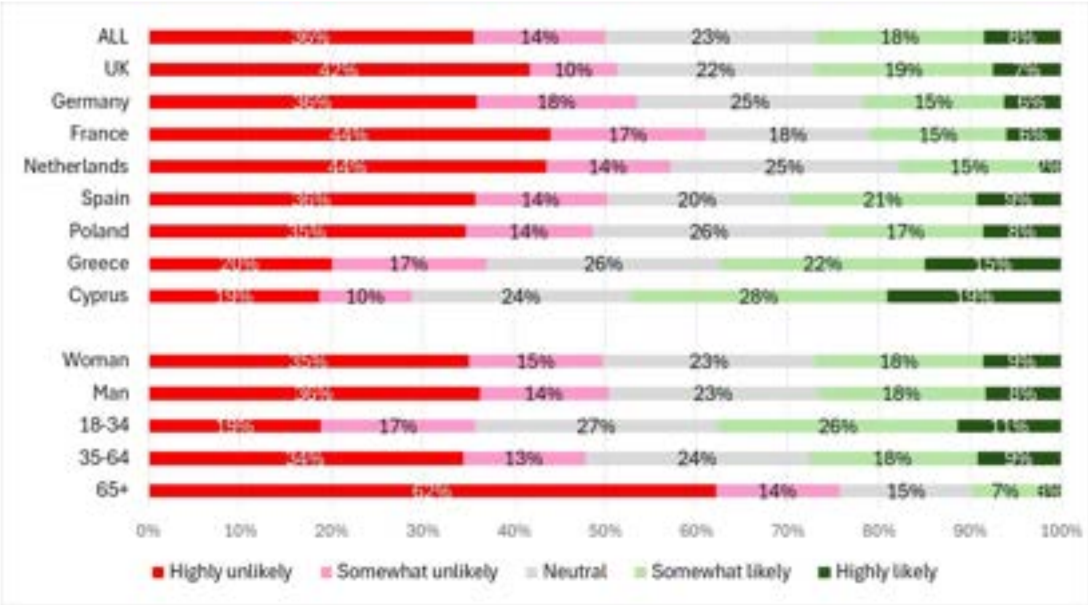

Figure 138. Likelihood of using self-driving delivery robot, by country, gender, and age

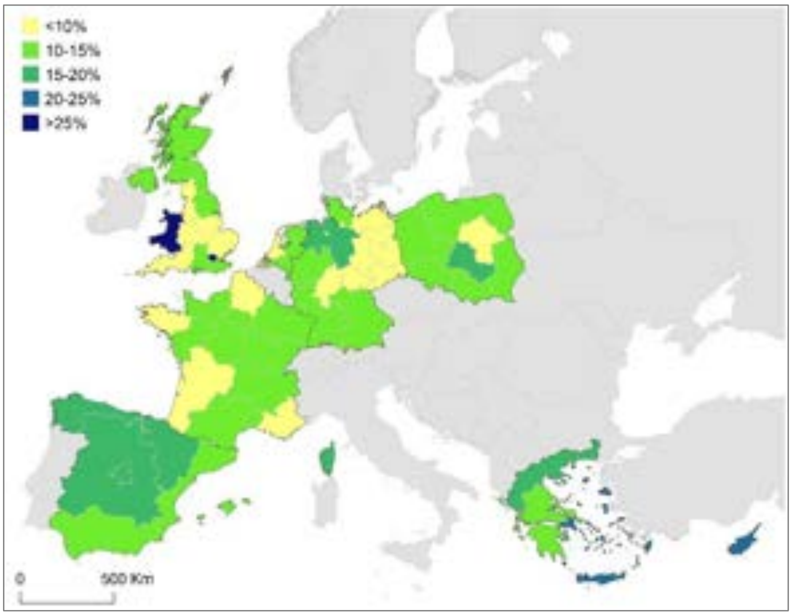

Figure 139. Proportion of participants likely to use delivery robot, by region

The following figure and map add detail to the results for the delivery drone. The proportions of participants (somewhat or highly) likely to use the robot are roughly between 30% and 40% in all countries (Figure 140) and those of participants unlikely to use it are between 40% and 50% in all countries except Cyprus. Again, women and men have very similar intentions and likelihood decreases sharply with age. Among the oldest age group, half said they were highly unlikely to use the robot, and another 11% said they were somewhat unlikely – a total of 61% of negative intentions (lower than in the case of the delivery robot). 22% had positive intentions among this group (with only 7% saying they were highly likely), higher than in the case of the robot.

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The map in Figure 141 shows the proportion of participants (somewhat or highly) likely to use the delivery drone, by region. The proportion of participants stating they are likely to use the delivery drone are below 25% in all regions. There are also fewer within-country variations, compared with the case of the delivery robot or the passenger use cases shown in Section 5.6.2.

Later in this chapter (Section 5.11), we estimate statistical models relating likelihood with demographic, travel behaviour, and locational variables.

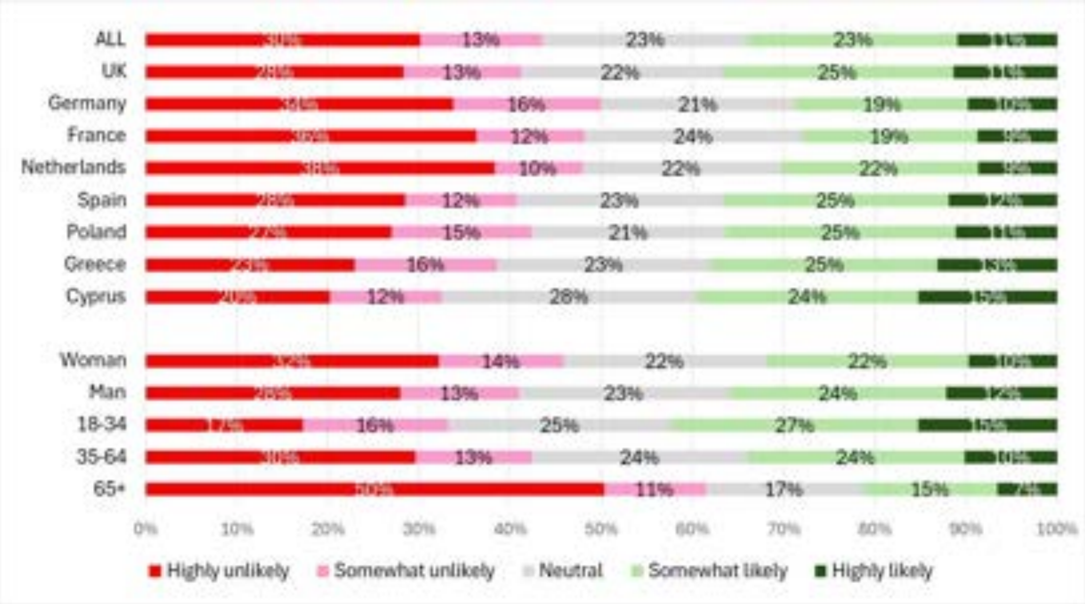

Figure 140. Likelihood of using delivery drone

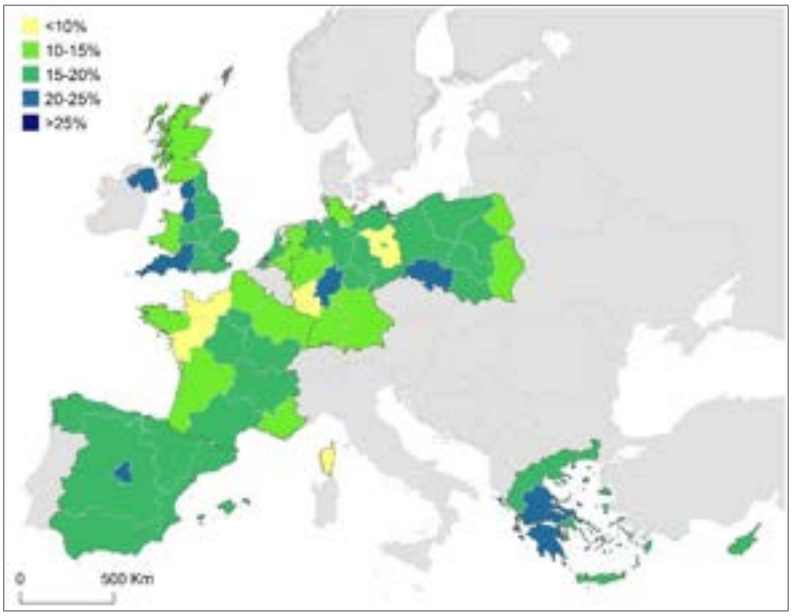

Figure 141. Proportion of participants likely to use delivery drone, by region

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5.10 Impacts of self-driving freight vehicles on individual behaviour

