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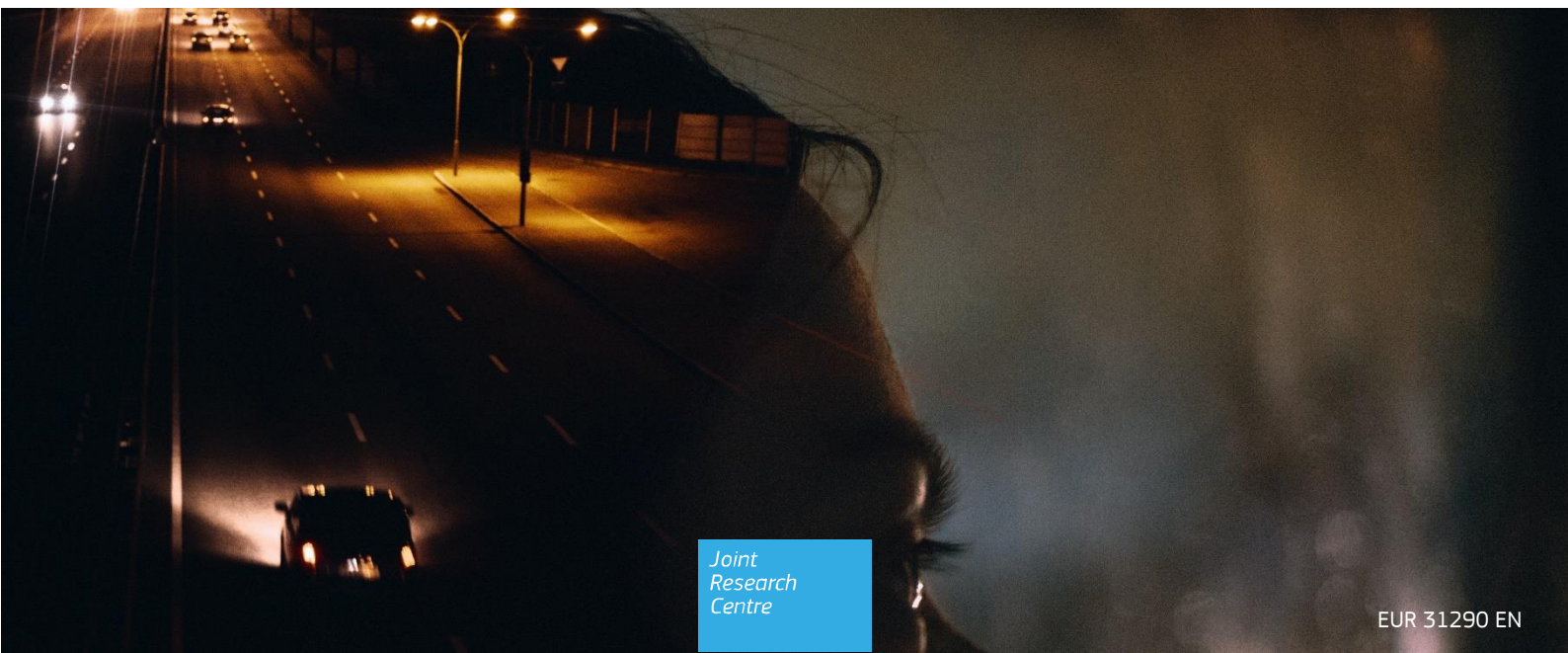
## JRC SCIENCE FOR POLICY REPORT

# Women's opinions, attitudes and concerns about automated vehicles

*If and how automated vehicles could fit into women mobility needs*

Grosso, M., Duboz, L., Raileanu, I. C., Naegele, S., Kolarova, V., Cordera, R., Mourtzouchou, A., Alonso Raposo, M., Garus, A., Krause, J. Ciuffo, B.

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#### Contact information

Name: Biagio Ciuffo  
Address: European Commission, Joint Research Centre, Vie E. Fermi 2749, I-21027, Ispra (VA) — Italy  
Email: Biagio.CIUFFO@ec.europa.eu  
Tel.: +39 0332 789732

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## **Abstract**

Automated Vehicles are expected to transform the transport sector by contributing to reduce transport externalities and improving the mobility of people, which may depend on several influencing factors to their acceptance. Gender differences exist with regard to transport and mobility patterns, also when considering opinions, attitudes and concerns about Automated Vehicles. Despite women being half of the world population, their views on their current and future mobility are still under investigation and little research has been conducted regarding their opinions towards Automated Vehicles. This research aims at shedding light on European women current mobility and if and how Automated Vehicles could fit into mobility needs and habits, arguing as well about possible mobility improvement as well as problems associated with such vehicles. It identifies key issues based on relevant existing literature and presents the results of Focus Group discussions, surveys and citizen engagement activities conducted by the European Commission's Joint Research Centre, the German Aerospace Center and the University of Cantabria. It concludes by providing policy insight on the topic and indicating future research areas of investigation.

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## **Authors**

Monica Grosso, European Commission, Joint Research Centre, Italy

Louison Duboz, European Commission, Joint Research Centre, Italy

Ioan Cristinel Raileanu, Independent researcher, Milan, Italy

Sophie Naegele, Institute of Transport Research, German Aerospace Center e.V., Germany

Viktoriya Kolarova, Institute of Transport Research, German Aerospace Center e.V., Germany

Rubén Cordera, University of Cantabria, SUM+LAB Research Group, Spain

Andromachi Mourtzouchou, University of Cantabria, Spain

María Alonso Raposo, European Commission, Joint Research Centre, Italy

Ada Garus, European Commission, Joint Research Centre, Italy

Jette Krause, European Commission, Joint Research Centre, Italy

Biagio Ciuffo, European Commission, Joint Research Centre, Italy

## **Executive Summary**

### ***Policy context***

Gender Equality is at the core of the European Commission's (EC) agenda, as von der Leyen Commission's commitment is to achieve a Union of Equality. This objective is also pursued through the creation of a dedicated Commissioner for Equality and the publication of "A Union of Equality: Gender Equality Strategy 2020-2025" (European Commission, 2020a). Transport is one of the areas where the strategy is implemented through different EC initiatives and policy documents: "Women in Transport - EU Platform for change" (European Commission, 2017), which aim is to strengthen women's employment and equal opportunities for women and men in the transport sector also through the Platform members' s actions; the European Institute for Gender Equality, a EU autonomous body contributing to strengthen and promote gender equality in all societal dimensions, that produced a study on Gender in Transport, (European Institute for Gender Equality, 2016). The European Economic and Social Committee opinion on "Women and Transport" which acknowledged the transport sector as being male oriented (European Economic and Social Committee, 2015). The European Parliament's initiatives on gender equality in transport dates back to 2011 when in the White Paper on "Transport: taking stock and the way forward towards sustainable mobility" the European Parliament focused on measures to boost women's participation in the transport labour market (European Economic and Social Committee, 2015). In a more recent study of the European Parliament, achievements in gender and transport in the EU are explored from two different points of view: knowledge and policies considering women as transport users and as workers in the transport sector (Sansonetti and Davern, 2021). Finally, the Sustainable and Smart Mobility Strategy, in its 70 action, launches activities to increase the attractiveness of the transport sector in particular for women and young people (European Commission, 2020b).

## ***Main findings and conclusions***

This research aimed at shedding light on women's current mobility and if and how Automated Vehicles (AVs) could fit into their mobility needs and habits, arguing about possible mobility improvements as well as problems associated with such vehicles.

Overall, the results of the analysis showed a generally positive view about AVs among the women who participated in this study, although there are still acceptance barriers.

ALVs could be associated both with positive and negative aspects. Positive ones related often to better driving experience, more comfort, better use of driving time and increased safety; the negative aspects reflected concerns about safety both related to the technology itself and to the vehicle behaviour and the loss of control.

Women evaluated AVs as a promising solution for more sustainable and accessible transport as well as for improved traffic conditions for all road users. They could potentially contribute to safety improvements or provide more sustainable individual mobility options, as car sharing or public transport complement.

The women surveyed showed willingness to buy AVs and to share them with persons they already know in order to generate less pollution and save money, although mostly with people they know such as family members or friends.

Safety standards have to be proven by independent authorities, demonstrated and transparently communicated to citizens, again by independent entities (e.g., scientist rather than car companies) to build users' trust in AVs as a safe and reliable means of mobility.

Although concerned about equal access (in terms of race, age, gender, income, disability etc.), mainly in the first phase of the deployment, women would find it useful to rely on such vehicles for children and family members' daily routine management.

Women would require transparency about data privacy, knowing which data is collected and how it is used, stressing the importance to develop corresponding law enforcement strategies to prevent data misuse.

Although greener mobility choices and safety concerns are key when it comes to women's mobility priorities, no clear evidence was found in this study on how AVs could serve as women's mobility problem solvers or on how AVs could improve their mobility or mitigate its negative impacts.

Apart from the feeling of safety that women wish to feel while traveling, they also highlighted the importance of having a defined mobility schedule, less travel costs and reliable public transport, as well as the need for value of travel time.

AVs would nonetheless bring positive effects into women's mobility in relation to daily transport activities and time management. The rather complex daily travel habits that generally characterize women's lives could be eased by the use of AVs, which could help save time or improve time management, being able to devote some of the travel time to other daily activities, either personal or paid work (e.g., spend time with children, organize work/personal daily agendas, etc.).

## ***Related and future JRC work***

This analysis was framed within the JRC Sustainable Transport Unit research investigating technical and socio-economic impacts of AVs and inside the JRC Future Mobility Solutions Living Lab (FMS-Lab).

Future research will look at other transport users whose opinions, needs and expectations may not be fully explored yet, for example those of young generations and will study other transport technologies and business-market models within the JRC FMS-Lab framework, by means of quantitative and qualitative analysis.

## ***Quick guide***

The report is structured as follows: Chapter 2 provides a brief introduction to women and transport issues based on a literature review. Chapter 3 describes the policy background regarding gender equality and transport.

Chapter 4 displays the method of the present study. Chapter 5 presents the study results, namely of the focus group discussions, the questionnaire and the citizen engagement activity. Finally, Chapter 6 concludes with some final takeaways and indications for future research activities.



## 1 Introduction

Overall, in the EU countries, efforts to improve gender equality are on the rise. However, not all domains are fast gaining ground. The transport sector is one of these areas where much remains to be done, being a sector with low rate women employment participation and still with many gender stereotypes. In the meantime, the rapid technology development and digitalization trends in all areas of daily life including transport, facilitate the development of Automated Vehicles (AVs) and new mobility services. Using the potential of technology for improving individual mobility equally for all citizens is becoming a priority in the development of such new vehicles and mobility services. However, little is known about the requirements and concerns of various potential user groups of mobility technology and services, notably women.

Gender inequality in the transport sector arises from diverse issues. Women mobility patterns differ from male's ones in terms of mode choice, activity at destination, nature of trip chains or mobility level (number of trips, time and distance) (Beige and Axhausen, 2017; Scheiner, 2020; García-Jiménez et al., 2020). Women are also more likely to transport children to and from school and to provide day care at certain times of the day (Craig and Brown, 2014; Craig and Powell, 2013), meaning that they often travel under time pressure (Kim et al., 2012; McQuaid and Chen, 2012). Women also tend to switch more often between the role of the worker and the caregiver during the day compared to men, leading to more multi-purpose trips, and as a result to more complex trip-chains. According to Pocock et al. women undertake more often compared to men ad hoc care-related travel at short notice (Pocock, Skinner, and Williams, 2012). In the same line are the results of the Transport Innovation Gender Observatory H2020 project (TInnGO) where women surveyed seemed to travel more often for shopping and for reasons related to dependent persons, and less for leisure, work and studies compared to men. Women have different needs on transport modes concerning personal safety. Terminals and modes of transport can be particularly dangerous places for women, especially when shared (Coppola and Silvestri, 2021). Women tend to follow different mobility patterns, compared to men concerning the design of, and the access to modes of transport (Heinen, van Wee, and Maat, 2010). Transport planning has been often based on men's travel patterns, which results in unequal transport options for men and women. For example, public investment in the lighting of bus stops is often ignored, even though many women consider it as a pre-condition to using public transport at night. Similarly, overcrowded public transport can increase the risk of sexual harassment.

Different needs of men and women also apply to AVs. Initial works show differences in perception of the technology between women and men (Tennant, Stares, and Howard, 2019). As AVs are still being developed, it is important to investigate and consider these different needs and perceptions carefully. The results from the recent Eurobarometer 496 on expectations and concerns related to AVs suggest that European women have less experience with advanced driver assistance systems, and they have heard or read less about AVs compared to men. A higher share of women stated not feeling comfortable with the idea of using vehicles without any human intervention, and the acceptance of AVs in general seems to be lower among women than among men (European Commission, 2020c). Although these results provide early insights on differences in perception of AVs depending on gender, analysing the roots of these differences is essential in order to develop the technology in line with the requirements and needs of various user segments, including women among others.

The primary aim of this report is to explore the mobility needs and behaviours of women in European countries and secondly to gather their expectations regarding increased connectivity and automation in the transport sector in order to influence current AV developments to better reflect gender equality. Our investigation was based on focus group (FG) discussions (online and face-to-face), organized by the Joint research Centre (JRC) in Italy, the German Aerospace Center (DLR) in Germany and the University of Cantabria (Unican) in Spain. The face-to-face FG discussions were followed by a demonstration of an AV prototype and a mood board activity. Furthermore, we analysed a questionnaire which was administered after the FG discussions to gain quantitative insight. Even though the number of participants was adequate for a qualitative study based on FG discussions, results need to be drawn with attention due to participants' limited background and geographical origin. Based on the results of these explorative works, political implications were discussed.

The report is structured as follows: Chapter 2 provides a brief introduction to women and transport issues based on a literature review. Chapter 3 describes the policy background supporting gender equality in the transport sector. Chapter 4 displays the methodology of the present policy brief. Chapter 5 presents the results of the focus group discussions, the questionnaire and the citizen engagement activity. Finally, Chapter 6 presents the main conclusions and suggestions for future work.

## **2 Literature Review**

### **2.1 Women's mobility patterns**

Women transport patterns are distinct from other user groups and relate to specific socio-economic factors, as well as personal and family reasons. This topic has been extensively considered in transport technology and planning research, as well as when dealing with transport safety and security or more recently in relation to transport equity (Hortelano et al., 2021). Women represent half of the population: understanding the way they move is key, in relation not only to transport planning and policy, but as a societal and economic phenomenon as well. Women's views on current and future mobility trends and technologies are still under investigation and little research has been conducted regarding underlying reasons about their opinions towards AVs.

A previous JRC work (Hortelano et al., 2021) on the role of women in research and innovation (R&I) in transport provided insights on specific women characteristics in relation to transport mode choice, travel time and purposes. This previous work reflected also on those factors that influence such choices, namely safety and security, environmental concerns or the impact of new transport technologies.

In fact, evidence on different transport patterns in women's daily mobility has been proven by several scholars who reported on the higher number of daily trips and shorter daily trip distances compared to men, mainly associated to domestic chores, as well as family dependent reasons (Rosenbloom, 2004; European Parliament, 2012; Kawgan-Kagan, 2015; Ng and Acker, 2018; Closing Gap, 2019; García-Jiménez et al., 2020).

