48. I would want that the conditionally automated car "sees" me and monitors my behaviour to make sure that I am able to respond to requests from the car to take over control	○	○	○	○	○
49. I assume that people whose opinions I value would prefer that I use a conditionally automated car	○	○	○	○	○
50. Using a conditionally automated car would give me status and prestige among people important to me	○	○	○	○	○
51. It would make me proud to own a conditionally automated car	○	○	○	○	○

52. Using a conditionally automated car would be enjoyable	○	○	○	○	○
53. I find it important that the conditionally automated car has a sleek and cool design	○	○	○	○	○
54. The brand of the conditionally automated car would be the most important thing I would consider before purchasing one	○	○	○	○	○
55. I could acquire the necessary knowledge to use a conditionally automated car	○	○	○	○	○
56. I would be able to get help from my friends and/or family when I have difficulties using a conditionally automated car	○	○	○	○	○
57. I would not be able to get help from car dealers when I have difficulties using a conditionally automated car	○	○	○	○	○
58. I would be able to read the driver manual when I have difficulties using a conditionally automated car	○	○	○	○	○

Now, we would like to know whether you are planning to use conditionally automated cars once they are on the market.

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
59. I intend to use a conditionally automated car in the future	○	○	○	○	○

60. The next car I buy will be a conditionally automated car, if it is available	○	○	○	○	○

Section E: Attitudes towards using different conditionally automated car systems (Q61-Q80).

STREAM 1:
The next section will provide a list of statements about the different Conditionally Automated Cars systems. You are asked to read each of these statements and to answer some questions on whether you would use each of the systems.

System A: The Motorway System can be activated by the driver on free-flowing motorways **up to 130 km/h**. When it is on, the car will do **all of the steering, accelerating and braking,** and you will not be required to monitor the road ahead. It will **maintain a safe distance** to the vehicle in front, **changing lane** to overtake traffic if required. To what extent do you agree or disagree with the following statements?

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
61. I would be suspicious of the motorway system	○	○	○	○	○
62. I would trust the motorway system	○	○	○	○	○
63. I would engage in other tasks while the motorway system is turned on	○	○	○	○	○
64. I would feel hesitant about using the motorway system	○	○	○	○	○
65. I plan to use a motorway system once it becomes available	○	○	○	○	○

System B: The Traffic jam system is designed to deal with slow or stationary traffic in motorway environments, up to a speed of 60 km/h. It can be activated by the driver on the approach to a traffic build-up on open roads. The car will do all of the steering, accelerating and braking for as long as the traffic jam persists, and you will not be required to monitor the road ahead. To what extent do you agree or disagree with the following statements?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
66. I would be suspicious of the traffic jam system	○	○	○	○	○
67. I would trust the traffic jam system	○	○	○	○	○
68. I would engage in other tasks while the traffic jam system is turned on	○	○	○	○	○
69. I would feel hesitant about using the traffic jam system	○	○	○	○	○
70. I plan to use a traffic jam system once it becomes available	○	○	○	○	○

System C: The Urban System can be activated on urban roads up to a speed of 50 km/h. When the system is activated, the car will do all of the steering, accelerating and braking, and you will not be required to monitor the road ahead. It can drive in signalized and unsignalized intersections, along with simple roundabouts. To what extent do you agree or disagree with the following statements?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
71. I would be suspicious of the urban system	○	○	○	○	○
72. I would trust the urban system	○	○	○	○	○
73. I would engage in other tasks while the urban system is on	○	○	○	○	○

74. I would feel hesitant about using the urban system	○	○	○	○	○
75. I plan to use an urban system once it becomes available	○	○	○	○	○

System D: The **Parking System** can be activated to complete **parallel and perpendicular parking** manoeuvres for parking into and out of a parking space, **both on-street and in parking lots.** The system can detect non-motorized road users including pedestrians and cyclists.