5.10.1 Overview

This section reports the results of participants' stated impacts of self-driving freight vehicles on individual behaviour. Section 5.10.2 analyses correlations between the impacts. The following sections focus on the various impacts: delivery orders (5.10.3), order substitution (5.10.4), delivery costs (5.10.5), number of trips (5.10.6), parking needs (5.10.7), and residential location (5.10.8). The analysis uses similar methods as the one for passenger transport use cases in Section 5.7:

- For impacts on continuous scales (**number of delivery orders** and **number of trips**), we analyse the statistical distribution, across the whole sample, of the impacts of the two vehicles, and the average impact, overall and by country, gender, and age.
- For **order substitution,** expressed on a 5-point ordinal scale, we analyse the distribution of answers on the 5-point scale across the whole sample. We also estimate average substitution rates across countries, genders, and age groups.
- For other impacts on 5-point ordinal scales (**delivery costs**, **parking needs** and **residence location**), we analyse the distribution of participant answers on the 5-point scale, comparing the two vehicles across the whole sample, the average impacts across the whole sample and disaggregated by country, gender, and age, and the distribution of participant answers on the original 5-point scale for each vehicle, disaggregated by country, gender, and age.

These impacts are analysed separately. In Section 5.11, we estimate statistical models relating the impacts with demographic, travel behaviour, and locational variables.

5.10.2 Correlations between impacts

Table 95 shows the correlations between the various impacts of robots and drones. There are only two strong correlations (i.e. above 0.6): between number of delivery orders and number of trips (for both vehicles). While self-driving delivery vehicles could substitute shopping trips (which would result in a negative correlation), a positive correlation is also plausible because:

- If participants think that self-driving vehicles are more efficient in making deliveries, they can also think that this enables them to reduce both the number of orders they make (for example, because self-driving vehicles can consolidate orders) and the number of shopping trips.
- If, in contrast, they think their number of orders will increase, this could reduce the number of shopping trips than can be replaced by a larger number, in absolute value, of trips for other purposes such as leisure. For example, instead of a single trip to a supermarket, people could make several trips to other locations for leisure.
- There could even be substitution of destinations for shopping trips: if self-driving vehicles could delivery heavy products or large shopping baskets (e.g. supermarket deliveries), individuals could complement that with more short trips to small shops.

The other correlations range from very weak to slightly moderate (i.e. just above 40%). It is worth noting that all correlations are positive, i.e., changes in number of delivery orders, delivery costs, number of trips, parking needs, and residence re-location (towards more central areas) tend to all vary in the same direction.

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Table 96 shows correlations between the perceived impacts of self-driving freight vehicles and the respective impacts of passenger vehicles. All correlations are around 0.40, i.e. the impacts are correlated, but the magnitude of this correlation is borderline between weak and moderate.

Table 95. Correlation between impacts of self-driving freight vehicles on individual behaviour

Impact A	Impact B	N	Correlation	
Number of orders (robot)	Delivery costs (robot)	3968	0.11	Spearman
Number of orders (robot)	Number of trips (robot)	3968	0.69	Pearsons
Number of orders (robot)	Parking needs (robot)	3968	0.10	Spearman
Number of orders (robot)	Residence location (robot)	3968	0.15	Spearman
Delivery costs (robot)	Number of trips (robot)	3968	0.16	Spearman
Delivery costs (robot)	Parking needs (robot)	3968	0.43	Spearman
Delivery costs (robot)	Residence location (robot)	3968	0.37	Spearman
Number of trips (robot)	Parking needs (robot)	3968	0.18	Spearman
Number of trips (robot)	Residence location (robot)	3968	0.17	Spearman
Parking needs (robot)	Residence location (robot)	3968	0.41	Spearman
Number of orders (drone)	Delivery costs (drone)	3973	0.14	Spearman
Number of orders (drone)	Number of trips (drone)	3973	0.69	Pearsons
Number of orders (drone)	Parking needs (drone)	3973	0.11	Spearman
Number of orders (drone)	Residence location (drone)	3973	0.23	Spearman
Delivery costs (drone)	Number of trips (drone)	3973	0.16	Spearman
Delivery costs (drone)	Parking needs (drone)	3973	0.42	Spearman
Delivery costs (drone)	Residence location (drone)	3973	0.40	Spearman
Number of trips (drone)	Parking needs (drone)	3973	0.19	Spearman
Number of trips (drone)	Residence location (drone)	3973	0.26	Spearman
Parking needs (drone)	Residence location (drone)	3973	0.44	Spearman

Note: N=number of observations.

Table 96. Correlation between impacts of self-driving passenger and freight vehicles

Impact A	Impact B	N	Correlation	
Number of trips (robot)	Number of trips (car)	2657	0.37	Pearsons
Number of trips (robot)	Number of trips (taxi)	2645	0.36	Pearsons
Number of trips (robot)	Number of trips (bus)	2634	0.43	Pearsons
Number of trips (drone)	Number of trips (car)	2642	0.39	Pearsons
Number of trips(drone)	Number of trips (taxi)	2623	0.37	Pearsons
Number of trips(drone)	Number of trips (bus)	2681	0.41	Pearsons
Parking needs (robot)	Parking needs (car)	2657	0.36	Spearman
Parking needs (robot)	Parking needs (taxi)	2645	0.38	Spearman
Parking needs (robot)	Parking needs (bus)	2634	0.47	Spearman
Parking needs (drone)	Parking needs (car)	2642	0.36	Spearman
Parking needs (drone)	Parking needs (taxi)	2623	0.39	Spearman
Parking needs (drone)	Parking needs (bus)	2681	0.49	Spearman
Residence location (robot)	Residence location (car)	2657	0.40	Spearman
Residence location (robot)	Residence location (taxi)	2645	0.38	Spearman
Residence location (robot)	Residence location (bus)	2634	0.42	Spearman
Residence location (drone)	Residence location (car)	2642	0.40	Spearman
Residence location (drone)	Residence location (taxi)	2623	0.39	Spearman

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Residence location (drone)	Residence location (bus)	2681	0.43	Spearman

Note: N=number of observations. It differs from correlation to correlation as each participant answered questions for two types of passenger vehicle and one type of freight vehicle only.

5.10.3 Impact on number of delivery orders

Figure 142 and Figure 143 show the statistical distribution, across the whole sample, of the impact of delivery robots and drones on the number of online delivery orders that participants make per month. Table 97 shows the average impact by country, gender, and age.

As with the impacts reported for passenger transport vehicles, this one also follows a normal distribution centred around a peak slightly above zero. Most values are between -4 and +8 delivery orders per month. On average, robots and drones would increase orders by 0.2 and 0.4, respectively. This is a positive impact but of a small magnitude. Although data was not collected for the current number of monthly delivery orders people make, the 0.2 and 0.4 increases above can be compared with the frequency of orders shown in Figure 98, which shows that 64% of the sample makes deliveries at least “a few times per month” (with 16% making deliveries at least a few times per week).

The values are both positive and negative in different subsets of the data. Similarly to the impact of passenger vehicles in number of trips, seen before in Section 5.7.4, impacts tend to be higher (and positive) in Spain, Poland, Greece, and Cyprus than in the other four countries (where they are negative). Age is inversely related to change in number of delivery orders: younger age groups believe the number will increase more than older ones do.

The mix of positive and negative values is the result of different perceptions, which can be related either to an intention to make more delivery orders due to the availability of new, and flexible, modes, or to a belief that this flexibility is also related to efficiency, and more orders can be consolidated into a single delivery. There could also be a concern with the cost of the new modes, or with aspects such as safety and data protection, which could lead to an intention to reduce deliveries if they are made using self-driving vehicles.