Some literature mentions that women tend to use public transport, walk and use bicycles more than men do, because of lower motorization rate but also due to a greener approach towards mobility (Denton, 2002; Polk, 2003; Duchène, 2011; Civitas, 2014; Sovacool et al., 2018) while some other studies state that men cycle more than women (Wittmann et al., 2015) or that women use bicycles when there is safe and appropriate infrastructure (Aldred, Woodcock, and Goodman, 2016; Le et al., 2019; ECF, 2021)

Although cycling would fall under one of the preferred transport modes for women (Dill and Gliebe, 2008), still different impediments would prevent a full use of such transport mode, such as the perceived risk of cycling (Beecham and Wood, 2014; Griffin and Haworth, 2015; Aldred et al., 2017) or lack of confidence with biking (Heesch, Sahlqvist, and Garrard, 2012). Women might cycle less than men because they tend to hold household-serving labour and this work is assumed to be more challenging to complete by bicycle compared to other transport modes (Steinbach et al., 2011; Wang, Akar, and Guldman, 2015; Ravensbergen, Buliung, and Sersli, 2020).

Women seem more prone to adopt more sustainable and greener travel behaviours (Alonso-Almeida, 2019; Scholten and Joelsson, 2019; European Parliament, 2012) supporting speed limit reductions in cities, being more positive in accepting congestion charging or similar measures to reduce climate change. Women are more positive when it comes to public investment on cycling and public transport infrastructures (Polk, 2009).

One of the main issues that women face in their mobility is related to personal safety and security (Atkins, 1990) as exposure to physical harassment or violence, as well as unwelcomed behaviours from other people which make women's mobility attitudes and behaviours change, mainly in terms of public transport and infrastructure (Gardner, Cui, and Coiacetto, 2017; Gekoski et al., 2017; Bakran, 2018; Chowdhury and van Wee, 2020; Coppola and Silvestri, 2021). Personal safety, hence, is one of the main decision-making factors for mode, route and travel time choices (Smith, 2008; Loukaitou-Sideris, 2014; Gardner, Cui, and Coiacetto, 2017), which is limiting h women in terms of travelling alone at night (Lubitow, Abelson, and Carpenter, 2020). These factors can significantly vary from country to country.

### **2.2 Women and automation**

Academic literature investigates and reports gender differences related to acceptance, attitudes, interest, adoption and willingness to use new technologies and services. Women are more sceptical about the benefits of technological advancement to society in general (Acheampong and Cugurullo, 2019) and tend to have lower level of acceptance towards technology (Kawgan-Kagan, 2020). Women have less positive attitudes towards technology use compared to men (Cai, Fan, and Du, 2017). Research on the intention to use technology-based services identified that women's acceptance is influenced by aspects such as performance expectancy (the degree to which using such services will provide benefits to consumers in performing certain activities) and social influence (the extent to which consumers perceive that family and friends believe they should use a particular service) (Tsourela and Roumeliotis, 2015).

As for the perspective on vehicle technology features, women are more interested assisting features such as lane keeping assist system (LKAS), backup (rear-view) camera (RVC) and adaptive cruise control (ACC), that have the human driver in control and are less inclined towards active features such as automatic braking systems (ABS) considering the increased safety concerns regarding technology (Asmussen, Mondal, and Bhat, 2022).

Women's perspectives on AVs represent a theme of interest for the academic literature. Gender disparities are identified in relation to perceptions, interests, acceptance, concerns and willingness to use new transport technologies such as AVs and AV-based services (e.g., ride sharing).

AVs have the potential to ease the often-complex mobility patterns of women, supporting travels related to domestic chores, to family-related reasons and to increase personal safety and security. For example, women could decrease their trips if their kids are driven to school or other activities by an AV. Additionally, AVs could help in reducing some of the travel constraints that bound women to choose work opportunities within short commuting time or distance. Also, with AVs women could take trips to some of the currently omitted destinations (Dannemiller et al., 2021). Still, improving the mobility of women with the use of AVs must overcome, among others the reluctance to experience longer commute times (Moore et al., 2020), the concerns related to their personal or children's safety while travelling in AVs, and those related to privacy of travel data.

Women tend to have less positive views, attitudes and level of enthusiasm regarding AVs (Wang et al., 2020; Liljamo, Liimatainen, and Pöllänen, 2018; Tennant, Stares, and Howard, 2019), are less likely to be interested in driving AVs (Rezaei and Caulfield, 2020), anticipate that they would not trust Connected and Automated vehicles (CAVs) and that such vehicles would not fully meet their needs as a passenger (Mateo et al., 2022).

The lower level of willingness to use AVs among women compared to men is registered in multiple studies (Rahimi et al., 2020; Saeed et al., 2020; Sener, Zmud, and Williams, 2019; Hohenberger, Spörrle, and Welppe, 2016). Still, women tend to accept sharing a ride on an AV more often than men, but a higher compensation (in terms of discount) is needed to attract women to share a ride according to König and Grippenkovén (2020). Women would exhibit a lower tendency of sharing rides in work-related commuting contexts compared to leisure ones as identified by Lavieri and Bhat (2019).

Some of the factors recognized in the literature as influencing the perceptions, attitudes and opinions of women regarding AVs include safety aspects, anxiety in using AVs, lack of human interaction, cost and concerns about privacy.

Pflugfelder (2018) has identified that women have a lower level of perceived safety in AVs and are less likely to trust new vehicle technologies (e.g., self-parking, automatic emergency braking, and adaptive cruise control). Acheampong and Cugurullo (2019) pointed out that women are more likely to agree with views that AVs could have potential negative safety and security impacts and tend to disagree with some of the potential benefits that AVs could bring such as saving lives, providing comfortable and reliable travel and reducing congestion and travel-related pollution. In Finland, (Liljamo, Liimatainen, and Pöllänen, 2018) an analysis of the attitudes of adult population (18–64 years old) towards AVs identified that women are more concerned about traffic safety (accidents) than men. Analysing the pedestrian perspective regarding fully autonomous vehicles in USA, Deb et al. (2017) concluded that the reluctance of women to interact with AVs and the safety concerns around such vehicles could be attributed to the lack of human interaction.

Liu et al. (2019), observed a higher level of anxiety (dread) among women compared with men when thinking about riding in an AV, still women did not express higher risk concerns regarding such vehicles. A similar higher anticipated anxiety from riding in an AV among women was identified by Hohenberger, Spörrle, and Welppe (2016), which could explain why women tend to have a lower willingness to use AVs than men.

Ensuring the privacy of travel data, especially in a sharing AV scenario, was identified by Gurumurthy and Kockelman (2020) as an important aspect among women.

In the study of Bernhard et al. (2020), on the users' acceptance of an automated minibus in Germany it was identified that women consider relevant some specific aspects such as: environmental friendliness of the minibus, on board presence of an operator to ensure that the vehicle is safe and reliable, and spaciousness of the vehicle. A study on a similar target group in Finland, observed that women passengers in a driverless shuttle bus assessed their overall experiences with traffic safety, in-vehicle security and emergency management lower compared with men (Salonen, 2018). Lee and Mirman (2018) analysis of parents' perspectives on using AVs to improve children's mobility pointed out that women perceive less benefits and greater concerns compared to men (in particular regarding the way AV will protect their children when confronting with dangerous or aggressive behaviour from other road users).

### 3 Policy Background

In order to frame the current research within the EU policy background, it is important to mention the main initiatives and relevant legislation that support the implementation of gender equality and mainstreaming in the transport sector.

Gender Equality is at the core of the European Commission's (EC) agenda, as President von der Leyen committed to achieve a Union of Equality in her inaugural speech. This objective is also pursued by the designation of a dedicated Commissioner for Equality and the adoption of "A Union of Equality: Gender Equality Strategy 2020-2025" (European Commission, 2020a), which aims to achieve a gender equal Europe where gender-based violence, sex discrimination and structural inequalities between women and men are overcome. The Strategy has a clear vision and contains concrete actions developed around six themes:

1. Being free from violence and stereotypes
2. Thriving in a gender-equal economy
3. Leading equally throughout society
4. Gender mainstreaming and an intersectional perspective in EU policies
5. Funding actions to make progress in gender equality in the EU
6. Addressing gender equality and women's empowerment across the world

The current European Funding Program, Horizon Europe, supports the EU strategies to help achieve gender equality objectives within the R&I landscape and through research policy-making. Gender is now a crosscutting, legal and horizontal requirement in the Horizon Europe framework programme, reflected in its framework regulation and in the specific programme itself. Calls for proposals have to take gender into consideration at different layers: projects participants must have a gender equality plan in place; gender balance must be ensured in the project's consortium and the gender dimension should be integrated into the project proposal. The goal of these policy measures is to improve the European research and innovation system, create gender-equal working environments with gender balance in leadership, gender equality in recruitment, gender dimension in R&I content and measures against gender-based violence.

The European Investment Bank (EIB) Group adopted, in 2016, a Strategy on Gender Equality and Women's Economic Empowerment entitled "Protect, Impact, Invest". The strategy will help align EIB Group activities with Sustainable Development Goal 5 and help "achieve gender equality and empower all women and girls" by 2030 (European Investment Bank Group, 2016).

Transport is one of the areas where the strategy's objectives are implemented through the Sustainable and Smart Mobility Strategy, including through the initiative "Women in Transport - EU Platform for change", already launched in 2017. The platform aims at strengthening women's employment and equal opportunities in the transport sector, while also serving as a forum for discussion and exchange of good practices (European Commission, 2017).

A study initiated by the European Commission's Directorate-General for Mobility and Transport (DG MOVE), identifies good staff scheduling and rostering practices in the transport sector and makes practical recommendations on how staff and shift scheduling systems can be improved to respond to the needs of a diverse transport workforce, notably in terms of improving their work-life balance (European Commission, 2021a). In addition, a recently published series of educational toolkits aim to help fight gender stereotypes based on the example of the transport sector, where only 22% of the workforce are women (Janečková et al., 2021).

Another study was published by EC's DG MOVE in 2021 on the "Social dimension of the transition to automation and digitalisation in transport, focusing on the labour force". This study puts forward policy-oriented recommendations and measures to accompany the transition to automation and digitalisation for the labour force in the transport sector. Additionally, its 6<sup>th</sup> recommendation focuses on diversity and to the need to attract women workers and retain them in the transport sector. For this reason, a close collaboration among trade unions, workers' representatives, policy-makers, training institutions and companies is needed. Interviewed stakeholders indicated that changing some of the prevalent working conditions in transport, making them less manual and physical work required, providing a better work-life balance and higher flexibility, can work as a "pull factor" for women workers (European Commission, 2021b)

Women were also among the six user groups explored in the recently published study of EC, “Social dimension of the future EU transport system regarding users and passengers” (European Commission, 2022). This study maps the challenges and opportunities posed by the modernisation of the system to different groups of transport users in terms of affordability, reliability and accessibility. At the same time, it analyses possible solutions that ensure users are at the centre of the future transport system.

With a focus on CAVs, the European Commission has published a report in 2020 from an independent group of experts on Ethics of Connected and Automated Vehicles (Bonnefon et al., 2020). The study pointing out that CAVs’ manufacturers and dealers are responsible for acting without being discriminating or creating inequalities. Instead, diversity is proposed to be built (in terms of gender, ethnicity and other socially pertinent dimensions) starting from the initial phase of the designing until the final service.

In the Strategic Research and Innovation Agenda (SRIA) 2021-2027 of the Connected and Cooperative Automated Mobility (CCAM) Partnership, inclusiveness is expected to be among the positive societal impacts of the full integration of CCAM in the transport system, although inclusiveness and equity are mentioned as less common in CCAM design and R&I, and mainly restricted to persons with reduced mobility, gender, age groups, or vulnerable road users.

The European Parliament’s initiatives on gender equality in transport dates back to 2011 when in the White Paper on “Transport: taking stock and the way forward towards sustainable mobility” the European Parliament focused on measures to boost women’s participation in the transport labour market, (European Economic and Social Committee, 2015). This urgency was reinforced in 2012 when the Commission and Member States were called to create sustainable transport systems which would take in equal account women’s and men’s transport needs (European Parliament, 2012). Recently, the European Parliament, explored achievements in gender and transport in the EU from two different perspectives: knowledge and policies considering women as transport users and as workers in the transport sector (Sansone and Davern, 2021).

In 2015, the European Economic and Social Committee adopted the opinion: “Women and Transport” where the transport sector was acknowledged as male oriented sector, considering for example the imbalance in male and female jobs, with gender considerations being absent from EU transport policy. The document informed the transport sector stakeholders about the need to be more inclusive and called for gender-neutral policies to support competitiveness, innovation, growth and jobs (European Economic and Social Committee, 2015).

The European Institute for Gender Equality (EIGE), created in 2006, published a dedicated report on gender in transport under its gender mainstreaming programme aiming at improving individual and institutional competences into the different sectorial areas and throughout the different stages of policy, programme and project development (European Institute for Gender Equality, 2016).

A more extensive review of the European gender policy initiatives and background is presented in Hortelano et al. (2021) which looks at the topic of women in transport with a more holistic perspective, providing additional insight about the role of women in transport research and innovation activities.

At international level, The World Bank looked at the nexus between gender and transport, and explored how to make transport work for women: inadequate transport systems can restrict women’s access to education, economic opportunities and healthcare (The World Bank, n.d; Clarke, 2012). Additionally, the third edition of the International Transport Forum’s (ITF) Compendium on Women in Transport showcases the role of innovation in promoting gender equality in the sector. This compendium gathers voices from the transport sector that highlight positive examples of how women as transport users can benefit from the innovations that are transforming this sector achieving more inclusive and sustainable transport (ITF, 2021).