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
76. I would be suspicious of the parking system	○	○	○	○	○
77. I would trust the parking system	○	○	○	○	○
78. I would engage in other tasks while the parking system is on	○	○	○	○	○
79. I would feel hesitant about using the parking system	○	○	○	○	○
80. I plan to use a parking system once it becomes available	○	○	○	○	○

Section F: Attitudes towards driving & experience with driver assistance systems (Q81-Q91)

With the last questions, we would like to ask you to provide some information on your previous experience with road vehicle automation.

Please indicate on a five-point scale (1 = strongly disagree; 5 = strongly agree) to what extent you agree with the following statements.					
	Strongly	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**

	disagree (1)				
81. My own risky driving behavior could cause an accident.	○	○	○	○	○
82. The high speed I drive at can be the cause of a car accident.	○	○	○	○	○
83. My lack of driving skills could produce an accident.	○	○	○	○	○
84. The risky overtaking maneuvers that I initiate may lead to accidents.	○	○	○	○	○
85. Traffic accidents can result from my own driving errors.	○	○	○	○	○

Have you ever experienced the following systems in any car you have travelled in?	Yes	No
86. Lane Keeping Assistance (LKA) helps the driver to avoid inadvertently moving out of the lane by controlling the steering	○	○
87. Adaptive Cruise Control (ACC) maintains speed, but automatically slows down or speeds up to keep a pre-selected distance from a car ahead	○	○
88. Self-parking Assist System controls the car 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 maneuver. The driver is in the car during the parking maneuver	○	○

How often do you activate the following systems in your car.	**Not applicable***	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**
89. Lane Keeping Assistance (LKA) helps the driver to avoid inadvertently moving out of the lane by controlling the steering	○	○	○	○	○	○

90. Adaptive Cruise Control (ACC) maintains speed, but automatically slows down or speeds up to keep a pre-selected distance from a car ahead	○	○	○	○	○	○
91. Self-parking Assist System controls the car 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 maneuver. The driver is in the car during the parking maneuver	○	○	○	○	○	○

* **to me because I don't have it**

STREAM 2:
The next section will provide a list of statements about the different Conditionally Automated Cars systems. You are asked to read each of these statements and to answer some questions on whether you would use each of the systems.

System A: The Motorway System can be activated by the driver on free-flowing motorways **up to 130 km/h**. When it is on, the car will do **all of the steering, accelerating and braking**, and you will not be required to monitor the road ahead. It will **maintain a safe distance** to the vehicle in front, **changing lane** to overtake traffic if required.

The car requires visible lanes and road markings, so may ask the driver to re-take control if, for example, there are roadworks where lane markings have been removed, or a situation where there is poor weather conditions, including heavy rain, snow, or surface water. The driver will also be asked to re-take control when the vehicle is leaving the motorway. To what extent do you agree or disagree with following statements?

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
1. I would be suspicious of					

the motorway system					
2. I would trust the motorway system					
3. I would engage in other tasks while the motorway system is turned on					
4. I would feel hesitant about using the motorway chauffeur system					
5. I plan to use a motorway chauffeur system once it becomes available					

System B: The Traffic jam system is designed to deal with slow or stationary traffic in motorway environments, up to a speed of 60 km/h. It can be activated by the driver on the approach to a traffic build-up on open roads. The car will do all of the steering, accelerating and braking for as long as the traffic jam persists, and you will not be required to monitor the road ahead.

The car **requires visible lanes and road markings** so may ask the driver to re-take control if, for example, there are roadworks where lane markings have been removed, or a situation where there is **poor weather conditions, including heavy rain, snow, or surface water**. The driver will also be asked to re-take control when the vehicle is **leaving the motorway,** and if there is no longer a **vehicle in the lane ahead**.

To what extent do you agree or disagree with following statements?

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**

6. I would be suspicious of the traffic jam system	○	○	○	○	○
7. I would trust the traffic jam system	○	○	○	○	○
8. I would engage in other tasks while the traffic jam system is turned on	○	○	○	○	○
9. I would feel hesitant about using a traffic jam system	○	○	○	○	○
10. I plan to use a traffic jam system once it becomes available	○	○	○	○	○

System C: The Urban System can be activated on urban roads up to a speed of 50 km/h. When the system is activated, the car will do all of the steering, accelerating and braking, and you will not be required to monitor the road ahead. It can drive in signalized and unsignalized intersections, along with simple roundabouts.