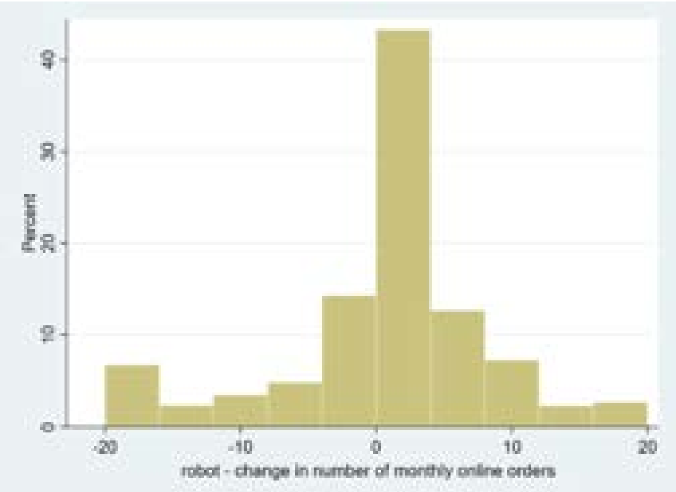

Figure 142. Impact of delivery robots on number of delivery orders

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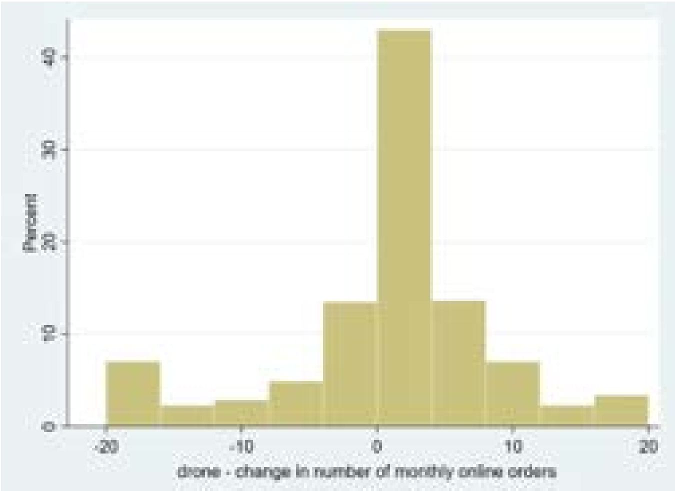

Figure 143. Impact of delivery drones on number of delivery orders

Table 97. Average impact on number of monthly delivery orders

	Delivery robot	Delivery drone
All	0.2	0.4
UK	-0.7	-0.6
Germany	-0.1	-0.1
France	-0.9	-0.4
Netherlands	-0.9	-1.0
Spain	0.6	0.4
Poland	0.0	0.9
Greece	2.3	2.7
Cyprus	2.7	2.3
Women	0.3	0.2
Men	0.0	0.6
18-34	1.9	1.9
35-64	0.0	0.2
65+	-1.9	-1.6

Notes: Cyprus sample is 18-64 only and is not gender-balanced.

5.10.4 Impact on order substitution

Participants were asked about the proportion of their monthly number of delivery orders they would substitute with a self-driving robot or drone. Answers were on a 5-point scale, from “none of them (0%)” to all of them (100%). Figure 144 shows the distribution of the answers. The chart shows results only for participants who currently make at least order per month. 6-7% of participants stated that they would substitute all their orders with these vehicles. A further 16% would substitute most of their orders. 35% would not substitute any of their orders with a delivery robot and 32% would not substitute any with a delivery drone.

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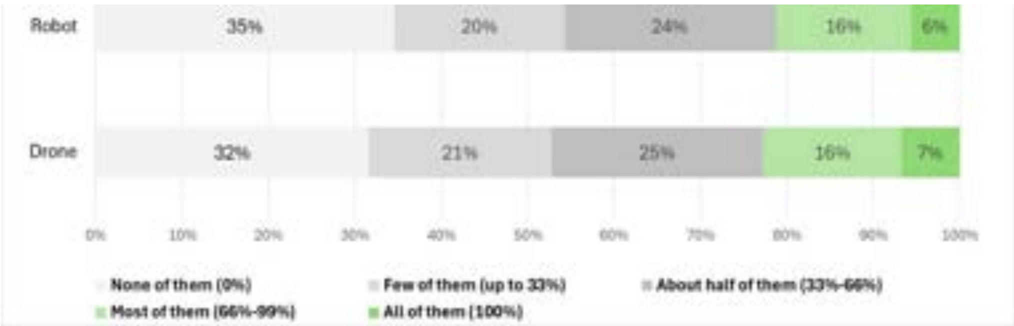

Note: results include only participants who currently make at least “a few times per month”

Figure 144. Delivery orders that self-driving vehicles would substitute

Table 98 quantifies order substitution in terms of percentage of current delivery orders substituted by self-driving vehicles. This was estimated by multiplying:

- The number of current orders people make, estimated as the mid-point of the interval indicated in the question about order frequency (for example, “few times per week (2-3 times per week”) was assigned a value of 2.5; and
- The mid point of the interval indicated for substitution of current orders. For example, someone indicating they would substitute “most of them (66%-99%)” with a given self-driving vehicle would be assigned a value of 82%.

The values were then aggregated for the whole sample to estimate a percentage of substituted orders, i.e. the total number of delivery orders substituted with self-driving vehicle as a percentage of the total number of delivery orders current made. A similar aggregation was made for countries, genders, and age groups.

Table 98 shows the results. Self-driving delivery vehicles would substitute an estimated percentage of 34%-35% of orders. In the case of robots, the percentages are higher in Poland (39%), Greece (37%), and Cyprus (42%). In the case of drones, the proportion is roughly similar in all countries except the Netherlands, where is smaller (29%). The proportions are the same or similar between men and women and are inversely related with age.

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Table 98. Proportion of delivery orders substituted with self-driving vehicles

	Delivery robot	Delivery drone
All	34%	35%
UK	31%	36%
Germany	32%	35%
France	32%	35%
Netherlands	27%	29%
Spain	34%	37%
Poland	39%	39%
Greece	37%	37%
Cyprus	42%	36%
Women	34%	34%
Men	34%	37%
18-34	45%	46%
35-64	34%	34%
65+	17%	22%

Notes: Cyprus sample is 18-64 only and is not gender-balanced.

5.10.5 Impact on delivery costs

Opinions about impacts of self-driving delivery vehicles on delivery costs were expressed by participants on a 5-point scale from “reduced significantly (50% reduction or more) to “increase significantly” (50% increase or more). The results are almost identical for delivery robots and drones (Figure 144). 62% of the sample think there will be no change. Almost equal proportions think costs will increase (18-19%) and decrease (19-20%). If we convert the original 5-point scale to a numerical scale from -2 to +2 and estimate average scores (Table 100), this is only slightly negative (-0.05 for the robot and -0.04 for the drone).

In Greece and Cyprus, there is a stronger perception that delivery costs will decrease, for both types of vehicle (Table 100, Figure 146, Figure 147). In Spain and Poland and (in the case of drones) also in Germany, on average participants think deliver costs will increase. Women have a stronger tendency to believe delivery costs will decrease, compared with men. On average, the 18-34 group thinks delivery costs will increase (Table 100). This is a view held by 28-29% of participants in this group (Figure 146, Figure 147). The other age groups think delivery costs will decrease, with the 65+ being more likely to think they will decrease than the 35-64 group.

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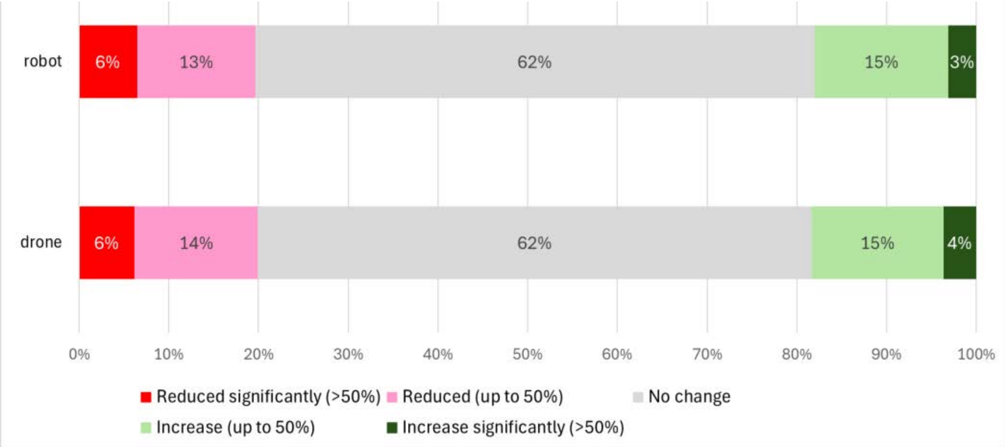

Figure 145. Impact of self-driving freight transport vehicles on delivery costs

Table 99. Average impact of self-driving freight vehicles on delivery costs

	Robot	Drone
All	-0.05	-0.04
UK	0.00	0.00
Germany	-0.03	0.07
France	-0.05	-0.03
Netherlands	-0.04	-0.06
Spain	0.06	0.08
Poland	0.10	0.06
Greece	-0.19	-0.19
Cyprus	-0.48	-0.52
Women	-0.08	-0.06
Men	-0.02	-0.03
18-34	0.06	0.07
35-64	-0.09	-0.06
65+	-0.11	-0.13

Notes: Cyprus sample is 18-64 only and is not gender-balanced.