## 4 Methodology

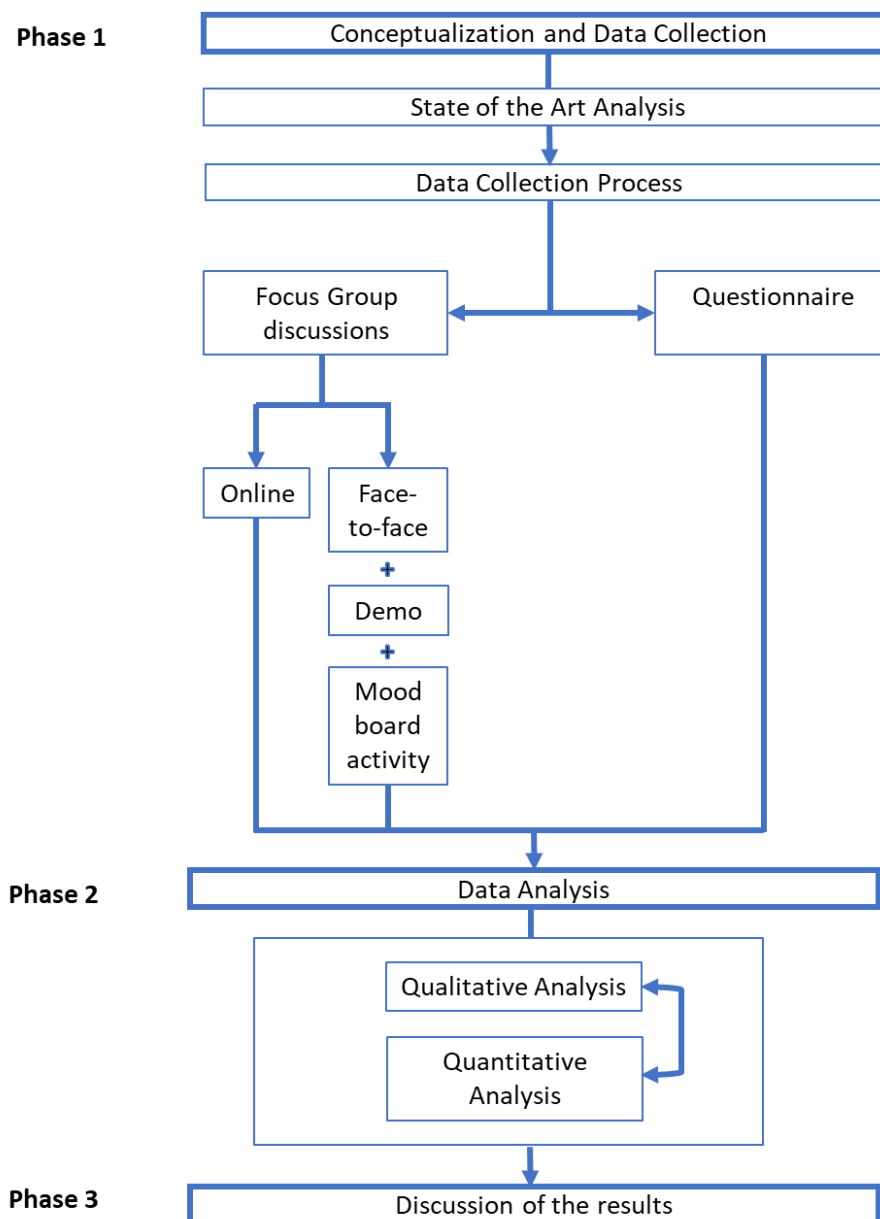
The study was composed of three main phases (Figure 1); conceptualisation and data collection (Phase 1), analysis (Phase 2) and discussion of the results (Phase 3).

The first phase (conceptualisation and data collection) included the mapping of the main topics to be explored with this targeted group and the implementation of the FG discussion's script, moreover the definition of the demonstration of an AV prototype and the mood board activity linked to it were defined and planned. A final questionnaire was developed and structured to be distributed after the FG discussion to the participants.

The second phase (analysis) was dedicated to the data analysis where data from the FG discussions and other relevant activities were firstly analysed and then confronted with results gained from a quantitative questionnaire distributed to the participants at the end of the discussions.

The last phase (discussion of the results) included discussing the results and putting them in context.

**Figure 1.** Study description



Source: JRC, 2022.

From July to November 2021, seven semi-structured FG discussions with women participants (four online and three face-to-face) were organised by JRC, DLR and Unican. Each discussion lasted approximately two hours. The participation to this study was completely voluntary and participants were asked to have at least a basic level in English. Additionally, the research team recruited participants with no previous knowledge on the topic to avoid any potential bias. All FG discussions were audio/video recorded and participants were provided with a consent form and privacy statement at the beginning of the study. One trial FG discussion took place in order to get familiar with the recording tools, the meeting platforms, to adjust the time and identify weaknesses of the script.

The FG discussions were organized both on-line and face-to-face. Although the discussion points were identical for both groups content-wise, the main difference was in the additional involvement of the face-to-face women group in some activities, namely a real-life demonstration of an AV prototype and a related mood board engagement activity trying to describe the feelings when seeing the AV in action. These additional activities were conducted in order to have additional supporting elements, compared to the FG discussions' results that would reinforce or retract previous FG discussions' findings. Moreover, with the participants on the face-to-face activities it was possible to test if their participation would support a more positive approach towards the AV technology due to the real-life experience. These activities were framed within the JRC Future Mobility Solutions Living Lab (FMS-Lab)<sup>1</sup>. The purpose of these two different approaches was to notice changes (if any) in participants' views when they experience an AV under semi or real-life conditions instead of a discussion that stays only at theoretical level.

The online FG discussions were hosted on Webex and Zoom meeting platforms, and 15 participants were divided into four discussion sessions. The face-to-face FG discussions took place at the JRC Ispra site, and 16 women joined three discussions.

#### **4.1 Focus Group Discussions' Methodology**

FG discussions can be the basis of a complete study or, combined with other methods, they can enrich the findings with more elaborated opinions. This research technique "collects data through group interaction on a topic determined by the researcher" (Morgan, 1996), mainly building upon and contrasting each other's ideas (Stewart and Shamdasani, 2014). According to Krueger (2014), FG discussions are described as a small group of people, with certain characteristics, that provide qualitative data in a focused discussion helping in this way to better understand a topic of interest. The main point that differentiates FG discussions from other methods is the collection of attitudes, feelings, beliefs, experiences and reactions that couldn't be collected through other research methods such as observation, one-to-one interviewing, or questionnaire / surveys (Gibbs, 1997). Moreover, this method has been successfully used to gain insights and deeper understanding in transport research in general (Jacobsson, Arnäs, and Stefansson, 2017; Naznin, Currie, and Logan, 2017; Ferrer and Ruiz, 2018; Nikitas, Njaya, and Dani, 2019) or on new transport solutions (Trommer et al., 2016; Pudāne et al., 2019).

In this study FG discussions were carried out both online and physically. Each approach comes with its advantages. The online focus groups are able to overcome challenges related to travel costs, and can easily reach out participants across broad geographic regions, with busy schedules, people with physical impairments and teenagers. At the same time, an online setting facilitates the presentation of supporting visual material used during the discussions and the session's recording. Despite the advantages mentioned, occasional connection breakdowns and technical problems can create interruptions or prolong the duration of the discussions (Schneider et al., 2002; Stewart and Shamdasani, 2017). On the other hand, a face-to-face FG discussion, can increase spontaneity, interaction, intimacy and verbal communication among participants (Stewart and Shamdasani, 2017).

At the beginning of each FG discussion and after a brief introduction to the topic, a short discussion outline was provided (see Annex A for the script of the discussion). The first part of the discussion was dedicated to the mobility habits and needs of the participants together with the challenges that they might face in a daily basis. A clear reference was made to COVID-19 pandemic to investigate if and in which way it has affected their mobility habits. At the end of this first part and in order to increase participants' interaction they were asked to participate in two online activities: a word cloud and a poll. The aim of the word cloud was to gather ideas about words (up to a maximum of five) the participants first think of when they hear AVs, while the poll was used to explore which use of the AV they foresee for the future (Figure 2 and Figure 3).

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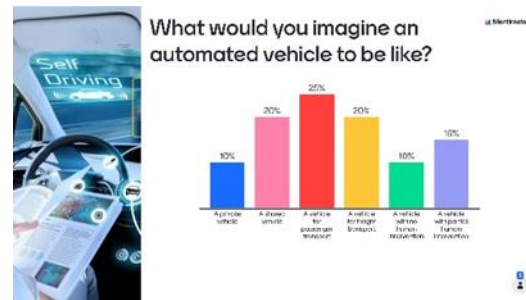
<sup>1</sup> [https://joint-research-centre.ec.europa.eu/pilot-living-labs-jrc\\_en](https://joint-research-centre.ec.europa.eu/pilot-living-labs-jrc_en)

**Figure 2.** Word cloud activity



Source: Participants' contributions.

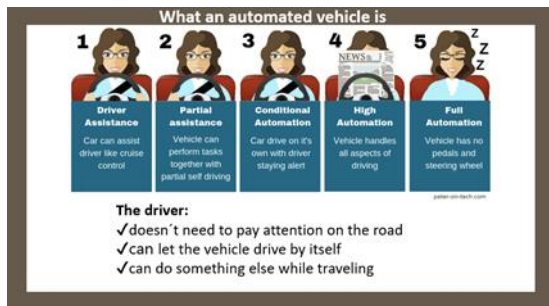
**Figure 3.** Poll activity



Source: Participants' contributions.

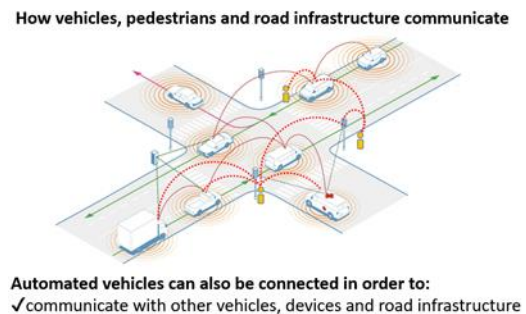
In the second part of the FG discussions, participants were presented first with the definition of AVs through a visual representation of the five levels scale according to Society of Automotive Engineers (SAE) (Figure 4) and a description of connectivity through a picture of the road infrastructure and the links between its different components (Figure 5). These descriptions were important to set a common understanding for the second part that was related to the potential fit of AVs to participants' needs followed by the third part of the discussion that was dedicated to AVs and ethics. The fourth and last part aimed to identify any change of the participants' views after the FG discussion and any knowledge that they might have obtained thanks to their participation in the FG discussion.

**Figure 4.** Description of an automated vehicle



Source: Peter on tech.com.

**Figure 5.** Connectivity description



Source: JRC, 2019.

When the FG discussions were completed, all the recordings were transcribed verbatim by a professional transcriptionist and were anonymised with fictive pseudonyms in the frame of the General Data Protection Regulation (GDPR) guidelines. The pseudo anonymised transcriptions were then inserted to MAXQDA 2020 (VERBI Software, 2019) software for the data analysis applying a content analysis method (Neuendorf, 2019). The software package is designed for computer-assisted qualitative and mixed methods data and all partners (JRC, DLR, Unican) had agreed on a common way forward, developing a common coding used in the analysis phase. The analysis was done by two different research groups that worked in parallel. Frequent meetings were used to assure coding alignment.

For the analysis, a combination of deductive and inductive category construction (Lune and Berg, 2017) was used. The main themes of the coding systems were deductively designed following the script of the FG discussions, while within each theme, the different categories and sub-categories were created inductively following the transcriptions of the discussions. Whenever a segment of text was represented in more than one category, the quote was assigned to each of these categories. Thereby, a deductive procedure following the structure of the script was followed to identify the main sections, while the categories, sub-categories and themes within each section were created inductively by grouping codes together. In addition, particular attention was given to specific topics where participants were asked to provide an opinion on a certain question, or to enumerate different views on the same subject. Thus, when the question requested a general opinion from each participant, only the opinion was counted, and not the number of times it was mentioned by that same



respondent. However, when the addressed topic allowed multiple answers from each participant, the frequency of each opinion expressed was counted. Relevant and illustrative quotes of each topic addressed were retained from the transcriptions and will be presented in the results chapter, indicating the fictive name of participants, the focus groups they participated in and their age.

## 4.2 Survey methodology

All women who took part in the seven FG discussions completed a survey in the days following their participation. The questionnaire was distributed through EU-Survey, EC's online survey-management system, and paper copies were also provided when requested by participants. This survey was designed to collect information on the socio-economic characteristics of the participants (age, possession of driving licence, income level and place of residence), their mobility habits on both weekdays and weekends (typical number of trips made, main trip purpose and most common mode of transport used on both types of day) and their assessment of fourteen questions related to AVs, such as willingness to buy an AV, willingness to use an AV etc.

The questions about the issues related to AVs were valued using a Likert scale with five points: strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4) and strongly agree (5). The entire survey is presented in Annex 3.

The aspects investigated in the questionnaire were: willingness to purchase an AV, type of use associated to the vehicle, the willingness to share an AV, its possible socio-economic impacts, the role played by public and private entities in its deployment and the willingness to share the AV trips' data.

This survey allowed us to provide a quantitative estimate of the perceptions of the women who took part in the participatory process. In addition, it was also possible to estimate, by means of statistical tests, whether there are significant differences in the answers to any questions among different groups defined by the socio-economic variables collected or other characteristics observed in the FG discussions. For this purpose, Kruskal-Wallis tests, considering the ordered type of response, were applied to check if the answers of the different groups presented the same distribution. These results will also be compared with the qualitative answers obtained in the FG discussions in order to complement and support the information collected.

## 4.3 JRC Citizens' engagement activities

In order to broaden the interaction and gather additional views of the face to face women participants, after having completed the FG discussions, they were invited to participate in a real-life demonstration of an AV prototype, Rob.Y, currently tested at the JRC FMS-Lab. Rob.Y is being developed by an Italian SME, e-Shock, part of the e-Novia group<sup>2</sup> and who was granted access to the JRC Living Lab (LL) through an application to an open call for expressions of interest<sup>3</sup>. The demonstration was organised in a dedicated open-air urban test track closed to traffic. Members of e-Shock and of the FMS-Lab research team gave a short introduction and mentioned the technical characteristics of the vehicle. Then the real-life demonstration followed, and participants could see Rob.Y driving in the road and reacting to obstacles (dummies). At the end of the demonstration, participants had the opportunity to express their views in an open discussion and ask questions related to the vehicle behaviour, potential price, year of deployment, etc. (Figure 6). This real-life demonstration of an AV prototype was organised in the framework of the JRC FMS-Lab. The application of the LL approach enabled the active engagement of users and aimed to help citizens to better understand what automation could mean for their lives, set realistic expectations, discuss fears/concerns, etc. LLs are thus important tools to engage citizens and relevant private and public stakeholders since the early stages of development of automated mobility systems and services, promoting the development of AV systems that support broad societal benefit and help cities achieve sustainability goals.

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<sup>2</sup> For more information:

<https://e-novia.it/e-shock-living-lab-jrc-european-commission/>

<https://www.e-shock.it/products/rob-y>

<sup>3</sup>[https://joint-research-centre.ec.europa.eu/research-facility/living-labs-at-the-jrc/call-expression-interest-future-mobility-and-digital-energy-solutions\\_en](https://joint-research-centre.ec.europa.eu/research-facility/living-labs-at-the-jrc/call-expression-interest-future-mobility-and-digital-energy-solutions_en)

**Figure 6.** Real-life demonstration of the AV prototype

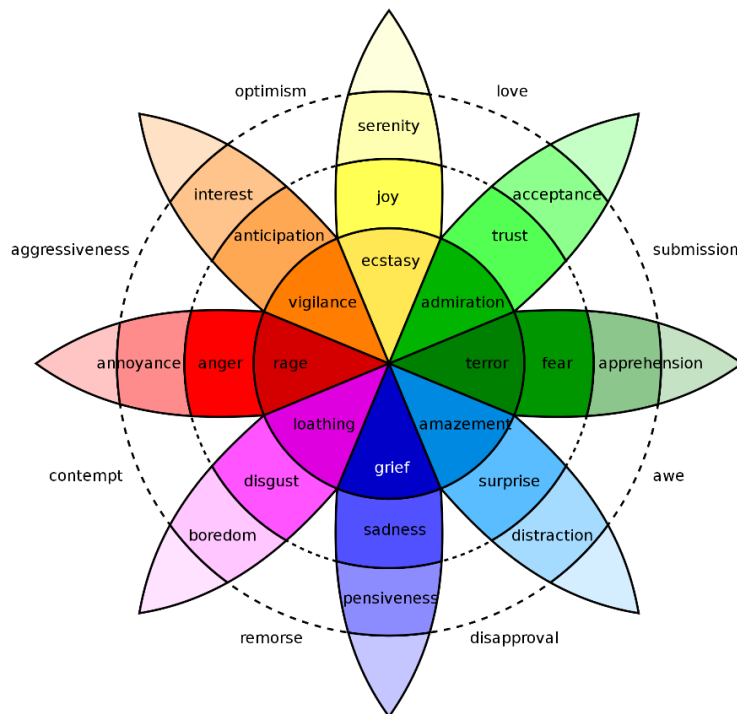


Source: JRC, 2021.