The car **requires visible lane and road markings, along with markings of street parking and cycle lanes,** so may ask the driver to re-take control if these are not present. Drivers will also be asked to take control in **poor weather such as rain or snow, or situations where there is surface water.** Finally, the driver will also be asked to re-take control **to deal with complex roundabouts, junctions, or railway / tram crossings**.

To what extent do you agree or disagree with following statements?

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**

11. I would be suspicious of the urban system	○	○	○	○	○
12. I would trust the urban system	○	○	○	○	○
13. I would engage in other tasks while the urban system is on.	○	○	○	○	○
14. I would feel hesitant about using an urban system	○	○	○	○	○
15. I plan to use an urban system once it becomes available	○	○	○	○	○

System D: The **Parking System** can be activated to complete **parallel and perpendicular parking** manoeuvres for parking into and out of a parking space, **both on-street and in parking lots.** The system can detect non-motorized road users including pedestrians and cyclists. The car **requires visible markings or parked cars to indicate the parking space,** and the driver **must monitor** the parking manoeuvre. To what extent do you agree or disagree with following statements?

	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
16. I would be suspicious of the parking system	○	○	○	○	○
17. I would trust the parking system	○	○	○	○	○

18. I would engage in other tasks while the parking system is on	○	○	○	○	○
19. I would feel hesitant about using a parking system	○	○	○	○	○
20. I plan to use a parking chauffeur system once it becomes available	○	○	○	○	○

With the last questions, we would like to ask you to provide some information on your previous experience with road vehicle automation.

Please indicate on a five-point scale (1 = strongly disagree; 5 = strongly agree) to what extent you agree with the following statements.					
	Strongly disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
92. My own risky driving behavior could cause an accident.	○	○	○	○	○
93. The high speed I drive at can be the cause of a car accident.	○	○	○	○	○
94. My lack of driving skills could produce an accident.	○	○	○	○	○
95. The risky overtaking maneuvers that I initiate may lead to accidents.	○	○	○	○	○
96. Traffic accidents can result from my own driving errors.	○	○	○	○	○

70. Have you ever experienced the following systems in any car you have travelled in?

	Yes	No

Lane Keeping Assistance (LKA) helps the driver to avoid inadvertently moving out of the lane by controlling the steering	○	○
Adaptive Cruise Control (ACC) maintains speed, but automatically slows down or speeds up to keep a pre-selected distance from a car ahead	○	○
Self-parking Assist System controls the car 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 maneuver. The driver is in the car during the parking maneuver	○	○

71. How often do you activate the following systems in your car.	**Not applicable to me because I don't have it**	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**
Lane Keeping Assistance (LKA) helps the driver to avoid inadvertently moving out of the lane by controlling the steering	○	○	○	○	○	○
Adaptive Cruise Control (ACC) maintains speed, but automatically slows down or speeds up to keep a pre-selected distance from a car ahead	○	○	○	○	○	○
Self-parking Assist System controls the car 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 maneuver. The driver is in the car during the parking maneuver	○	○	○	○	○	○

ANNEX 2: Scientific publications

This annex gives readers a more detailed overview of the scientific publications, mentioning the title of the publication, abstract / description, and status / reference.

Using the UTAUT2 model to explain public acceptance of conditionally (L3) automated cars: A questionnaire study among 9,118 car drivers from eight European countries

Research questions

- What is the influence of performance expectancy (perceived usefulness), effort expectancy (perceived ease of use), social influence, facilitating conditions and hedonic motivation on the intention to use L3 cars?
- What are the interrelationships between these factors?
- How are the relationships between performance expectancy (perceived usefulness), effort expectancy (perceived ease of use), social influence, facilitating conditions, hedonic motivation and the intention to use L3 cars moderated by age, gender and experience with advanced driver assistance systems?