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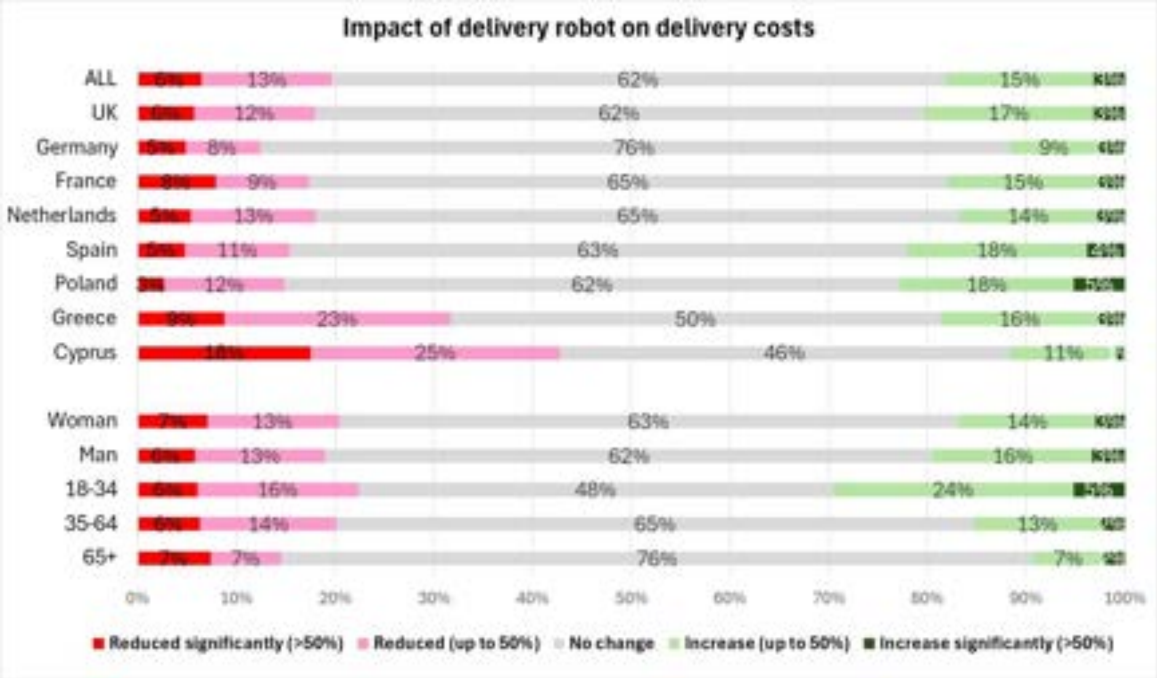

Figure 146. Impact of delivery robot on delivery costs

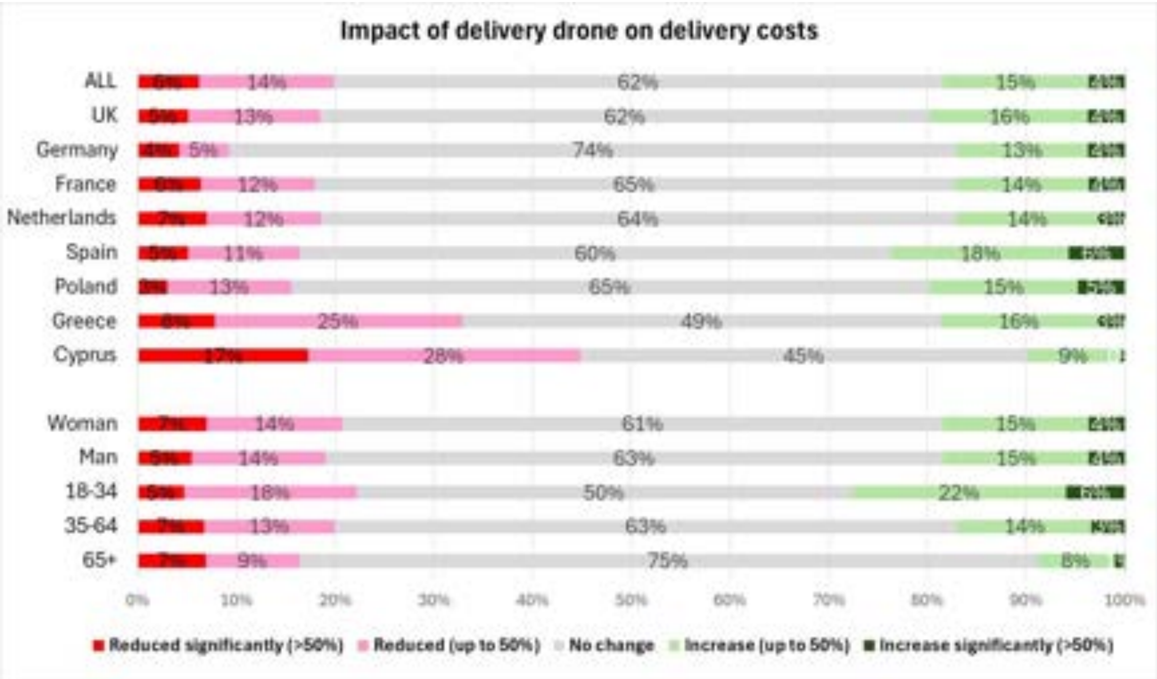

Figure 147. Impact of delivery drone on delivery costs

5.10.6 Impact on number of trips

Figure 148 and Figure 149 show the statistical distribution, across the whole sample, of the impact of delivery drones and robots on the number of delivery orders that participants make per month. Table 100 shows the average impact by country, gender, and age.

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The distributions are remarkably similar to the ones for the impact on number of orders (e.g. compare Figure 148 with Figure 142 and Figure 149 with Figure 143), as the variables are strongly correlated as seen in Section 5.10.2.

On average, the delivery robot has no impact on number of trips and the delivery drone has almost no impact (average impacts of 0 and 0.2 respectively) (Table 100). Drones increase trips slightly more or decrease less than delivery robots do in almost all cases. Both vehicles (very) slightly decrease the number of trips in the United Kingdom, Germany, France, and Netherlands. However, they increase trips in Cyprus (1.7-2.2 additional trips per week de to the robot and drone, respectively), followed by Greece (1.5-1.8), Poland (0.7-1.3), and Spain (0.5-0.7). The impact of trips by men and women is similar. There is no impact on trips by the 35-64 group, a positive impact on trips by the 18-34 group (1.4-1.9) and a negative impact on trips made by the 65+ group (-1.7 and -1.4)

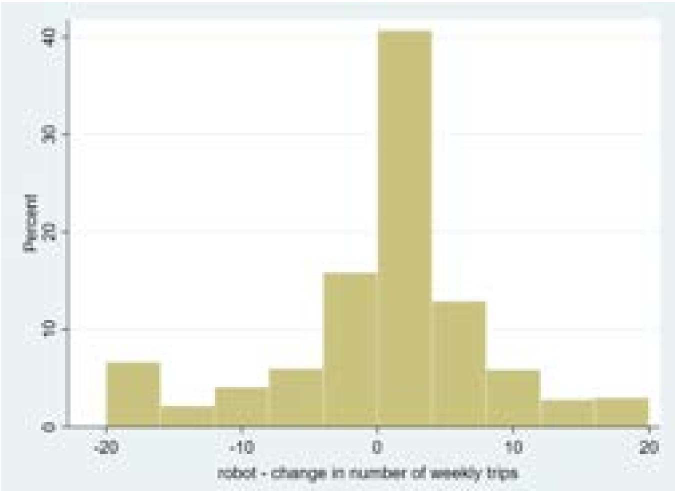

Figure 148. Impact of delivery robots on number of trips per week

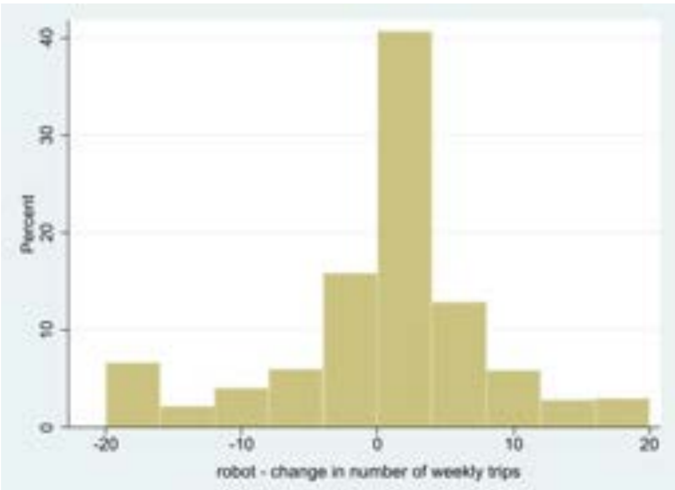

Figure 149. Impact of delivery drones on number of trips per week

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Table 100. Average impact of self-driving freight vehicles on number of trips per week