Right after the demonstration, women participants were involved in a mood board activity. Mood boards, according to Endrissat, Islam, and Noppene (2016) are collaborative and creative activities and are commonly used as a visual expression of intangible qualities (an idea or vision for a new product). In this way, participants can better express their thoughts, feelings and abstract concepts by focusing more on the different meanings of the picture than on the picture itself (Pimlott-Wilson, 2012).

Each participant received a folder with 16 cards, where eight emotions were represented twice (see Annex 2); one through a facial expression or human interaction and another card showing natural elements, animals, etc. The feelings were based in Robert's Plutchik categorisation (known as wheel of emotions - see Figure 7). This categorization is based on eight bipolar emotions: joy versus sadness; anger versus fear; trust versus disgust; and anticipation versus surprise, each one linked with a colour. The pictures below were chosen to represent fear (Figure 8) and anticipation (Figure 9).

**Figure 7.** Robert's Plutchik wheel of emotions



Source: 6seconds.org

**Figure 8.** Representation of fear



*Source:* samer daboul from Pexels.com and alex milu from Unsplash.com (respectively).

**Figure 9.** Representation of anticipation



*Source:* Karolina Grabowska and Engin Akyurt from Pexels.com (respectively).

After the distribution of the cards, participants were asked to pick up as many cards as needed which were representing the emotions that they felt during the demonstration. They were also allowed to write a few words or short sentences on the back of the cards explaining how these emotions were linked to the demonstration. At the end, each participant had to orally elaborate on the choices made and then all the cards were put on a board divided in three main sections; positive, negative and mixed related emotions based on participants' elaborations, with the aim to create a map of emotions (Figure 10). The activity was audio-recorded and aimed firstly at catching the emotions derived directly after the demonstration and then engage participants with an innovative technology.

**Figure 10.** Emotions' mapping

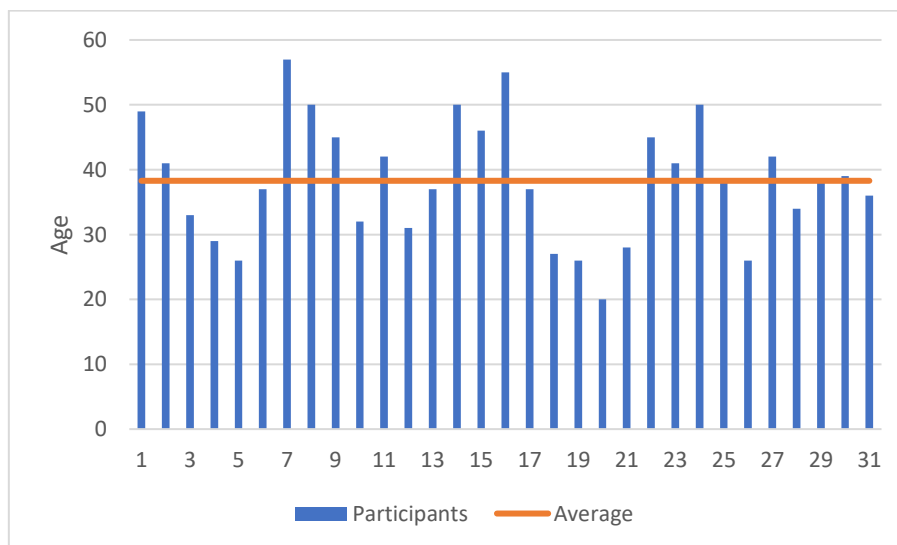


Source: JRC, 2022.

#### 4.4 Sample characteristics

The 31 women who participated in the activities had no transport related professional background and participated voluntarily to the research. Their average age was 38.3 years (Figure 11) with a range between 20 and 57 years old.

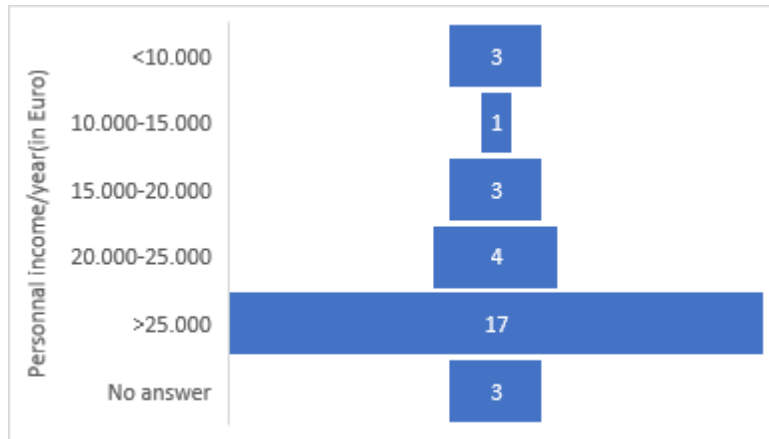
**Figure 11.** Average age-Total FG discussions



Source: JRC, 2022.

The majority of the women who participated in the study had a personal annual income >25.000 Euros (17 out of 31) and the rest was almost equally distributed to the lower categories (Figure 12).

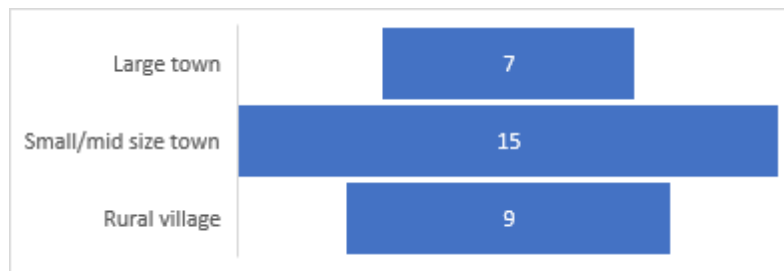
**Figure 12.** Personal income/year (in Euro) total FG discussions



Source: JRC, 2022.

Concerning the place of residence, the majority of the participants (15 out of 31) lived in small/mid-size towns while the rest was almost equally distributed in rural villages and large towns (Figure 13).

**Figure 13.** Participants' place of residence



Source: JRC, 2022.

## 5 Main Results and Discussion

As the research performed included variety of activities, we have decided to present the results in subsections, for the purpose of clarity. Firstly, we will describe the FG discussions results, followed by the survey outcomes and concluding with the citizens' activities results.

### 5.1 Focus Groups Results

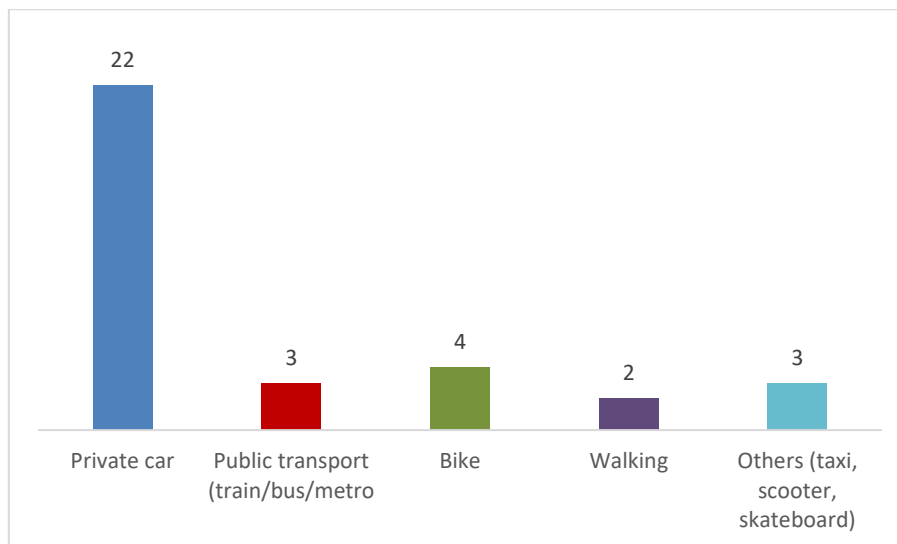
This section presents the main results obtained from the FG discussions, which are illustrated following the FG discussion's script.

#### 5.1.1 Mobility part

The first part of the FG discussions concerned mobility patterns and habits (see Annex 1), linked to the main challenges and positive elements experienced in daily mobility.

The participants were asked to share experiences of their daily mobility illustrating the transport mode mainly used and the underlying reasons for their mode choice. The transport mode most commonly chosen was the private car, in fact 22 participants out of 31 declared to use it on a daily basis, while the other transport mode options were chosen evenly, as illustrated in Figure 14.

Figure 14. Main daily transport mode



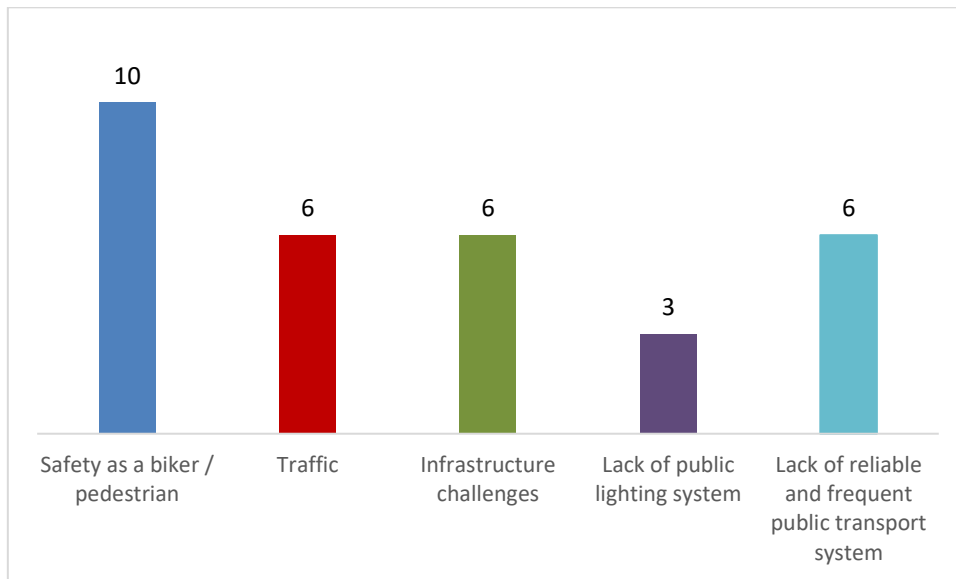
Source: JRC, 2022.

Among those mainly using private cars, 20 declared to live in Italian rural areas or small cities and two in big cities in Germany. The motivations explaining the choice of using a private vehicle were associated to the lack of or lagging quality of public transport infrastructure, to the fact of not being particularly sporty, or, to a general convenience in using a private vehicle, to guarantee a good degree of flexibility to organise the daily routine. The participants opting for other transport modes were instead referring to escaping traffic congestion and the satisfaction with public transport services or biking infrastructures.

*“...all the requirements both work-related and family-related do not fit with the strict timetable offered by the shuttle. While the flexibility offered by the car, at the end, wins” (Giulia, FG6, 50 y/o)*

The main problems faced during their daily mobility are illustrated in Figure 15. Safety was the problem which was mentioned most often in general, therefore, this aspect seems to be urgent and a common concern. It is followed by traffic congestion, lack of reliable and frequent public transport services and transport infrastructures issues, like a lack of bike lanes, pedestrian paths or public lighting system. Other problems associated with daily mobility were also mentioned, such as the environmental pollution created by the transport activities, personal safety concerns, especially when travelling at night, and the difficulty to find parking spots.

**Figure 15.** Problems in daily mobility



Source: JRC, 2022.

*“...when I’m biking, I don’t feel that there is enough awareness from the drivers about the presence of bikes in the lane. Sometimes you have to be over-cautious and really take the whole lane for them to understand that they have to slow down”* (Nataly, FG2, 26 y/o)

*“I don’t always feel safe in public transport, especially if I have to travel late at night, or if I have to wait in the stations for a long time. I feel a bit safer if I am inside the transport, but to wait outside sometimes is a bit uncomfortable”* (Nataly, FG2, 26 y/o)

Personal safety and flexibility were the mobility priorities of women. It’s not surprising that the value of travel time is key for women, who do not like to spend time stuck in traffic jams. Further mentioned aspects included, the environmental effects of transport activities, travel costs and reliability of public transport, the importance of having a defined mobility schedule, which would fit with a daily plan, and the importance of being physically engaged in mobility/transport activities, together with the pleasure of the travelling experience.

*“I think a lot on how environmentally safe the transports are”* (Nataly, FG2, 26 y/o)

*“I want to be sure that I can go everywhere by public transport in a safe and efficient way.”* (Sofia, FG1, 39 y/o)

Then, participants discussed the mobility changes due to the COVID-19 pandemic. The women reported to move less than before the pandemic, as they were working from home, but also because they preferred to do less shopping trips, and trips outside their countries of residence. Some participants indicated increased car dependency shifting their choice from other transport modes, such as public transport or air transport for long distances or leisure trips.

Evidence from these FG discussions is aligned with previous literature on the topic of women mobility patterns, as illustrated in section 2.1. More in detail, women participating in this analysis confirm the outcome of previous scholars who have identified women daily mobility as more complex and time-consuming due to essentially family related responsibilities (Rosenbloom, 2004; European Parliament, 2012; Kawgan-Kagan, 2015; Ng and Acker, 2018; Closing Gap, 2019; García-Jiménez et al., 2020).

*“And I think also because we are not individuals ... with the kids and the family and we have to drive them everywhere”* (Vera, FG5, 45 y/o)

*“...I manage things in timing... if I need to bring someone somewhere ... I would go home, when I go home I do my shopping”* (Manuela, FG5, 57 y/o)

Safety and security aspects were mentioned during the FG discussions, both in relation to personal concerns and to infrastructure issues. These aspects confirmed the outcome of earlier work on the topic (Gardner, Cui, and Coiacetto, 2017; Gekoski et al., 2017; Bakran, 2018; Chowdhury and van Wee, 2020; Coppola and Silvestri, 2021). The safety aspects were perceived as very relevant in relation to personal protection, harassment or violence especially on board of public transport or within the public transport infrastructures. Safety issues were



also associated to the lack or poor quality of transport infrastructure or facilities that could create dangerous situations in relation to other transport users, namely car drivers.