Abstract / description

We investigated public acceptance of conditionally automated (SAE Level 3) passenger cars using a questionnaire study among 9,118 car-drivers in eight European countries, as part of the European L3Pilot project. 71.% of respondents considered conditionally automated cars easy to use while 28% of respondents planned to buy a conditionally automated car once it is available. 42 % of respondents would like to use the time in the conditionally automated car for secondary activities. Among these 42%, respondents plan to talk to fellow travellers (45%), surf the internet, watch videos or TV shows (44%), observe the landscape (42%), and work (17%). The UTAUT2 (Unified Theory of Acceptance and Use of Technology) was applied to investigate the effects of performance and effort expectancy, social influence, facilitating conditions, and hedonic motivation on the behavioural intention to use conditionally automated cars. Structural equation analysis revealed that the UTAUT2 can be applied to conditional automation, with hedonic motivation, social influence, and performance expectancy influencing the behavioural intention to buy and use a conditionally automated car. The present study also found positive effects of facilitating conditions on effort expectancy and hedonic motivation. Social influence was a positive predictor of hedonic motivation, facilitating conditions, and performance expectancy. Age, gender and experience with advanced driver assistance systems had significant, yet small (<0.10), effects on behavioural intention. The implications of these results on the policy and best practices to enable large-scale implementation of conditionally automated cars on public roads are discussed.

Status / reference

Nordhoff, S., Louw, T., Innamaa, S., Lehtonen, E., Beuster, A., Torrao, G., Bjorvatn, A., Kessel, T., Malin, F., Happee, R., & Merat, N. (2020). Using the UTAUT2 model to explain public acceptance

of conditionally automated (L3) cars: A representative questionnaire study among 9,118 car drivers from eight European countries. *Transportation Research Part F: Traffic Psychology and Behaviour, 74,* 280–297.

Are multimodal travellers going to abandon sustainable travel for L3 automated vehicles?

Research questions

What is the influence of a person's mobility behaviour on the acceptance of L3 cars?

Abstract / description

Reducing car dependency supports the creation of a more sustainable transport system. However, automated vehicles (AVs) are predicted to increase the attractiveness of car travel and decrease the use of public transport and active travel. This current study explored how travellers' intention to use AVs and their current travel behaviour influence their expectations of how they will use public transport and active travel, once conditionally automated (SAE L3) vehicles (L3 AVs) are available.

Survey data (collected during the EU H2020 L3Pilot project) from among current car users from eight European countries (n=9,118) was used. Respondents were asked about their current travel mode usage, intention to use L3 AVs, and expected changes in the use of public transport and active travel once L3 AVs are available. The respondents were divided into nine user segments based on their level of intention to use L3 AVs and multimodality.

Most respondents did not foresee changes in their use of public transport (62%) or active travel (67%). A higher intention to use L3 AVs increased the probability of a traveller expecting to decrease their use of public transport and, to a lesser extent, active travel. Multimodal travellers used public transport and active travel regularly and were also more likely to see a change, either up or down, in their use of public transport and active travel. The results suggest that L3 AVs may pose a challenge to the sustainability by encouraging current users of public transport and active travel to switch to personal AVs.

Status / reference

Lehtonen, E., Malin, F., Innamaa, S., Nordhoff, S., Louw, T., Bjorvatn, A., & Merat, N. (2021). Are multimodal travellers going to abandon sustainable travel for L3 automated vehicles? *Transportation Research Interdisciplinary Perspectives*, *10*, 100380. https://doi.org/10.1016/j.trip.2021.100380.

Profiling the sceptical, neutral, and enthusiastic users of conditionally automated cars in 17 countries: A questionnaire study

Research questions

How do people differing in their intention to use L3 cars vary with regards to their nationality, age, gender, understanding of the functionality of L3 cars, awareness of automated driving, frequency of receiving information from different sources, and expected changes on the productive use of travel time, comfort, and safety?