	Delivery robot	Delivery drone
All	0.0	0.2
UK	-1.0	-1.4
Germany	-0.6	-0.3
France	-0.8	-0.2
Netherlands	-0.9	-1.2
Spain	0.5	0.7
Poland	0.7	1.3
Greece	1.5	1.8
Cyprus	1.7	2.2
Women	0.1	0.2
Men	-0.1	0.3
18-34	1.4	1.9
35-64	0.0	0.0
65+	-1.7	-1.4

Notes: Cyprus sample is 18-64 only and is not gender-balanced.

5.10.7 Impact on parking needs

Opinions about change in parking needs are similar in the case of the delivery drone and robot. As shown in Figure 150, the proportion of people who think their parking needs will decrease is higher than the proportion who think they will increase: 15% think the delivery robot will increase their parking needs and 24% think it will decrease. The numbers for the drone are 14% and 22%, respectively. The numbers are also similar to the ones seen in the case of the self-driving bus, as seen in Figure 127.

Table 101 shows the average impact on this scale, on a numerical scale from -2 to +2 based on the original ordinal scale. The impacts are negative (-0.18 for the robot and -0.15 for the drone, respectively). These compare with values of -0.02 (car), -0.17 (taxi) and -0.20 (bus), shown previously in Table 85. The expected reduction in parking needs is consistent with prior expectations: the use of these vehicles could reduce the need for shopping trips.

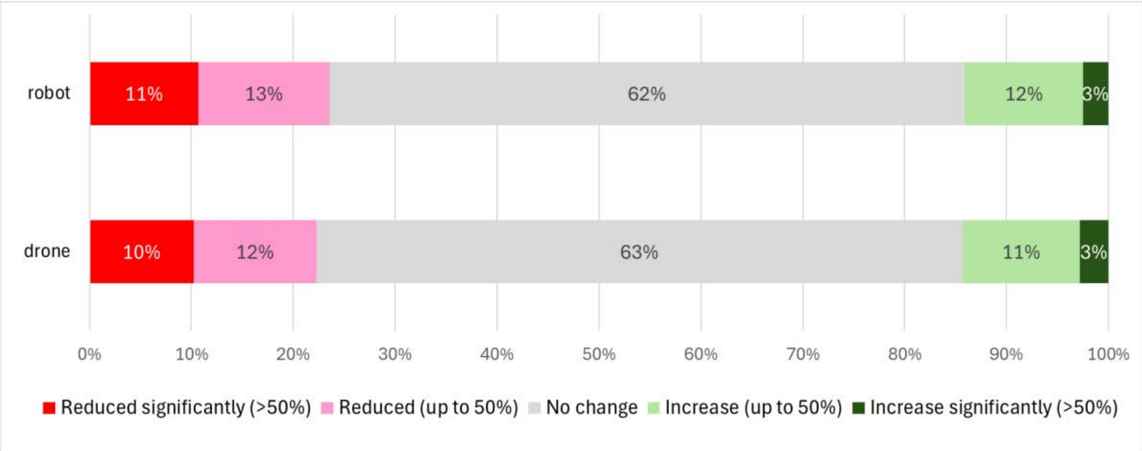

Figure 150. Impact of self-driving freight transport vehicles on parking needs

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Table 101. Average impact of self-driving freight vehicles on parking needs

	Robot	Drone
All	-0.18	-0.15
UK	-0.12	-0.15
Germany	-0.12	-0.04
France	-0.06	-0.12
Netherlands	-0.18	-0.17
Spain	-0.07	0.02
Poland	0.02	0.07
Greece	-0.48	-0.44
Cyprus	-0.69	-0.72
Women	-0.19	-0.17
Men	-0.16	-0.13
18-34	-0.09	-0.04
35-64	-0.19	-0.17
65+	-0.26	-0.27

Notes: Scale from -2 to +2. Assumes equal importance of distances between the points on the 5-point ordinal scale shown to participants. Cyprus sample is 18-64 only and is not gender-balanced.

Table 101 also shows how perceptions vary by country, region, and age. As in the case seen before for passenger vehicles (Section 5.7.6), in Greece and Cyprus, there is a stronger perception that parking needs will decrease, as seen by a more negative mean score, in both robot and drone cases. 37-39% of Greek participants and 50-53% of Cyprus participants believe parking needs will decrease (Figure 151 and Figure 152). The mean perception about parking needs in relation to the implementation of the delivery drone is still negative for all other countries except Poland, and the perception in relation the drone is negative for all countries except Poland and Spain (Table 101). In both Spain and Poland there are considerable proportions (18-22%) thinking parking needs will increase, in both the robot and drone cases. This pattern is similar to the one found for passenger transport vehicles in Section 5.7.6.

Women have slightly stronger perceptions that parking needs will decrease, compared to men (Table 101). As in the case of self-driving passenger vehicles, the average perceived change in parking needs decreases with age (Table 101). However, as seen in Figure 151 and Figure 152, increased age is associated both with fewer proportions of people thinking that parking needs will increase but also with fewer proportions thinking parking needs will decrease – and with a higher proportion of people with neutral perceptions. These patterns are similar to the ones found for passenger transport vehicles.

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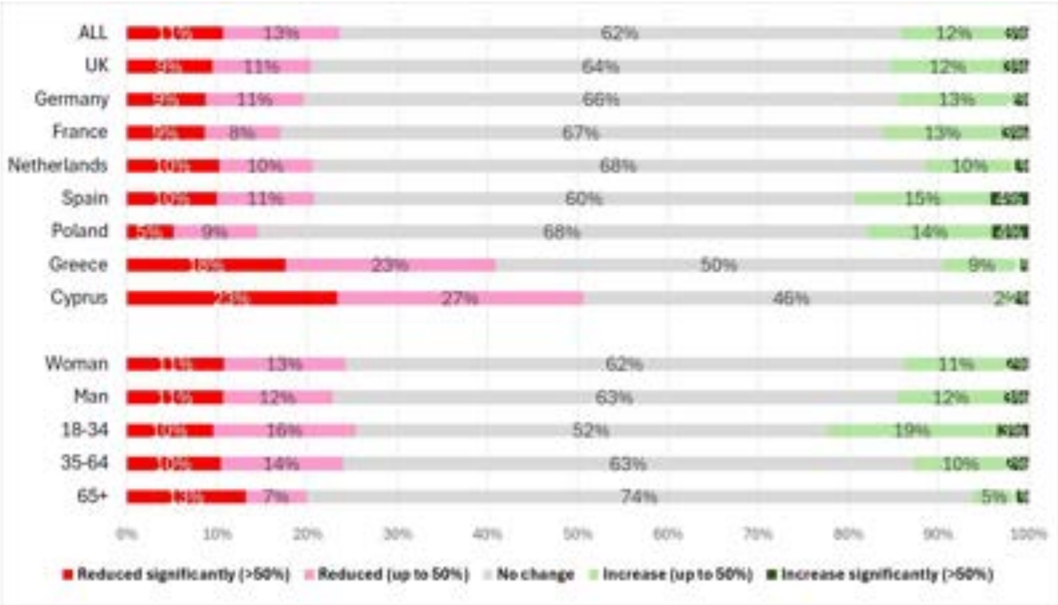

Figure 151. Impact of delivery robot on parking needs

Figure 152. Impact of delivery drone on parking needs

5.10.8 Impact on residential location

Impact on residence location was expressed by participants on a 5-point scale from “relocated to a rural area” to “relocate to the city centre”.