*"When we speak about safety it's not just a lack of infrastructures, but it's a lack of lighting"*  
(Patricia, FG5, 32 y/o)

*"I think it's very dangerous to go on your bicycle because there are no bicycle paths next to the main road"* (Rosa, FG3, 50 y/o)

Previous literature also found evidence of women preferring green modes of transport (European Parliament, 2012; Alonso-Almeida, 2019; Scholten and Joelsson, 2019), which in our analysis is supported more by a general concern about environment and effects of transport on it. Participating women made clear statements about their preference towards greener transport modes, such as walking, biking or public transport against car usage precisely to mitigate environmental pollution.

*"... if there would be the possibility to use public transport, it would be better, just for an environmental reason"* (Carol, FG1, 36 y/o)

Lastly, the importance of a reliable and flexible transport service is central in women mode choice and can influence the entire daily routine, as already pointed out in an earlier study of Pirra et al. (2021).

*"I want to be sure that I can go everywhere by public transport in a safe and efficient way."* (Sofia, FG1, 39 y/o)

*"Well, the key word would be flexibility and in terms of both very early, very late during the day and during the day, you know, being independent of others or times of buses, or trains."* (Nora, FG5, 50 y/o)

### **5.1.2 Knowledge/experience related to AVs and general expectations**

#### *Knowledge and experiences related to AVs*

Interestingly, experience with AVs was acquired by women often in the context of public transport, e.g., in the use of automated trains, trams, metro, or airport shuttles. Also, airplanes were mentioned.

*"I was I think on a fully automated vehicle sometimes but I mean mostly only on rail. There are some in airports, for example, they have those shuttles which take you from one part to the other one. In Venice there is one which brings you to the parking. So, there are some fully automated trains, trains actually, I was on and it's beginning to be there. It's okay, I feel safe because it's on rails and also, I took them during the day. I don't know what would happen if I would be on a train, on a long-distance train, fully automated with no people you know. Again, as a woman, how I would feel if I'm safe there? I think I would not feel safe at all."* (Gabriela, FG7, 55 y/o)

The evaluation of the experiences is mixed: some felt safe, but others indicated having difficulties to trust AVs. Trust seems also to depend on the vehicle used.

*"So, maybe we are not really aware because we know that there is the pilot there, and that's why we feel safe. We don't trust the technology yet, but I think that to do it in steps like, okay, first let's have the car that is parking by itself. Because worst case, you can destroy your car or the others, but you are insured anyway. So, this is the first step to convince us to the technology."* (Greta, FG2, 45 y/o)

Individual experience is not the only source of information, but also knowledge gained from the media or other articles related to the topic.

#### *General expectations related to AVs*

Some women perceive AVs as a vision of future: AVs appear futuristic, strange, not imaginable, or like Science Fiction.

*"I was on an automated metro in Paris once. So, it's something even we made use of, but still, it just doesn't feel very real in terms of it seems like something from a Si-Fi movie from the future, even though it's a reality. But because we don't have the use of it on a daily basis it does not seem very realistic."* (Daniela, FG3, 37 y/o)

General expectations related to AVs include the availability of electric vehicles with fully automated systems based on artificial intelligence and advanced connectivity:



*"I think electric, because [...] it usually goes hand in hand. If you were talking about self-driving or automated vehicles, that they're usually also electric or portray this electric vehicle." (Sonia, FG4, 27 y/o)*

Women were asked to indicate how they think AVs might look like. Various concepts were mentioned, including privately-owned AVs, vehicles on demand or public transport vehicles and the evaluation of these differ among women. When it comes to whether the vehicles have to be fully driverless or a human intervention is needed, there are good reasons for both from women's point of view. Human intervention is preferred mainly because of safety reasons (human should intervene in case of emergency), to improve the software, if the manoeuvre is too complex, and because of potential hacking. Also, the pleasure of driving plays a role.

*"What I've stumbled upon a bit is that all of those things are kind of hackable, and that's kind of frightening me a bit. That's also the reason I didn't say yes to the like fully autonomous without anyone having the possibility to intervene." (Ariana, FG4, 20 y/o)*

Reasons for vehicles being completely automated include the expectation that a machine perform better than a human. However, trust in the technology is a prior requirement.

*"At least for me, it means like automated should be like fully automated. That's what it means for me, so without any human intervention. And anything that is in between is just because of either technology not being able to do it like fully yet, or also because people are difficult to be convinced that the car can, let's say that the technology can do it better always and only by itself." (Greta, FG2, 45 y/o)*

Women envision almost equally privately-owned AVs, shared vehicles, and AVs in public transport, e.g., shuttles for rural areas with no connection to the next public transport option, are evaluated also as a promising solution, but also the use in freight is considered.

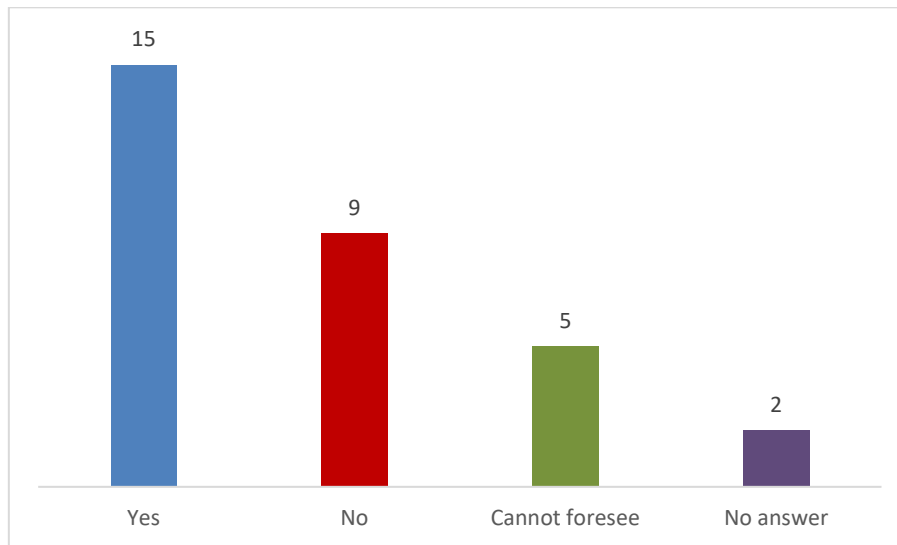
*"I have something to add. I think also on the lake, or [...] on the sea, on the shore, to distance between island and so on, it would be better to use it like you use the airplane, [...]. For short [travels], like you want to go from the island to the other one on the water. [...] Like a ferry." (Elena, FG1, 38 y/o)*

*"[...] and for freight transport because I think then you can have these predetermined paths for the cars. And maybe it's easier because you can choose places where you have the lanes and so on, rather than, you know, me with my private car maybe wanting to go somewhere a bit trickier. And then also I heard on the news yesterday, the Spanish news, that there is a lack of truck drivers because they simply, the conditions are really bad and no one really wants to do it. So, maybe that would be a good solution, right, to have that automated, with other challenges I suppose but I think it would be nice to see that solved." (Axelle, FG6, 37 y/o)*

### **5.1.3 AVs fit to mobility, threats and benefits**

Considering the specific mobility needs of women (described in detail in Section 2.1.), during the FG discussions one question of interest was if the AV can satisfy these specific needs and improve women's mobility in the future (Figure 16).

**Figure 16.** AVs would fit daily mobility requirements



Source: JRC, 2022.

From a total of 31 participants, 15 anticipated that AVs would satisfy their daily mobility needs, 9 said such vehicles would not fit their everyday mobility, five did not provide a clear answer either because they could not imagine themselves using AVs or were undecided and two participants did not answer.

Participants who answered positively to the question provided details on how AVs could improve their daily mobility experience. Some highlighted the better use of travel time by working or performing other activities while commuting in the vehicle, others pointed out that AVs could perform the driving task that they do not like in general and that AVs could make the travel more comfortable and relaxing.

*"I don't like driving so for me it would be like great to just sit in the passenger seat, as I do all the time, and just let the car drive me wherever need then."* (Virginia, FG6, 31 y/o)

*"Because probably it will be also faster, apart from being more comfortable and in some ways also relaxing because you can also sleep. You can read, you can continue working, [...]"* (Carmen, FG2, 28 y/o)

Although mentioning that AVs would satisfy their daily mobility needs, some mentioned that for using such vehicles, first trust must be gained.

*"I need also to, the car to gain my confidence and so I can feel more safety in that car."* (Elena, FG1, 38 y/o)

On the other hand, participants who answered negatively to the question explained that such vehicles would not fit in a rural context, or that they enjoy the current mode of transport they use.

*"[...] speaking about this rural context I don't see a lot of differences."* (Patricia, FG5, 32)

*"Well, in my daily life I think it will not change a lot, I mean because if I just go to pick up the kids or go to do grocery shopping. I mean those distances are not very long, so I could just drive myself."* (Rosa, FG3, 50 y/o)

Other negative views regarding the fit of AVs to daily mobility needs were related to the legislative challenges such vehicles could bring before their full-scale deployment, and the limitations of AVs in specific situations, such as being compliant to speed limits when the vehicle user is in a hurry.

*"[...] we have a law system here in Germany, and I don't think it would be possible to have autonomous vehicles on the streets when there are so many other transport modes whichever driver."* (Veronika, FG4, 26 y/o)

*"[...] if I'm late and you have to respect 50, then I go 60 for example, so to be less late, and then I mean if you have to pick up the kids or something. So, if everything is automated, of course it will only go 50 and so I think [...] probably I would prefer to drive myself."* (Rosa, FG3, 50 y/o)

Of those participants who were undecided or could not imagine the use of AVs, one mentioned that the technology looked “unrealistic” for the country where they are living and one had doubts about the availability of infrastructure needed for the adequate functioning of AVs in a near future.

*“I think that the change won’t be immediate, and we won’t be able to have the infrastructure and all the means of transport as automated vehicles. I think it will be like by stages, and until the final results, I’m not sure it would, it would function well. I’m quite sceptical now, and I think the nearest future would be the cities that it’s mostly like to cover with the net to connect them, because in the countryside, it’s always a problem. Even with the Internet connection, so I cannot imagine this net connecting so many vehicles for example.”* (Sofia, FG1, 39 y/o)

Finally, it is important to acknowledge that some of the participants who considered that AVs would satisfy their daily mobility needs, voiced their preference for a public transport option. Especially, considering the traffic problems due to the individual use of cars and the fact that such option would represent a “greener” solution. One participant provided specific details about the type of public transport foreseen (shuttle service on demand) for the future of personal mobility.

*“There are too many cars. So, I would move more on automatic vehicles, [...], for the public transport, to improve it instead of having one car for each person in the future, in the ideal world.”* (Amara, FG2, 42 y/o)

*“...I can imagine having an App or something like this where I can order a shuttle and I can set the dates or the times when I need the shuttle and the shuttle will come from this place to my home and I just have to wait for the shuttle outside. So, then it could transport me from my home to my destination.”* (Veronika, FG4, 26 y/o)

When questioned if AVs would satisfy their occasional/leisure mobility needs 15 participants answered positively, one could not foresee it and 15 did not provide an answer to this question.

Some participants pointed out the potential of AVs to improve their travelling experience on long distance trips by increasing the comfort while travelling, providing the possibility to perform other activities or to rest and sleep.

*“I have to say that I am flying on different travels, it would be, it would mean you can do other things. You can kill time reading, talking, eating.”* (Vivian, FG7, 49 y/o)

Another interesting aspect mentioned in relation to leisure mobility was the fact that the deployment of AVs could provide the possibility to use a vehicle while tired or to consume alcohol without worrying about driving.

*“So, it would be really nice, for example, for the vehicle to drive me in case of well I’m like tired of for example when I go out with friends, have some drinks.”* (Lauren, FG6, 29 y/o)

During the FG discussions, participants were requested to provide details about potential benefits and threats of AVs. The table below (Table 1) provides the aspects indicated by FG participants, which have implications either at personal mobility or at societal level.

**Table 1.** Anticipated benefits and threats of AVs

	<b>Benefits</b>	<b>Threats</b>
<b>Personal level</b>	Can do other things while driving (7 <sup>1</sup> ); Reduce stress (5); Increase safety (4); Reduce human error (3); Relax even drink when in the city and not worry about driving (2); Increase time for own person (1); Facilitate commuting together (1); Reduce time travelling and fuel consumption (1); Driving would become a leisure activity (1); Increase comfort (1); Flexibility (1); Free hands (1);	Hacking (4); Lack of control over the vehicle (4); Privacy issues (4); Cybersecurity and dealing with emergency situations (1); Issues of legal responsibility (1).
<b>Societal level</b>	Reduce number of accidents (5); Increase access for children, elderly, disabled (5); Reduce traffic (1); Increase society of production and productivity (1); Improve traffic flow by traveling at night (1); Gain of additional jobs (1); Increase shared mobility (1); Reduce traffic jams (1); Green and sustainable transport (1); Increase control of traffic at societal level (1).	Increase traffic (2); Loss of jobs (2); Safety and traffic issues (1); Loss of driving skills (1); Software not adjusted for some unusual situations (1); Increase inequality among countries (1).

<sup>(1)</sup> Number of persons who have indicated the specific aspect.

Source: JRC, 2022.

Overall, based on the results outlined in Table 1, women FG discussions' participants hold a diverse and positive view towards AVs future impact taking into consideration the higher number and variety of benefits identified both at personal and societal level compared with the number of threats highlighted during the discussions.

### *Benefits of automated vehicles*

Possible AVs benefits were linked to improvements of the travel experience. In particular, the possibility to perform other activities or sleep while travelling on long distances, a positive impact on their mood by lowering the stress related to traffic or to travel safety, a more relaxed travel experience as there would be no worries about reaching the destination, a gain in flexibility due to the increase in independence for children.

*"I will have more time for myself, so I won't be all the time stressed by the traffic."* (Elena, FG1, 38 y/o)

*"Well, it would help of course because also you don't need navigator as well, so it's something [...]. And you can in some way reach your destination in a more relaxed way, but in the same way."* (Patricia, FG5, 32 y/o)

Some of the participants indicated an increase of safety and a reduction of accidents, especially attributed to the potential reduction of human errors, alcohol consumption, as well as AVs being more compliant with driving rules compared to human drivers.

*"[...] there will be less accidents because there will be many different built-in features to prevent those from happening. [...] But I think actually it would be good also, you know, lots of young people go out and maybe they drink something, so you have much-, I guess it would prevent accidents from alcohol use."* (Rosa, FG3, 50 y/o)

Increase in accessibility for people without a driving licence or for people who have mobility constraints (aging people, people with disabilities, children) was indicated by some FG discussion respondents as a benefit that AVs could bring in the future.

*"I think it could be a really good advantage for disabled people or for elderly people to be, I mean there is an age that you should stop driving, but they are still needing to drive and they want to drive."* (Nataly, FG2, 26 y/o)

Participants mentioned also benefits related to improvements of the traffic conditions and reduction of traffic jams, since AVs could run at the same speed ensuring a better flow of vehicles and an overall better control of the traffic.

*"The main issue of using the car because you have to drive and so start and stop every time. So, with this I guess, that with this automation all cars go at same speed, so there is continuous flow of cars that avoids a traffic jam."* (Patricia, FG5, 32 y/o)

Other positive aspects mentioned were related to encouraging shared mobility and the fact that AVs could represent a more sustainable and predictable transport mode.