Abstract / description

The L3Pilot Project currently tests SAE Level 3 conditionally automated driving functions in order to address safety, driving and travel behaviour, socio-economic impact, and user acceptance. Previous research has identified substantial individual variance in L3 acceptance. The present L3 online survey study investigates acceptance across Sceptics, Neutrals, and Enthusiasts from 17 countries in terms of their age, gender, knowledge about the functionality of conditionally automated cars, information consumption, and expected benefits of conditionally automated cars. The Sceptics, Neutrals, and Enthusiasts differed most with regards to the expected benefits in the productive use of travel time, comfort and safety. The Enthusiasts were male, younger, more knowledgeable about conditionally automated cars, more aware of automated cars and more likely to receive information about automated cars from different sources, and expect improvements in the productive use of travel time, comfort, and safety due to conditionally automated cars. All groups were most knowledgeable about the lane-keeping behaviour of conditionally automated cars and least knowledgeable about the limited operational design domain of conditionally automated cars.

Status / reference

Nordhoff, S., Madigan, R., Louw, T., Lee, Y. M., Innamaa, S., Lehtonen, E., Malin, F., Bjorvatn, A., Kessel, T., Beuster, A., Happee, R., & Merat, N. (2021). Profiling the skeptical, neutral, and enthusiastic users of conditionally automated cars in 17 countries: A questionnaire study. Journal of Advanced Transportation.

Drivers' intention to use conditionally automated (L3) cars in different operational design domains: A survey study among 18,631 drivers in 17 countries.

Research questions

- Does intention to use CAC differ in different ODDs: Motorways, Traffic Jam, Urban, and Parking?
- How does intention to use CACs in different ODDs vary by **Age** and **Gender**?
- How does intention to use CACs in different ODDs vary by **experience with ADAS**?
- Are these responses different across **countries**?

Abstract / description

A number of studies have investigated the acceptance of conditionally automated cars (CACs). However, in the future, CACs will comprise of several separate Automated Driving Functions (ADFs), which will allow the vehicle to operate in different Operational Design Domains (ODDs). Driving in different environments places differing demands on drivers. Yet, little research has focused on drivers' Intention to use different functions, and how this may vary by their age, gender, country of residence, and previous experience with Advanced Driving Assistance Systems (ADAS). Data from an online survey of 18,631 car drivers from 17 countries (8 European) was used in this study to investigate intention to use an ADF in one of four different ODDs: Motorways, Traffic jams, Urban roads, and Parking. Intention to use was high across all ADFs, but significantly higher for Parking than all others. Overall, intention to use was highest amongst respondents who were younger (<39), male, and had previous experience with ADAS systems. However, these trends varied widely across countries, and for the different ADFs. Respondents from countries with the lowest Gross Domestic Product (GDP), and highest road death rates had the highest intention to use all ADFs, while the opposite was found for countries with high GDP and low road death rates. These results suggest that development and deployment strategies for CACs may need to be tailored to different markets, to ensure uptake and safe use.

Status / reference

Louw et al. (in preparation). Drivers' intentions to use different functionalities of Conditionally Automated Cars: A survey study of18,631 drivers, in 17 countries.

Assessing willingness to pay for (conditional) automated driving in European countries. Is there a difference?

Research questions

What is the willingness to pay for conditionally automated driving functions across European countries?

Abstract / description

The study aimed to investigate public attitudes towards conditionally automated cars (level 3 automation) in terms of willingness to pay for system-specific automated driving function, i.e. for driving on urban roads and motorways, in traffic jam and parking. The analyses were based on surveys in eight European countries. Descriptive statistics and ordered probit regression models were applied for the analyses. The findings indicated both within and between country differences in willingness to pay for level 3 automated driving systems.

Status / reference

Bjorvatn, et al. (in preparation). Assessing willingness to pay for (conditional) automated driving in European countries. Is there a difference? (to be submitted)

Does increased knowledge of specific automated vehicle functionalities affect ratings of trust and intentions to use these vehicles? A questionnaire study.

Research questions

- Does increased knowledge of specific ADF’s affect trust and intentions to use these functionalities?
- Specifically, does the inclusion of information on system limitations change levels of trust or behavioural intentions?