The results are similar to the ones obtained for self-driving passenger transport vehicles (Section 5.7.7). The large majority (77%) of participants do not think that self-driving freight vehicles will have an effect on their decision of residence location area (Figure 153). Only 2-3% would consider relocating to the city centre, 10% would relocate close to the city centre, 6% would relocate to the city’s suburbs, and 5% would relocate to a rural area. The decisions to relocate (or not) are almost identical for the two vehicles.

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The original scale was converted into a numerical scale from -2 to +2, assuming that higher values represent a move to more urbanised areas. Table 102 shows the average impact on this scale. Overall, the impacts are almost zero (i.e. "no change"): -0.01 (robot) and 0.01 (drone).

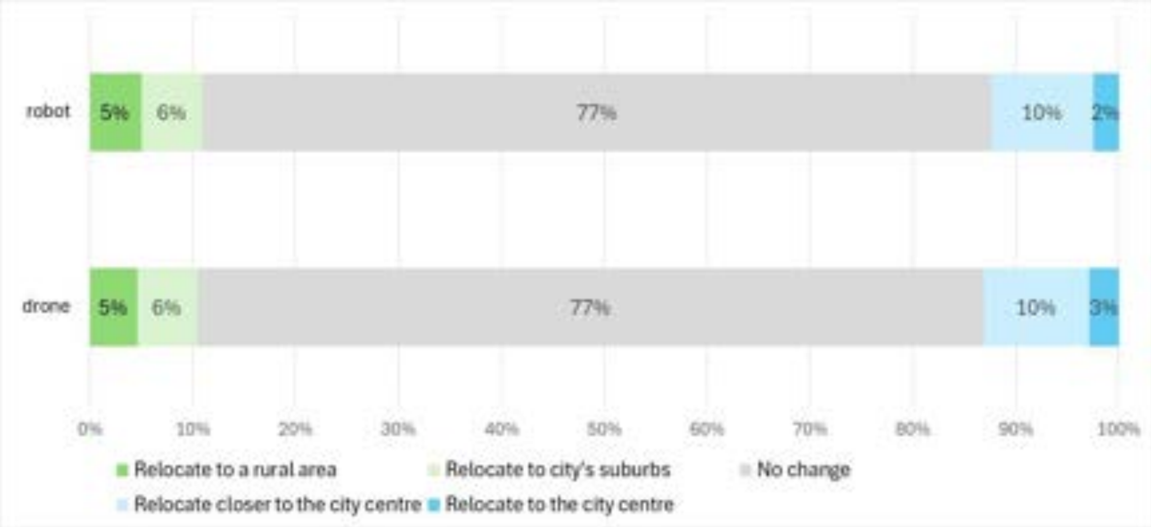

Figure 153. Impact of self-driving freight transport vehicles on residence location

Table 102. Average impact of self-driving freight vehicles on tendency to move to more urbanised areas, by country, gender, and age

	Robot	Drone
All	-0.01	0.01
UK	-0.04	-0.06
Germany	-0.05	-0.01
France	-0.02	0.01
Netherlands	0.00	-0.02
Spain	0.07	0.12
Poland	0.11	0.11
Greece	-0.08	-0.03
Cyprus	-0.17	-0.14
Women	-0.02	0.01
Men	0.00	0.01
18-34	0.09	0.12
35-64	-0.03	-0.01
65+	-0.10	-0.11

Notes: Scale from -2 to +2. Assumes equal importance of distances between the points on the 5-point ordinal scale shown to participants. Cyprus sample is 18-64 only and is not gender-balanced.

Decisions are very similar for the robot and drone cases across all countries, genders, and age (Table 102, Figure 154, and Figure 155).

There is a clear net tendency to move to less urbanised areas (i.e. rural areas or city suburbs) in Cyprus, in the case of both vehicles, as the mean score on the -2 to +2 scale is negative. 15%-16% of participants in Cyprus would move to these areas if they could use a delivery robot or drone (Figure 154 and Figure 155). In the case of the robot, in Greece, United Kingdom, and

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Germany, there is a similar tendency (but weaker than in Cyprus). In the case of the drone, this happens mainly in the United Kingdom.

In Spain and Poland, the tendency is to move towards more urbanised areas (city centre or areas close to centre). In Spain, 20% of participants would consider moving to these areas if they could use a delivery robot (Figure 154), and 18% would do so if they could use a delivery drone (Figure 155). In Poland, the numbers are slightly lower but still considerably higher than in other countries.

The mean scores for men and women are similar and are inversely related with age (Table 102), which is the pattern previously found for passenger vehicles. The 18-34 group tends to move to more urbanised areas (mean score of 0.12-0.13), the 25-64 is almost neutral (0-0.02), and the 65+ tends to move to less urbanised areas (-0.5 to -0.12). As shown in the figures, this pattern is driven mostly by the proportion of people in the three age groups who would consider moving to suburban areas: 18-19% in the 18-34 age group, 9% in the 35-64 group, and 3% in the 65+ group.

Figure 154. Impact of delivery robot on residence location

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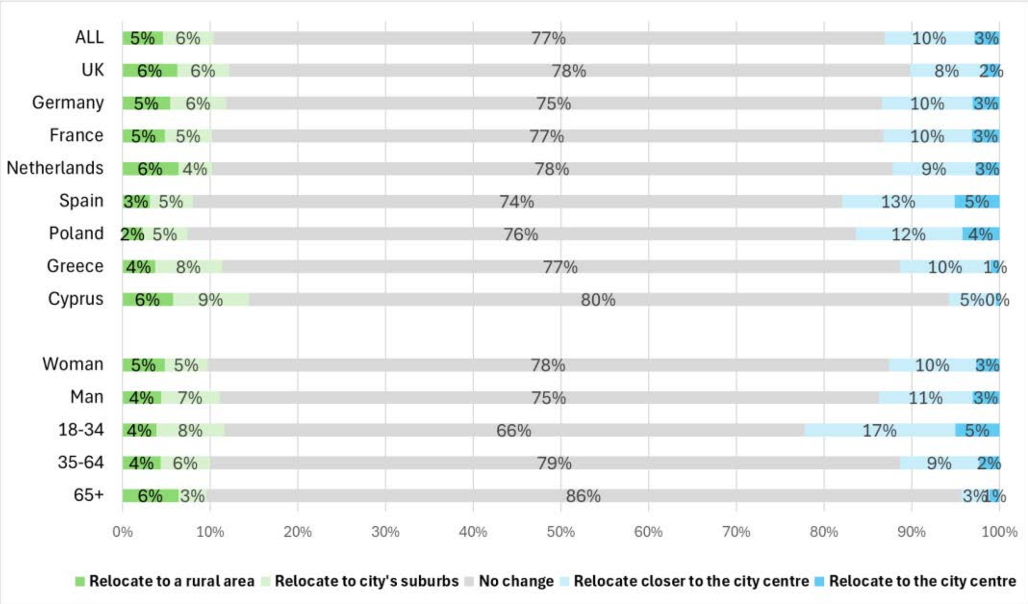
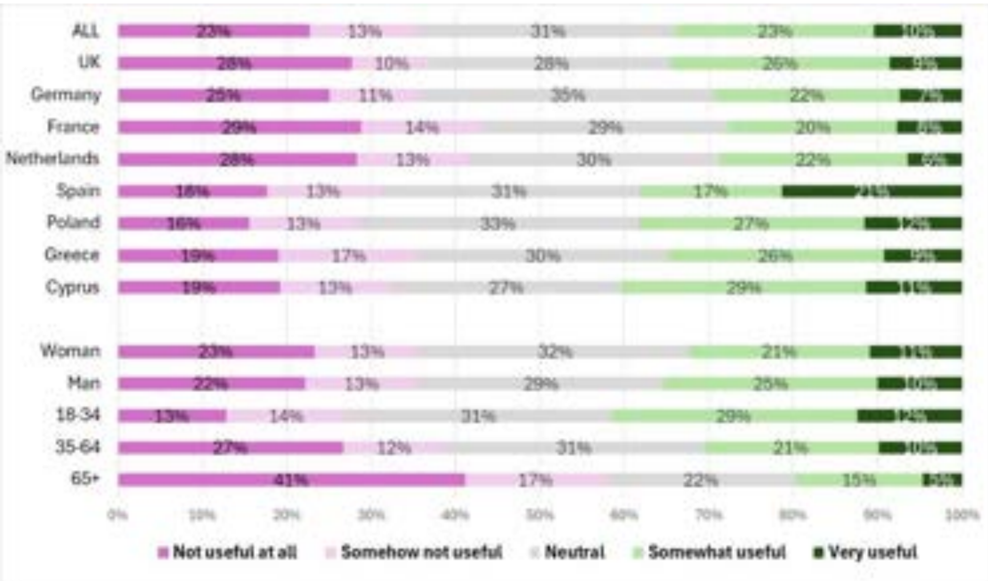


Figure 155. Impact of delivery drone on residence location

5.10.9 Utility of self-driving freight transport vehicles for work

Figure 156 and Figure 157 show the participants' perceptions of how useful delivery robots and drones could be for the organisation they work for. The question was only asked to individuals who are currently working (full or part time). There are few differences between perceptions of robots and drones. Overall, around 10-11% think these vehicles can be very useful and another 23%-24% think they can be somewhat useful. The proportions of participants with a negative view are higher: 13% think the two vehicles are "somewhat not useful" and 23% think they are "not useful at all". Spanish participants had the most optimistic views. Men are slightly more optimistic than women. Perceptions of utility decrease steadily with age. More than half of the 65+ age group thinks the two vehicles will not be useful.