*"I think is probably the easiest one to identify, is greener transport, more sustainable methods of moving around."* (Cynthia, FG3, 41 y/o)

*"The only things could be timetable, being able to really know at what time you are getting to the place."* (Valeria, FG3, 38 y/o)

Also, there is no need to have a driving license, which enable potentially also children to use such vehicles.

*"On the plus side it means you don't need to have a driving license. It is probably an app where you can say pick me up here and bring me there. So, would that be allowed to use for like kids of 12, 13 years old? That would be very helpful."* (Nora, FG5, 50 y/o)

### *Threats of automated vehicles*

Regarding the negative aspects of AVs, participants mentioned threats for their personal safety in relation to cybersecurity and hacking of AVs (especially if they are connected) that could increase accidents or the possibility of the vehicle being controlled remotely by someone else. Other challenges could come from a combination of mixed traffic context, from the fact that AVs are not prepared to react in case of natural or external disasters or loss of connectivity in remote areas.

*"I mean it, you know, being connected with some of a system I have no control of and on the other hand as much as I trust it, it can be also hacked. [...] I imagine situation that I'm, I don't know, my child or a family member is kidnapped by the car and drove somewhere and the person cannot react. I mean, you cannot do anything, it is this car where you have no control. [...] That's another problem, I think. To mix automated with not automated."* (Gabriela, FG7, 55 y/o)

*"I'm speaking also about, I don't know, natural disasters so that it's flooding, there is a hurricane, there is a windstorm. Is the vehicle trained enough to manage how would be the reaction? If you, so it could pose you a risk because of external factors. [...] You ride out of connection or whatever I mean, then you cannot do much, you are just sitting there alone."* (Patricia, FG5, 32 y/o)

Increase of traffic was identified by some FG discussion participants as a potential negative consequence of AVs deployment, either considering the increase of vehicles on the road, especially at night or by the increase of private vehicle usage which might be difficult to manage even if these vehicles are connected.

*"I see as a main risk these things that I said already, so everybody has his own vehicle and is moving like, I really don't think that in some cases we can manage, even with connectivity."* (Amara, FG2, 42 y/o)

Challenges related to the protection of privacy while using AVs were mentioned by participants as potential threats and one participant suggested that the data produced and collected by AVs should not be owned by a specific entity in order to ensure privacy.

*"I think it forces you to share a lot of information because you can just take our car now and go somewhere, I may not just tell anybody. But if you're in one of those vehicles, then I mean, they're bound to be connected so they have to communicate with each other. They have to know where you go, when you go and you know, it's a big word nowadays, but privacy."* (Vivian, FG7, 49 y/o)

Some participants were concerned about the lack of control over the vehicle behaviour that can be experienced while using AVs and this could be linked with "trust" towards the vehicles or the "fear of giving up on" human capabilities.

*"You know I see on this picture of me being in a car which does what it wants, yeah. I mean it, you know, being connected with some of a system I have no control of and on the other hand as much as I trust it, it can be also hacked."* (Gabriela, FG7, 55 y/o)

Participants also mentioned that the deployment of AVs could create more loneliness in general and reduce human interactions (aging people would not need help for their groceries and kids will not need help from their parents) and AVs could trigger "even more a society of production and productivity" where people need to be always available and productive.

*"And yeah, I think a bad thing might be that we might trigger even more a society of production and productivity and you have to be always doing something, accepting calls, reading emails, I don't know."* (Nataly, FG2, 26 y/o)

Some societal level threats mentioned by participants were related to the reduction in the number of jobs available and that AVs deployment will lead to losing driving skills.

*"And then three I guess on a more negative front, does it mean that as a society we are using-, we are losing a skill, i.e., the skill to drive a vehicle? Maybe that's a trend. If more and more people use automation, then there simply won't be a need to know how to drive a vehicle."* (Rosa, FG3, 50 y/o)

Other risks raised were linked to legal responsibility in case of accidents or speed limitation that could increase travel time.

*"I think that would be an issue also what would happen in case of like a crash, if one would appear, like who is at fault and stuff. I think that would be too hard for nowadays law system, let's say, like that, to acquire."* (Ariana, FG4, 20 y/o)

Finally, some participants doubted that AVs will be available in the near future due to infrastructure challenges or the fact that the full-automation technology will not be ready.

*"I think that the change won't be immediate, and we won't be able to, to have the infrastructure and all the means of transport as automated vehicles, or automated cars. I think it will be like by stages, and until the final results, I'm not sure it would, it would function well. I don't know."* (Carol, FG1, 36 y/o)

#### **5.1.4 Ethical aspects**

Opportunities to access AVs

In relation to ethical aspects, participants were asked if they thought all users would have the same opportunities to access AVs. Participants identified different barriers and opportunities regarding the deployment of the technology.

Participants identified both limitations and opportunities for different categories of the population that are often reduced in their mobility: minors, people with disabilities, and older people, in line with the work of Pirra et al. (2021). In line with Tremoulet et al. (2020), some participants were not in favour of letting children ride in AVs, judging their presence inappropriate. However, two participants highlighted the benefits that could result from their use, allowing parents to save travel time and teenagers to gain independence. One participant perceived benefits for teenagers living in the countryside that could access cultural and other activities, while another one saw the opportunity for parents to save driving time. On the other side, some participants were firmly opposed to their use by minors. These participants pointed out that very young children cannot be alone in the vehicle, creating a feeling of unsafety. AVs were also perceived as an opportunity for the older population to improve their mobility, although at the same time participants doubted that aging people would trust and understand automated driving technology. Finally, they also mentioned people with disabilities, but without providing any further information.

*"I also know many mums or parents that are practically working, especially having let's say more than one kid, or two, three kids at school, they are practically working as drivers. Between the school and different activities." (Greta, FG2, 45 y/o)*

*"Maybe also older people don't trust these vehicles, because for them it's something too much. They don't understand, so this could be another possibility." (Carmen, FG2, 28 y/o)*

In line with Sovacool et al. (2018) and Sovacool et al. (2019), participants highlighted the cost of AVs and AV services as a barrier to their adoption. They argued that part of the population will not have the financial resources to privately own an AV, especially at the beginning, when the technology will be affordable only by a few. However, some of the participants envisioned that AVs could be accessible to the whole population if they would be proposed as a shared service.

In addition, participants pointed out that AVs may not be accessible to everyone (particularly households with low income), or at least at the beginning of the deployment where only few people will have access to them, or only if a shared business model is favoured.

*"I don't know when you say automated vehicles, to me it sounds like something really expensive. I don't know if it's for the moment maybe because it seems something so futuristic, so that could be something that not all people can afford." (Valeria, FG3, 38 y/o)*

*"I imagined before that it would be a shared car, I think that the cost would be even maybe lower than the cost of now family having two cars." (Gabriela, FG7, 55 y/o)*

Participants emphasized during the conversations that the inequity to access AVs could also be geographically related. According to them, some countries and/or continents will need more time to deploy AVs while developed countries have more resources to deploy them. Participants mentioned also that possibly rural areas will have a more restricted access to AVs compared to urban areas. The reasons being the available infrastructure, and the long process for technologies (e.g., internet) or the different transport options to be fully accessible.

*"I don't think there will be equality over the world. If we're just talking about Europe, then I guess it would work." (Virginia, FG6, 31 y/o)*

*"I think especially people who live in more rural areas won't really be able to access this because I think especially if we look at the situation in Germany, I mean, there are still places where you don't have proper internet connection." (Sonia, FG4, 27 y/o)*

Participants could explain which information they would need to know before using AVs (e.g., as a pre-condition for usage). Safety was the most discussed element, followed by privacy issues and other elements, like legal aspects.

The women participating to the FG discussions were keen to provide different kinds of information they would like to know related to safety. Participants mentioned they would like to be informed about the tests performed on the vehicles (i.e., crash tests, tests of pilot vehicles) and how and where they are implemented. Participants would also like to know how the AVs operate or behave in case of unexpected circumstances and how they, as human drivers, should consequently behave. Other information needed concerned the interaction of AVs with elements that do not have connectivity technologies (e.g., bicycles or material on the street), their comparison with conventional vehicles, and the software and antiviruses installed as well as who developed them.

*"When you are commuting yourself in an automated vehicle, you know, some, some good understanding of how it can be operated, how humans can intervene [...] you know if there is a need. So, this again on taking control, if necessary, should something go wrong." (Daniela, FG3, 37 y/o)*

*"Because for sure at some point it will be safer if everything is connected. So, to point out also, it is not only the safe part but also statistically maybe speaking, the safety compared to normal vehicles, not automated vehicles." (Carmen, FG2, 28 y/o)*

Information on who will control the data and with whom it will be shared was also asked. The participants would like to be informed about how their data are treated, who controls and have access to them, where they are stored, which kind of information is shared and with whom, how and for what purpose it is used (i.e., to support their mobility, for commercial purpose, etc.). Linked to privacy, a participant explained she would like to know if AVs will be protected against hackers.

*"What happens with my data? [...] Absolutely, I want to know what happens with my data if put to this system." (Gabriela, FG7, 55 y/o)*

*"Then how safe is the IT of these vehicles? How hard is it to hack it, number one for our personal information? Like if we said that even if we aren't driving those cars, we will share our information of locations with it, so we'll be safer. How easy would it be for someone to hack the system and look at my GPS system?" (Ariana, FG4, 20 y/o)*

Other information considered necessary was related to legal aspects. One participant wondered who would be legally responsible in case of accident, and two others expressed concerns regarding the ownership of the AV fleet in the case of the deployment of shared services. Especially, it was highlighted through rhetoric questions two opposite business models: one "democratically controlled" and the other one "private".

*"I mean, if it's shared, who is the owner, the real owner, so who makes the money? Is it the government? Is it some kind of a I don't know, some kind of a cooperative or socially owned company? Or is it a Jeff Bezos or somebody else who just makes money and has little? Yeah, exactly, is it democratically controlled this company or is it a private company? Yeah, that would be very important." (Gabriela, FG7, 55 y/o)*

Finally, user-friendly information or technical reports containing "objective" information on the type of business model (i.e., shared or private) and vehicles (i.e., electric or not) that will be deployed, as well as information on the mobility coverage of the AVs (i.e., if they can drive everywhere) were mentioned.

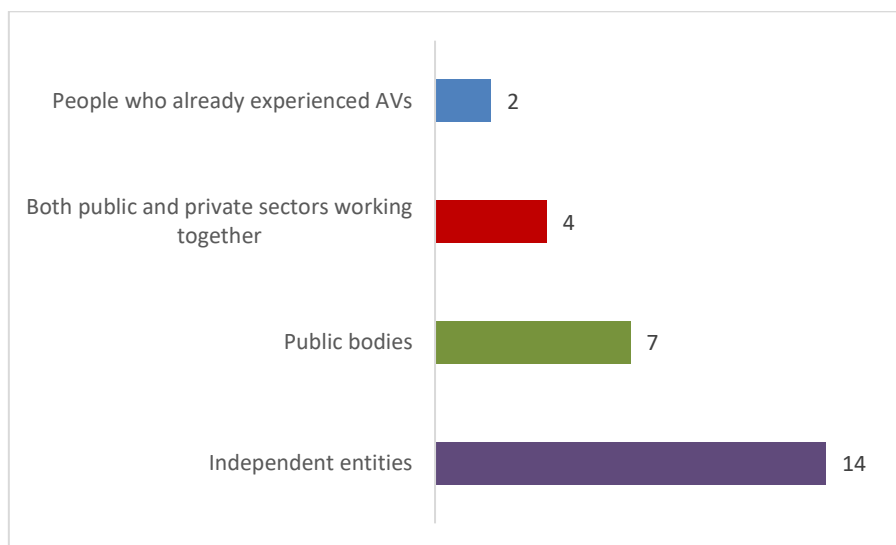
*"I think independent research, but it should be understandable also for someone like me who's not a researcher." (Valeria, FG3, 38 y/o)*

In line with literature (Liljamo, Liimatainen, and Pöllänen, 2018; Pflugfelder, 2018; Salonen, 2018; Acheampong and Cugurullo, 2019), safety was a concern expressed during the discussions that was also an opportunity to understand in details what women would expect as information to feel safe within AVs. In addition, the need for regulation on safety and explanations on how to react in case of emergency can also be linked to a high level of anxiety towards AVs, and as a lack of trust that are also factors identified in the literature (Hohenberger, Spörrle, and Welp, 2016; Pflugfelder, 2018; Liu et al., 2019).

Participants were also asked to detail who they would trust the most to be informed about AVs. From the answers of the participants, it appears that independent entities were more frequently mentioned compared to other entities (Figure 17).



**Figure 17.** Who should inform you about AVs (frequency)



Source: JRC, 2022.

Regarding independent bodies, participants mentioned universities, scientific organizations, experts and associations, and bodies providing certifications in the respect of public authorities' laws and rules. When providing their opinions about those different bodies, participants often pointed out their reliability using expressions like "scientific evidence", "reliable data" or "facts that are completely objective". Those participants explained that their preference was also driven by the lack of trust towards the private sector and the public bodies; as for example one of the participants who would reject a solution proposed by the private sector, or another one who expressed doubt towards politics.

*"You have the universities, then you have some kind of official organisation, but what I would reject is a solution that is only pushed by industry or private initiative." (Nataly, FG2, 26 y/o)*

*"[...] but with more importance to the scientific part because public bodies are partly by specific politics, so they can be manipulated, let's say, or manipulating." (Nancy, FG7, 42 y/o)*

Regarding public authorities, participants mentioned different public entities without providing further information: the municipalities, the national governments, and the European Authorities. Only one participant deepened her opinion, explaining she would give her trust to national Transport Departments because of their potential knowledge on transport regulations and by consequence on AVs. Finally, one participant suggested to harmonize the regulation at the International, European and National levels.

*"The general department of transport is the one that controls the whole laws of traffic. So I would assume, I would expect them to also be aware of the new laws and so transport of automated vehicles. So, I would always want to rely on the government department of transport." (Celeste, FG7, 26 y/o)*

*"I think we need some general regulation rules, country rules, EU rules or worldwide rules if we can agree all." (Sofia, FG1, 39 y/o)*

About the cooperation of both public and private sectors, participants provided different visions. From one side, two participants mentioned that both entities should collaborate to provide information to the public, through a "coordinated campaign", and also on elaborating the information. While on the other side participants mentioned that public authorities should "back up" the private sector, highlighting a need to control the information provided by the private sector. Finally, one participant mentioned that she would like to be independently informed by both entities.

*"I wouldn't mind it if it's written on the page of Tesla. But what's important for me is number one, that it is backed up by the government." (Ariana, FG4, 20 y/o)*

*"I would want to hear from the government, whether at a national or European level, but I would also be interested in knowing what the private sector has to say." (Ramona, FG7, 33 y/o)*

Finally, some participants mentioned that the information should be centralized to ease the access to the information for the citizens, while for another one, information channels should be tailored according to the different socio-demographic categories of the population.