Abstract / description

This study aimed to establish how the description of each of AV functionality impacts on respondents' trust and acceptance of these systems. A between-subjects intervention was designed, whereby half of the participants were provided with statements about the *capabilities* of the motorway, traffic jam, urban, and parking ADFs followed by questions on trust and intention to use, and the other half were provided with statements incorporating information on the *capabilities and limitations* of the ADFs. Results show no major influence of system description on trust or intention to use ratings. However, these ratings did differ across ADF's, with participants generally providing the highest ratings for the Parking ADF and lowest ratings for Urban and Motorway ADFs.

Status / reference

Madigan et al. (in preparation). Does increased knowledge of specific automated vehicle functionalities affect ratings of trust and intentions to use these vehicles? A questionnaire study.

Who are the users of conditionally automated cars? Results of a hierarchical cluster analysis.

Research questions

Main research question:

- Who are the users of conditionally automated cars?

Sub-research questions:

- How do users of conditionally automated cars differ with regards to their socio-demographic profile, travel behavior, personality, and attitudes towards driving?
- How do they differ with regards to their general attitudes towards conditionally automated cars?
- How do they differ with regards to their envisioned frequency of secondary task engagement in conditionally automated cars?
- How do they differ with regards to their acceptance of conditionally automated cars?

Abstract / description

An understanding of needs and expectations of potential users of conditionally automated cars is essential in order to design user-based strategies to effectively market conditionally automated cars. The present study contributes to the literature on the acceptance of automated cars by analyzing differences between potential users of conditionally automated cars using a large sample applying a principal component and hierarchical cluster analysis. The analysis of descriptive statistics revealed that one of the highest mean ratings was obtained for wanting to be engaged in the driving task by periodically touching the steering wheel. One of the lowest mean ratings was found for not wanting to stop another activity to respond to requests from the conditionally automated car to take over control. The cluster analysis resulted in the extraction of three user groups, named as Accepters, Neutrals, and Rejecters differing in a high, moderate, and low intention to use conditionally automated cars, respectively. The largest differences between these three clusters were found in their general acceptance of conditionally automated cars. The Accepters were most different from the Rejecters and Neutrals by their higher intention to use and buy conditionally automated cars. The second-largest group differences existed with regards to their envisioned frequency for secondary task engagement, with the Accepters being more willing to engage in eyes-off road activities than the Neutrals and Rejecters. Across all questions, the Rejecters provided the highest ratings than the Neutrals and Accepters for wanting to remain engaged in the driving task by periodically touching the steering wheel to be able to resume control from the conditionally automated car. The three groups differed the least with regards to their socio-demographic profile and travel behaviour. These findings underscore the importance of rational and functional attributes of conditionally automated cars for their acceptance and suggest that campaigns to promote and market conditionally automated cars should neglect key socio-demographic characteristics, such as age and gender. We recommend future research to investigate the interrelationships between key socio-demographic characteristics, such as age and gender, and other psychological variables (e.g., personality) to disentangle their role for the acceptance of conditionally automated cars.

Status / reference

Nordhoff, S., Louw, T., Madigan, R., Lee, Y. M., Innamaa, S., Lehtonen, E., Bjorvatn, A., Kessel, T., & Merat, N. (manuscript in preparation). Who are the users of conditionally automated cars? Results of a hierarchical cluster analysis.

Willingness to pay for conditional automated driving in European countries - Segmentation of potential buyers.

Research questions

Is there a difference in willingness to pay for ADFs among different consumer groups?

Abstract / description

The study aims at investigating willingness to pay for conditionally automated cars (CACs) among 9118 respondents in eight European countries by segmentation of potential buyers of CACs. Latent profile analysis is employed to identify which variables score highest on latent factors of willingness to pay based on latent constructs from the UTAUT2-model. We analyze to what extent the questions/variables explaining these latent factors differ among various classes of potential buyers of CACs in Europe and determining which factors are associated with willingness to pay for different automated systems in CACs, i.e., for driving on urban roads, motorways, congested motorways, and parking.

Status / reference

Skjeret, Bjorvatn et al. Willingness to pay for conditional automated driving in European countries-Segmentation of potential buyers (to be submitted).