Note: Question only asked to participants who are currently working

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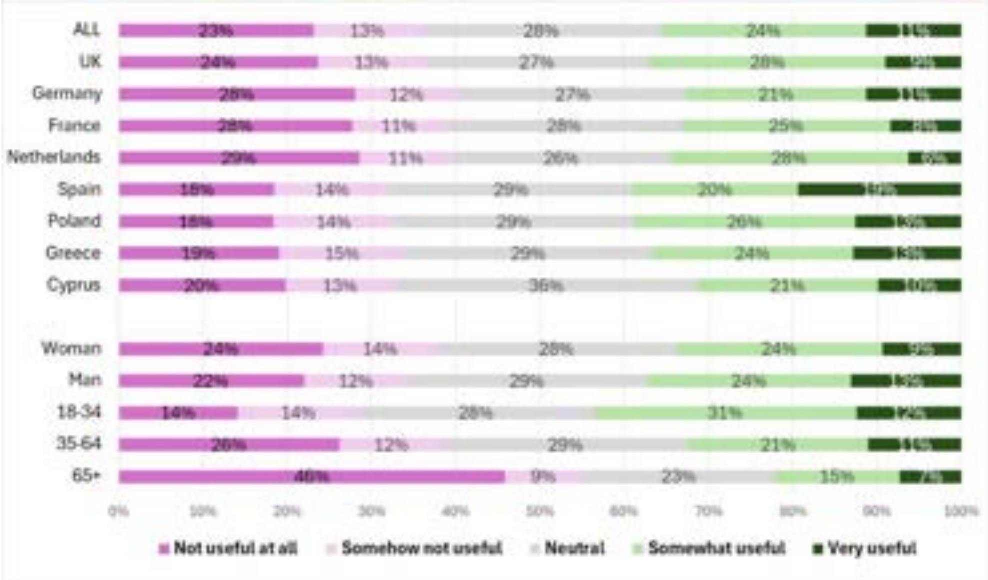
Figure 156. Utility of delivery robot for the organisation the participant works for



Note: Question only asked to participants who are currently working

Figure 157. Utility of delivery drone for the organisation the participant works for

5.11 Models of intentions and impacts - freight vehicles

5.11.1 Overview

This section estimates statistical models to identify the variables related to participants' intentions and perceived impacts of self-driving freight vehicles. Models for intentions include, as dependent variables, the likelihood of using the two types of vehicles (delivery robots and drones). Models for impacts include, as dependent variables, the change in number of delivery orders, delivery cost, number of trips, parking needs, and residence relocation, associated with the two vehicles.

As in the case of passenger vehicles, the objective of the models is to determine whether specific participants characteristics and other variables are significantly related to the intentions and impacts, when controlling for other relevant variables. The groups of explanatory variables are the same as in passenger transport models: participant demographic characteristics and current travel context and behaviour, attitude in relation to technology adoption, level of previous awareness of self-driving vehicles, and location. The model of likelihood of using the vehicles also includes as variables the impacts that participants expect that those vehicles would have in their behaviour.

Ordinal logit models were used for dependent variables expressed on a 5-point scale (likelihood, and impacts on delivery costs, parking needs, and residence location). Log-linear models were used for continuous variables (impact on delivery orders and number of trips). For each group of models (e.g. one model for each type of vehicle), variables were removed from the models when they were not significant at the 10% level in all models. We report only the signs of the significant variables. Appendix 12 contains the full models.

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5.11.2 Models of intentions about freight vehicles

Table 103 shows the estimated models of likelihood of using the self-driving freight vehicles. The likelihood is higher when participant believe that use will increase their number of delivery orders and trips. It is higher both for people who think delivery costs and parking needs will increase and those who think they will decrease (compared with those who think there will be no change). Intention to relocate to a rural area decreases likelihood of using both vehicles. Moves to suburban areas decrease likelihood of using a drone and moves to the city centre reduce likelihood of using the delivery robot.

Both vehicles are more likely to be used by participants in the 18-34 age group and those who make more trips. and less likely to be used by those in the 65+ group and who have no children. In addition, the delivery robot is more likely to be used in the city centre and less likely to be used in villages and in regions with higher income. The drone is more likely to be used by participants with a higher university degree (Master's, PhD) and those whose most frequent trip is shopping, and less likely to be used by women. Levels of technology adoption and awareness of self-driving vehicles tend to be related to higher likelihood.

Table 103. Models of likelihood of using self-driving freight vehicles

	Robot	Drone
Impact on number of delivery orders	+	+
Impact on delivery costs: negative	+	+
Impact on delivery costs: positive	+	+
Impact on number of trips	+	+
Impact on parking needs: negative	+	+
Impact on parking needs: positive	+	+
Relocate to rural	-	-
Relocate to suburban		-
Relocate to city centre	-	
Woman		-
Age: 18-34	+	+
Age: 65+	-	-
No children	-	-
Education: higher university degree		+
Current number of trips (all modes)	+	+
No driving licence		-
Most frequent trip: shopping		+
Technology: "innovator"	+	
Technology: "early adopter"		
Technology: "late majority"	-	-
Technology: "laggard"	-	-
Not aware of self-driving vehicles	-	-
Aware of self-driving vehicles		+
Well aware of self-driving vehicles	+	+
City centre	+	
Village	-	
Region: Income per capita (log)	-	

Notes: Ordinal model. Table shows only the sign of significant variables. Appendix 12 contains full models

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5.11.3 Models of impacts of freight vehicles

The models of impacts of freight vehicles have few significant variables, compared to equivalent models in the case of passenger vehicles. Table 104 shows the models of the impacts on delivery orders. Change in delivery orders decreases with age and with having children. Women are more likely to increase number of orders than man if delivery robots were available. Delivery orders are positively related with current number of trips (in the case of the robot) and negatively related with not having a car (in the case of drones). Levels of adoption of technology and awareness of self-driving vehicles are both positively related to change in orders. Living in the city centre increases the change, but living in richer areas reduces it.

Table 104. Models of impact of self-driving freight vehicles on delivery orders

	Robot	Drone
Woman	+	
Age: 18-34	+	+
Age: 65+	-	-
No children	-	-
Current number of trips (all modes)	+	
No car		-
Technology: “innovator”	+	+
Technology: “early adopter”	+	+
Technology: “late majority”	-	-
Technology: “laggard”		
Aware of self-driving vehicles		+
Well aware of self-driving vehicles		
City centre	+	+
Region: Income per capita (log)	-	-

Notes: Log-linear model. Table shows only the sign of significant variables. Appendix 12 contains full models

Table 105 shows the models of the impacts on delivery orders. The 18-34 age group reported higher expected change in delivery costs. In the case of the robot, change in delivery costs is higher in city centres and lower for women. In the case of the drone, change in higher in richer regions and lower for households without children and individuals who make less trips. Again, adoption of technology and awareness of self-driving vehicles relate positively with delivery costs.

Table 105. Models of impact of self-driving freight vehicles on delivery costs

	Robot	Drone
Woman	-	
Age: 18-34	+	+
No children		-
Current number of trips (all modes)		-
Technology: “innovator”		+
Technology: “early adopter”	-	
Well aware of self-driving vehicles	+	+
City centre	+	
Region: Income per capita (log)		+

Notes: Ordinal model. Table shows only the sign of significant variables. Appendix 12 contains full models

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Figure 113 shows the impact on number of trips. The model has some similarities with the one above for number of orders, when it comes to household composition, technology, awareness, and living in the centre. However, there are some differences. Women are more likely to increase number of trips. Current number of trips is positively related to change in trips (in the case of delivery robots), and regional income is negatively related with change in trips. Participants whose current main trip purpose is shopping are less likely to reduce number of trips if they had access to delivery robots.