*“So, of course the scientific one, but maybe for elderly people or less educated people also another type of communication. Otherwise, they-, I think they don’t trust. They think there is something wrong. It’s for the money, economic, political thing so they don’t trust.”* (Carmen, FG2, 28 y/o)

When asked about their agreement with sharing their mobility data to improve traffic safety and congestion, 19 out of 31 participants agreed, 1 would not, 1 was undecided and ten did not answer.

Although most of the participants would agree to share their mobility data, they would accept to do it under different conditions. Six participants expressed the need to construct a legal framework at European and International level in order to guarantee the privacy of their information. Two participants explained that the information should be shared to support mobility and not for other purposes, while two others would like to have the control over their personal information and to opt-out when they feel they are threatened.

*“In Europe I think we’re on the good way, on the right track, but I would not be willing to do it outside of Europe for now. So, it somehow has to be this legal, international legal network which works and which really protects every single user of this system.”* (Gabriela, FG7, 55 y/o)

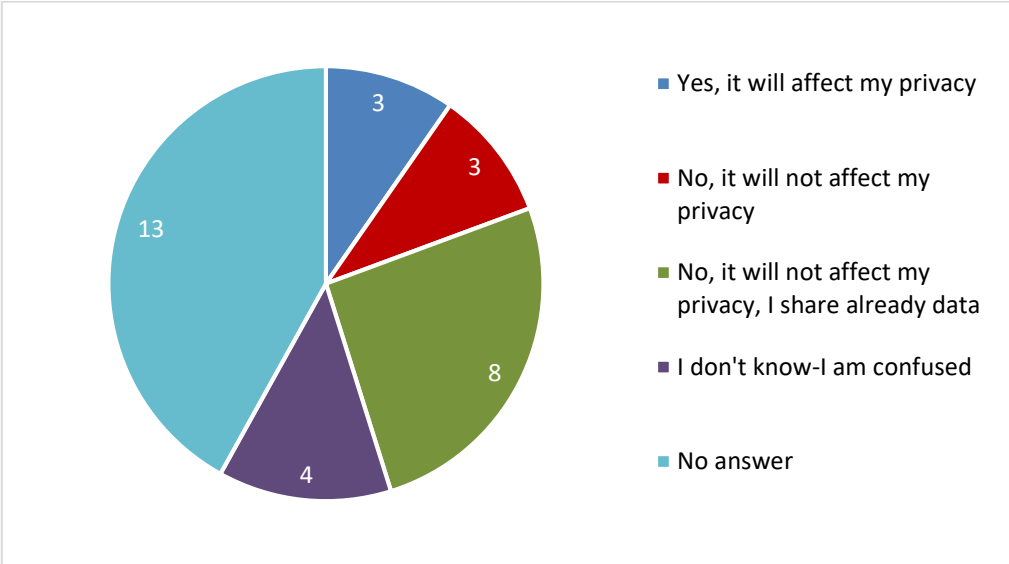
*“As long as the data comes to them anonymised and just for mobility reasons, I wouldn’t have a problem sharing data.”* (Celeste, FG7, 26 y/o)

Finally, three participants explained that they would prefer to share their information with public authorities, but not with private companies that could misuse them.

*“I would give my data to these public authorities or supervisory parties but not to private entities because of, they give to bad use of data and for commercial purposes.”* (Patricia, FG5, 32 y/o)

Participants were asked if sharing their mobility data with the entities mentioned in the previous questions would affect their privacy (Figure 18). 13 out of the 31 participants did not answer to the question, eight answered that they were already sharing data anyway, four were feeling both comfortable and uncomfortable with it. Finally, three mentioned that sharing their data will not affect privacy, while three thought that indeed, it would do so.

**Figure 18.** Participants’ opinion on if sharing their mobility data would affect their privacy



Source: JRC, 2022.

Participants who answered that they already share data would be bothered and concerned with the idea of sharing also mobility data. Most of them declared that they would have no problem to share them if they can benefit from the use of AVs. Behind the idea that they are already sharing their data, participants often described a routine where the share of data is omnipresent (e.g., when they move “to the toilet” with the GPS activated, when they buy “train ticket with [their] credit card” or when they use “Google Maps”) and impossible

to avoid. For instance, one participant explained how she feels trapped, but somehow always agrees with the privacy statements, or another one explained that despite her avoidance of social media and sharing whenever she can, she always finds herself receiving notifications related to her activities.

*"I think it's just that sort of lack of privacy and how it imposes on your lifestyle is my concern. [...] But I still sign these agreements all the time, yeah, so."* (Cynthia, FG3, 41 y/o)

*"I don't even have Facebook or Instagram because I already think that's almost too much, but so I'm a very private person. So I'd rather be that way, but I know like if you have your position on, so many times you go into a shop and then you come out, and then you see, 'How was your', how was the shop?"* (Rosa, FG3, 50 y/o)

Participants declaring mixed feelings, described situations in which they would accept or not to share their data. In general, those participants emphasized that they would agree to share their information for research purposes or if the purpose would be "good" according to their personal values, but not with private companies. Also, one participant explained that it would depend on the type of data, the legislation, and how they are anonymized.

*"For me at least that, you know, I don't, I don't have any secrets, but for example I don't like to keep the position on in Google, simply. So, these kinds of things. It's something that for me would be an issue."* (Amara, FG2, 42 y/o)

*"It depends on the data. It depends if we can keep up with the legislation [...] and [if] they are anonymised in the correct way."* (Megan, FG5, 37 y/o)

Participants who explained that it would not affect their privacy explained that the laws that were implemented and their anonymity are already protecting Europeans citizens.

*"I think we just trust because we have the laws and the rules in place, so we trust that."* (Gabriela, FG7, 55 y/o)

*"I think there are definitely ways in which you could share the mobility data anonymously, so you share the data so the system will see you are walking there, but they don't know that it's you. They just recognise there's someone walking. So, I think that would probably be a way to solve it."* (Ariana, FG4, 20 y/o)

### **5.1.5 Change of opinion**

With regard to their general opinion and evaluation of AVs, some women indicated the FG discussion changed their mind, some were unsure, but the majority indicated it did not.

*"Yeah. I haven't changed my mind but I see more aspects maybe."* (Gabriela, FG7, 55 y/o)

*"I don't know if it necessarily changed, and I don't think you can like, I wouldn't generalise it as a good or bad thing because like how it also came out in the discussion, there are so many different aspects to it and so many things that need to be discussed."* (Sonia, FG4, 27 y/o)

*"And I think I'm more positive about the technology."* (Megan, FG5, 37 y/o)

Finally, when asking about which (type of) information from the discussion have led particularly to the change of their opinions, women mentioned different aspects. The aspect most frequently mentioned is that they gain more knowledge about the topic, i.e., that now they knew more about AVs than before the discussion.

*"I think I have a wider view."* (Vivian, FG7, 49 y/o)

For others, the FG discussion made AVs more real.

*"Well, first of all, for me, doing the discussion and talking with you, it makes it like more real. Like, well, people are really researching into this, so it's not going to be a futuristic movie, but it's something that probably is really going to be real."* (Valeria, FG3, 38 y/o)

One woman indicated she would need more information and public debate.

*"I think what I find interesting is that all three of us had similar concerns because I think that also shows that there's maybe still some information lacking or public debate around it hasn't really given an answer to these questions. So, I think that's, I think, an interesting aspect that there's three different people who don't know each other but all have similar concerns."* (Sonia, FG4, 27 y/o)

## 5.2 Survey Results

### 5.2.1 Mobility patterns

The survey allowed to examine specific mobility characteristics of the participating women (see Table 2). The typical working weekday trip in the sample had the purpose of using transport for working or accompanying children or dependent family members and was made mainly by private car or active modes (e.g., walking, biking) followed by public transport and train. During the weekend, the most common trip was for a leisure/sport or shopping activity using the private car. The mean number of trips was slightly higher during the weekend (3.7) compared to working days (2.6).

**Table 2.** Mobility patterns of surveyed women

<b>Mean Trips working day</b>	-	2.6
<b>Most common trip purpose on weekday</b>	Work	35.5%
	Study	2.6%
	Shopping	18.4%
	Leisure-Sport activities	17.1%
	Accompany children or dependent family members	22.4%
	Other	4.0%
<b>Most used mode on weekday</b>	Walking	12.9%
	Bicycle	12.9%
	Public transport (bus, tram, metro)	9.7%
	Train	3.2%
	Private car	58.1%
	Other	3.2%
<b>Mean Trips weekend</b>	-	3.7
<b>Most common trip purpose at weekend</b>	Work	4.3%
	Study	1.4%
	Shopping	34.8%
	Leisure-Sport activities	40.6%
	Accompany children or dependent family members	15.9%
	Other	3.0%
<b>Most used mode at weekend</b>	Walking	12.9%
	Bicycle	3.2%
	Public transport (bus, tram, metro)	6.5%
	Train	3.2%
	Private car	71.0%
	Other	3.2%

## 5.2.2 Purchase and use of an AV

Through this section, the following notation is used for sample summary statistics: mean ( $\bar{x}$ ) and standard deviation (SD). Considering the questions about aspects related to AVs participants were presented with statements which they had to indicate their level of agreement based on a five-point Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree). The women surveyed showed a slight agreement with buying an AV if it was affordable ( $\bar{x}$ : 3.4) and with using it as a single passenger (see Table 3 and Figure 19). They fairly agree with sharing the vehicle with people they know ( $\bar{x}$ :3.9) and to a lesser extent with people they do not know ( $\bar{x}$ :3.2). In addition, they are clearly in favour of sharing the vehicle to protect the environment ( $\bar{x}$ :4), which coincides with a high general concern about the environment indicated during the FG discussions (see section 5.1.1). They also agreed to share an AV to save money, although with a lower mean ( $\bar{x}$ :3.7).

## 5.2.3 Economic impacts and ethical aspects

The economic impacts of AVs are experienced as probably more positive than negative ( $\bar{x}$ :3.2 vs  $\bar{x}$ :2.8) although with the risk of generating inequality among individuals ( $\bar{x}$ :3.6) as it was also mentioned during the FG discussions given that part of the population may not have the necessary resources to take advantage of the benefits of a private AV (see for more details section 5.1.4). In general, they have more confidence in public authorities than in private companies regarding the deployment of AVs ( $\bar{x}$ :3.9 vs.  $\bar{x}$ :2.8). The issue of sharing the data can generate contrasting opinions. In the survey, the most supported alternative is to share anonymised data with public/private road administrators to improve traffic safety and congestion ( $\bar{x}$ :3.9), to a lesser extent with other road users ( $\bar{x}$ :3.6) and to an even lesser extent with private companies ( $\bar{x}$ :3.2), with an important dispersion in responses (SD: 1.3) in the latter case. This reluctance towards private companies and sharing personal mobility data with them is in line with the discussion about ethical aspects (section 5.1.4) in which the participants showed more confidence in independent entities and public administrations to receive information about AVs.

## 5.2.4 Differences according to socio-economic characteristics and other variables obtained in the FGs

No significant difference in the evaluations of the questions using a Kruskal-Wallis test was detected considering the variables: possession of driving license, level of income and place of residence. The alpha level to consider a difference among groups as significant was corrected taking into account that 14 tests were estimated. Bonferroni and Benjamini-Hochberg methods were applied to calculate the corrected alpha levels (Lesack and Naugler, 2011). The same procedure was followed in the case of variables such as if the person usually accompanies children and relatives, whether AVs fit their mobility needs and if the person had previous experience with automated features. In any case, significant differences were detected considering the corrected alpha levels. This importance of efficiency and above all safety was also highlighted in the FG discussions (section 5.1.4).

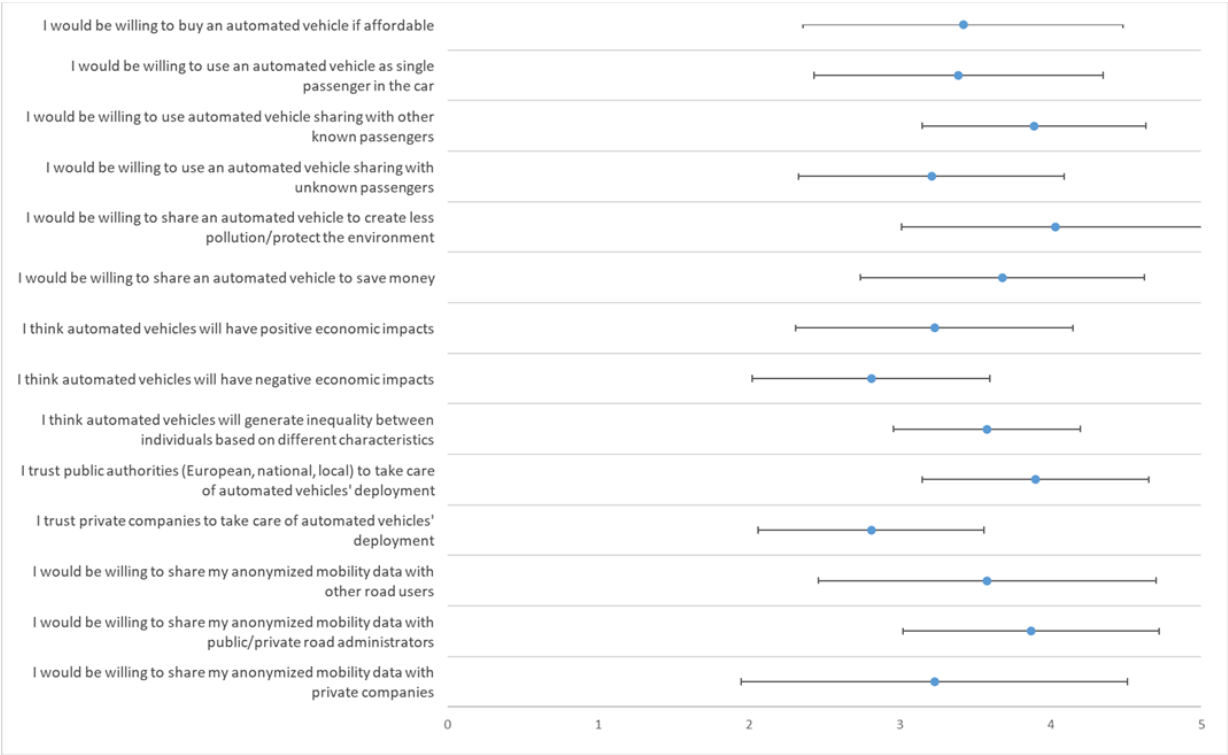
**Table 3.** Mean and standard deviation of the obtained answers in the survey about the AVs related aspects

Question	Mean	SD
I would be willing to buy an automated vehicle if affordable	3.42	1.06
I would be willing to use an automated vehicle as single passenger in the car	3.39	0.96
I would be willing to use automated vehicle sharing with other known passengers (family, friends)	3.89	0.74
I would be willing to use an automated vehicle sharing with unknown passengers	3.21	0.88
I would be willing to share an automated vehicle to create less pollution/protect the environment	4.03	1.02
I would be willing to share an automated vehicle to save money	3.68	0.94

I think automated vehicles will have positive economic impacts (more jobs/increase economic growth)	3.23	0.92
I think automated vehicles will have negative economic impacts (less jobs/decrease economic growth)	2.81	0.79
I think automated vehicles will generate inequality between individuals based on different characteristics (race, age, gender, income, ethnicity, disability, etc.)	3.58	0.62
I trust public authorities (European, national, local) to take care of automated vehicles' deployment assuring that automated vehicles' design, development and roll out is done in line with sustainability, accessibility and ethical goals	3.90	0.75
I trust private companies to take care of automated vehicles' deployment assuring that automated vehicles' design, development and roll out is done in line with sustainability, accessibility and ethical goals	2.81	0.75
I would be willing to share my anonymized mobility data with other road users to improve traffic safety/congestion/efficiency	3.58	1.12
I would be willing to share my anonymized mobility data with public/private road administrators to improve traffic safety/congestion/efficiency	3.87	0.85
I would be willing to share my anonymized mobility data with private companies to improve traffic safety/congestion/efficiency	3.23	1.28

Source: JRC, 2022.

**Figure 19.** Mean and standard deviation of the obtained answers in the survey about the AVs related aspects



Source: JRC, 2022.

### 5.3 JRC Citizens’ engagement activities Results

The mood board activity was an opportunity for the participants to express their feelings towards AVs after the demonstration of Rob.Y AV prototype. During the activity, people had to choose among different pictures the ones reflecting the best their emotions towards AVs. In total, participants commented on 24 cards although some of the cards proposed were not chosen by the participants, namely the two cards associated to sadness, one to disgust, one to fear, one to joy, one to trust, and one to anger.

Generally, participants linked the cards with the initial emotion previously associated to it by the researchers. This was mainly the case for the cards related to happiness, trust, hope and expectations, and fear. However, sometimes, participants did not associate the cards with a specific emotion but were more attracted by the character or the situation depicted on it. As it is for the cards associated to anger and happiness with a child and an aging woman pictured on them; or the card associated with disgust that was rather used by participants to talk about unexpected events.

Table 4 shows the issues that were most commonly assigned to an emotion by the participants.

**Table 4.** Common issues raised during the mood board and FG activities assigned to a specific emotion by the participants

Emotions	Issues raised during the mood board activity and the FG discussions
Happiness	Better use of driving time; Relaxation
Hope and expectations	Environment; Safety
Fear	First applications of AVs; Safety

Source: JRC, 2022.

**Joy** was associated by three participants to the better use of driving time that AVs would allow, emphasising the possibility to have more “quality time with [their] family” or “time to enjoy life”. Related directly to the experience with Rob.Y, one participant associated the **joy** card with the sensation of “relaxation” and lack of “anxiety while [Rob.Y was] moving around”. Still related to the automated prototype, three participants associated their experience with the **surprise** emotion, highlighting being “impressed” by the complexity of the technology and to see it “in action”. The cards related to **anticipations** were associated with the barriers that “need to be overcome” in order to innovate, as well as the positive impact of AVs on the environment. The card associated to **fear** was used by one participant to describe the apprehension to use AVs at the beginning of their deployment. One participant associated the card related to **anger** to speak about the disagreement that one could have with the decision of the vehicle while driving.

*“If some people don’t agree with the decision of the AVs does. Make it stops but then have to wait a long time... so they show the feeling we cannot see and communicate.” (Lauren, FG6, 29 y/o)*

*“I am very surprised because something is to hear about these vehicles, and it is another thing see it in action.” (Vivian, FG7, 49 y/o)*

Different feeling and cards were associated with various issues related to safety. Choosing the cards associated to *anger* and *joy*, participants highlighted that roads would be safer for children (e.g., avoiding accidents as children cross unexpectedly the streets), or that the safety will be improved due to the absence driving aging people. Other participants that choose the *disgust* card, expressed worries related to unexpected situations where the algorithm would not be prepared to intervene. Finally, the card associated to **fear** was used by one participant to highlight the risk for the vehicle to not stop, while the one depicting **anticipation** was related to the positive impact on road accidents.

*“How long it will take for the autonomous vehicle to take over unforeseen situations where the algorithm hasn’t been trained for?” (Axelle, FG6, 37 y/o)*

After commenting on the different cards chosen, participants had the opportunity to classify them according to the nature of the feeling (i.e., if it is positive, negative or neutral). 16 out of the 24 cards were classified as positive, five as negative, and three as neutral.

## 6 Conclusions and future work

The present work investigates women's mobility needs and how AVs could satisfy such requirements in case of their full deployment.

While previous studies pointed out at the gender differences in AV acceptance (Rezaei and Caulfield, 2020; Bansal, Kockelman, and Singh, 2016) highlighting a general more cautious approach of women compared to male counterparts, limited evidence is showing the underlying reasons of such cautious attitudes. This research aimed at shedding light on the topic of women's opinions, attitudes and concerns towards AVs, starting from women's current mobility and discussing about how AVs could fit into their mobility needs and habits, arguing as well about possible mobility improvements as well as problems associated with such vehicles.

Although the qualitative and quantitative analysis showed positive views about AVs among the women participating in the study, there are still some acceptance barriers mentioned throughout all activities.

AVs could be associated both with *positive and negative aspects*: the former relate often to better driving experience, more comfort, better use of driving time and increased safety; the latter reflects concerns about safety aspects both related to the technology itself and also to the vehicle behaviour and the loss of control.

Some core benefits, such as *potential safety improvements or providing a more sustainable individual mobility option*, as car sharing or public transport complement, are evaluating AVs as a promising solution for a more sustainable and accessible future transport as well as improved traffic conditions for all road users. The women surveyed showed a willingness to buy an AV and to share it in order to generate less pollution and save money, although mostly with people they know as family members or friends.

*Safety standards* have to be proven from *independent authorities, demonstrated and transparently communicated to citizens*, again by independent entities (e.g., scientist rather than car companies) to build users' trust in AVs as a reliable means of mobility. In general, public authorities are more trusted than private companies to properly deploy AVs, as well as public or private infrastructure managers in case mobility data needs to be shared to improve travel efficiency and safety.

*Accessible AVs* seems to be an important factor for women. Although being concerned about equal access, mainly in the first phase of the deployment, they would find useful to allow access to such vehicles for children and family members' daily routine management.

*Regarding data privacy* in the context of AVs, women *require transparency about which data is collected and how it is used*, but most of them admit that nowadays sharing data is part of the advanced technology used in the daily life. Corresponding laws developed to ensure data privacy and prevent data misuse are required.

Women's mobility needs, as presented in previous studies and discussed during the FG discussions, relate, among the others, to greener mobility choices, safety concerns as well as complex daily travel patterns. When looking at these aspects and to which extent AVs would satisfy these needs, interesting insight came out of the current work.

Although the first two aspects, greener mobility and safety, are felt as key mobility issues, both in literature and out of the current analysis, no clear evidence was found on the way AVs would solve women's mobility problems or how AVs could improve their mobility or mitigate the negative impacts from mobility. Out of the FG discussions run in this analysis, it was nonetheless possible to draw conclusions on the anticipated positive effects AVs would bring into women's mobility in relation to daily transport activities and time management. Based on their declared mobility habits, generally characterized by complex daily travel routines, women's lives could be eased by the use of AVs (Level 5 of automation-fully automated vehicle), which could help saving time or improve time management being able to devote some of the travel time to other daily activities, either paid work, personal or family related (e.g., enjoy time with children, organize work/personal daily agendas, etc.). This could apply equally to anyone being characterized by similar mobility patterns, regardless of gender differences.

Framing AVs analysis based on users' needs and expectations helps defining better research and policy priorities as well as supports further technical and operational initiatives. As it was the case in this work where women views were investigated, similar research could benefit women employed by the transport sector (e.g., public transport, logistics and freight transport) and their thoughts on the increased automation and connectivity. Future research could also focus on other transport users whose opinions, needs and expectations may not be fully exploited yet. Young and older generations, users with disabilities or reduced mobility or those on lower incomes or living in rural areas could be among the ones who could be looked at next to ensure that users are at the center of the future transport system, in line with the latest EC's DG MOVE report (European Commission, 2022) which defines recommendations to improve coordination, build knowledge and evidence, integrate the



social dimension when reviewing existing practice and provide resources. In addition, future work on the use of specific use cases studies would support the definition of more granular conclusions on user behaviours, needs and expectations. Moreover R&I plays a key role in technology definition and development, aiming at providing user friendly and useful tools for the society.

As technological advancements are numerous in the transport field (e.g., drones, cable cars, Hyperloop, etc.), future investigation should qualitatively investigate user's views on those technologies, similarly to the exercise conducted here on AVs. Last but not least, the study underlines the importance of Living Labs (LLs) as real-life environments where users can gain their first experience with the technology, be engaged in discussions about innovation's potential use and impact and start reflecting on its implications. LLs put together all stakeholders (such as citizens, academia, companies, cities and regions) to achieve a joint value co-creation, rapid prototyping, and/or validation in order to scale-up the innovation. Systematic scientific studies on user, citizen acceptance and engagement in R&I and technology development have to be therefore an essential element of AV development and deployment projects.

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## List of abbreviations and definitions

ABS	Automatic Braking System
ACC	Adaptive Cruise Control
AV	Automated Vehicle
CAV	Connected and Automated Vehicle
DG MOVE	Directorate-General for Mobility and Transport
DLR	German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt)
EC	European Commission
EIB	European Investment Bank
EIGE	European Institute for Gender Equality
FG	Focus Group
FMS-Lab	Future Mobility Solutions Living Lab
GDPR	General Data Protection Regulation
GEP	Gender Equality Plan
GPS	Global Positioning System
h	Hour
ITF	International Transport Forum
JRC	Joint Research Centre
LKAS	Lane Keeping Assist System
LL	Living Lab
R&I	Research and Innovation
RVS	Rear View Camera
SAE	Society of Automotive Engineers
SME	Small and medium-sized enterprise
Unican	University of Cantabria
VELA	Vehicle Emissions Laboratories
y/o	Years old



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## **Annexes**

### **Annex 1. Script of the FG discussions**

#### **Part 0. Introduction of the FG activity (5 min)**

#### **Part 1. Mobility habits/needs/challenges (20 minutes)**

1. Please present yourself sharing your name and the place where you live, and tell us which mode of transport you usually use and for which purpose.
2. Could you explain which are the main problems you face during your daily mobility?
3. Could you please tell us what is most important in your daily mobility?
4. Did your mobility change because of the COVID-19 pandemic? If so, in which way?

#### **Part 2. Knowledge/experience/opinion about Automated Vehicles (15 min)**

In this part we will propose you to participate to two activities.

5. Word cloud activity “What comes to your mind when you hear automated vehicles?”
6. Poll activity “Which of the following modes of transport presented to you represent better your vision of what an automated vehicle is?”
7. Did you experience any form of automated vehicle?

Automated Vehicles and Connectivity Definition (3 min)

[Slide with different levels of automation]

[Slide with the crossroad and connections among people and vehicles]

#### **Part 3. Automated Vehicles and mobility (30 min)**

8. Please think about your everyday life and mobility. Based on your current mobility, do you think that AVs would satisfy your daily mobility needs?
9. Do you see any difference with your occasional/leisure mobility needs? Do you think that automated vehicles would fit your occasional/leisure mobility needs?
10. Which are, for you, the benefits of using automated vehicles? And which are the threats?

#### **Part 4. Automated Vehicles and ethics (30 min)**

11. Do you think that all users will have the same opportunities to access these vehicles/services?
12. Considering that in the future, automated vehicles will be on the roads, which are the information about automated vehicles would you need to know before they are on the roads?
13. Who do you trust most to inform you about AVs?
14. Having in mind these different actors that you just shared with us, would you agree to share your mobility data with them for improving traffic safety/congestion?
15. Do you think that sharing your data with these different actors will affect your privacy?

#### **Part 5. Change of opinion (5 min)**

16. Did you change your view/opinion about AVs in your mobility after this discussion?

Conclusion-end of discussion (5 min)

## Annex 2. Photos used during the mood board activity

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Source: mohamed abdelghaffar from Pexels.com



Source: Marcus Woodbridge from Unsplash.com

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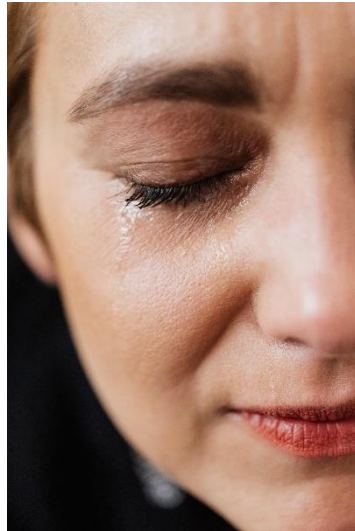


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Source: Pixabay from Pexels.com



Source: Oleksandr Pidvalnyi from Pexels.com

### Annex 3. Questionnaire



Source: rawpixel.com from Freepik.com

Please indicate your name and surname.

1. Which is your gender identity?
  - Woman
  - Man
  - Other
  - Prefer not to say
2. How old are you?
3. Do you have a driving license?
  - Yes
  - No
4. Which is your annual personal income (Euro)?
  - <10.000
  - 10.000-15.000
  - 15.000-20.000
  - 20.000-25.000
  - >25.000
5. What better describes the place where you live?
  - Large town
  - Small/mid-size town
  - Rural village
6. How many trips do you make on a working day?
7. For which purposes do you make these trips?
  - Work
  - Study
  - Shopping
  - Leisure/sports activities
  - Accompany children or dependent family members
  - Other
8. Which is the mode of transport you use the most in your daily mobility?

- Private car
- Motorbike/scooter
- Bicycle
- e-Scooter
- Public transport (bus, tram, metro)
- Train
- Walking
- Other

9. How many trips do you make during weekends?

10. For which purposes do you make these trips?

- Work
- Study
- Shopping
- Leisure/sports activities
- Accompany children or dependent family members
- Other

11. Which is the mode of transport you use the most during weekends?

- Private car
- Motorbike/scooter
- Bicycle
- e-Scooter
- Public transport (bus, tram, metro)
- Train
- Walking
- Other

12. Please indicate how much you agree or disagree with the following statements at the time of the Focus Group discussion.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I would be willing to buy an automated vehicle if affordable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to use an automated vehicle as single passenger in the car	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to use automated vehicle sharing with other known passengers (family, friends)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to use an automated vehicle sharing with unknown passengers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



I would be willing to share an automated vehicle to create less pollution/protect the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to share an automated vehicle to save money	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think automated vehicles will have positive economic impacts (more jobs/increase economic growth)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think automated vehicles will have negative economic impacts (less jobs/decrease economic growth)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think automated vehicles will generate inequality between individuals based on different characteristics (race, age, gender, income, ethnicity, disability, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I trust public authorities (European, national, local) to take care of automated vehicles' deployment assuring that automated vehicles' design, development and roll out is done in line with sustainability, accessibility and ethical goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I trust private companies to take care of automated vehicles' deployment assuring that automated vehicles' design, development and roll out is done in line with sustainability, accessibility and ethical goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to share my anonymized mobility data with other road users to improve traffic safety/congestion/efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to share my anonymized mobility data with public/private road administrators to improve traffic safety/congestion/efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would be willing to share my anonymized mobility data with private companies to improve traffic safety/congestion/efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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Source: JRC, 2022

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