Table 106. Models of impact of self-driving freight vehicles on number of trips

	Robot	Drone
Woman	+	
Age: 18-34	+	+
Age: 65+	-	
No children		-
Current number of trips (all modes)	+	
Most frequent trip: shopping	-	
Technology: “innovator”	+	+
Technology: “early adopter”	+	+
Technology: “late majority”	-	-
Technology: “laggard”		
Not aware of self-driving vehicles		+
City centre	+	+
Region: Income per capita (log)	-	-

Notes: Log-linear model. Table shows only the sign of significant variables. Appendix 12 contains full models

Table 107 shows the impact on parking needs. Apart from the usual effects of technology adoption and awareness of self-driving vehicles, only six variables are significant. The youngest age group, those with education below university degree, and those living in the city centre are more likely to move and women are less likely. In the case of robots, those with higher university degrees are more likely to move and those who currently make more trips are less likely.

Table 107. Models of impact of self-driving freight vehicles on parking needs

	Robot	Drone
Woman	-	-
Age: 18-34	+	+
No children		-
Education: below university degree	+	+
Education: higher university degree	+	
Current number of trips (all modes)	-	
Technology: “innovator”		
Technology: “early adopter”	+	
Well aware of self-driving vehicles		+
City centre	+	+

Notes: Ordinal model. Table shows only the sign of significant variables. Appendix 12 contains full models

Table 108 shows the models of impacts on residence location. The dependent variable is the intention to move to more urbanised areas. Apart from the usual effects of technology adoption

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and awareness of self-driving vehicles, only four variables are significant: the youngest age group and those living in the city centre is more likely to move. Women (in the case of delivery robots) and those without children (in the case of drone) are less likely.

Table 108. Models of impact of self-driving freight vehicles on intention to move to more urbanised areas

	Robot	Drone
Woman	-	
Age: 18-34	+	+
No children		-
Technology: “innovator”	+	+
Technology: “early adopter”		
Technology: “late majority”		
Technology: “laggard”		-
Not aware of self-driving vehicles	-	
Well aware of self-driving vehicles	+	
City centre	+	+

Notes: Ordinal model. Table shows only the sign of significant variables. Appendix 12 contains full models

5.12 Needs and requirements

This section presents results of the part of survey that captured needs and requirement, i.e. specific preferences for the use of self-driving vehicles. This includes preferences for the type of vehicle (Section 5.12.1) and for the use of travel time (Section 5.12.2).

5.12.1 Preferred type of self-driving passenger transport vehicle

Participants were asked to rank five types of self-driving passenger transport vehicles. The options included the three vehicles presented in the impact questions presented in Section 5.7 of this report (private car, taxi, and public bus) and two extra vehicles: a pod (defined as a small two-seater vehicle for shorter trips) and an on-demand shuttle bus. Figure 158 shows the vehicle ranked as the most preferred.

The private car was the most preferred vehicle (ranked as number one by 37% of the sample) (Figure 158), followed by bus (15%), taxi (13%), pod (10%), and on-demand shuttle (6%). 18% of the sample indicated that they would not use any of these vehicles. Cyprus had the strongest preferences for the private car (47%), pod (18%), and on-demand shuttle (13%) among all countries. Greece has the strongest preference for the taxi (21%) and pod (18%), with the second strongest preference for the on-demand shuttle (11%) (considerably higher than the average of 6%). In both countries, almost no participants stated they would not use any of the vehicles. Preferences did not differ much between men and women. Preference for the car and taxi decreased with age, and preference for none of the vehicles increased with age.

A separate question asked about the most preferred vehicle for commuting trips – the results are shown in Figure 159. Preferences for car are only slightly weaker, comparing with the general case shown in Figure 158. The only relevant difference is the increase in the proportion of participants aged 65+ stating they would not use any vehicle (which is related to a lower need to commute among this age group).

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Figure 160 shows the rank position of the private car among the five vehicles (i.e. excluding participants who stated they would not use any of the five vehicles. The private car was ranked the most preferred by 45% of participants, second by 16% and third by 13%. Only 26% of the sample did not include the car on the top three preferred vehicles. The private car was ranked in relatively lower positions in Greece and among the 65+ group, compared with other sub-sets of the sample.

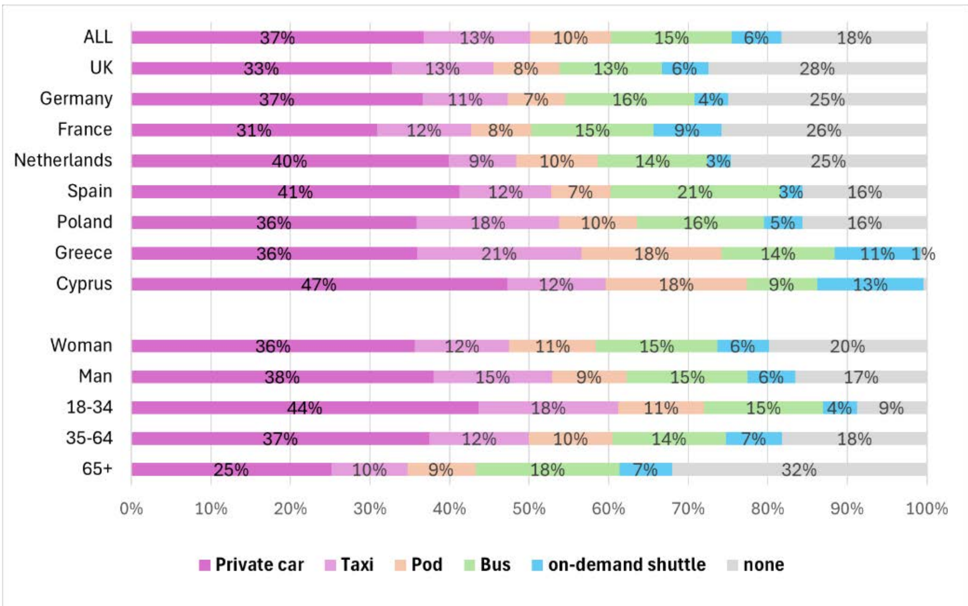

Figure 158. Preferred self-vehicle type, by country, gender, and age

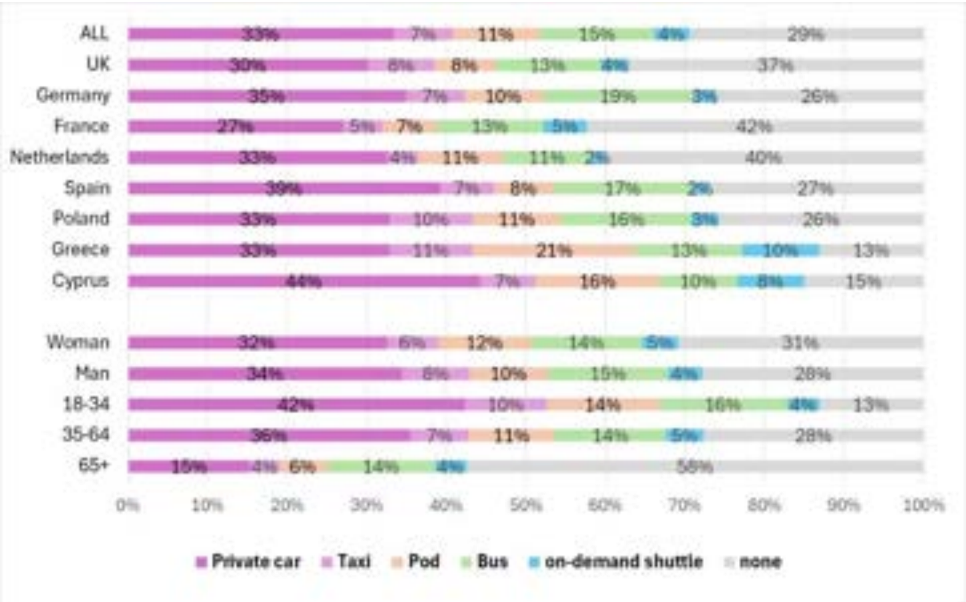

Figure 159. Preferred self-vehicle type for commuting trips, by country, gender, and age

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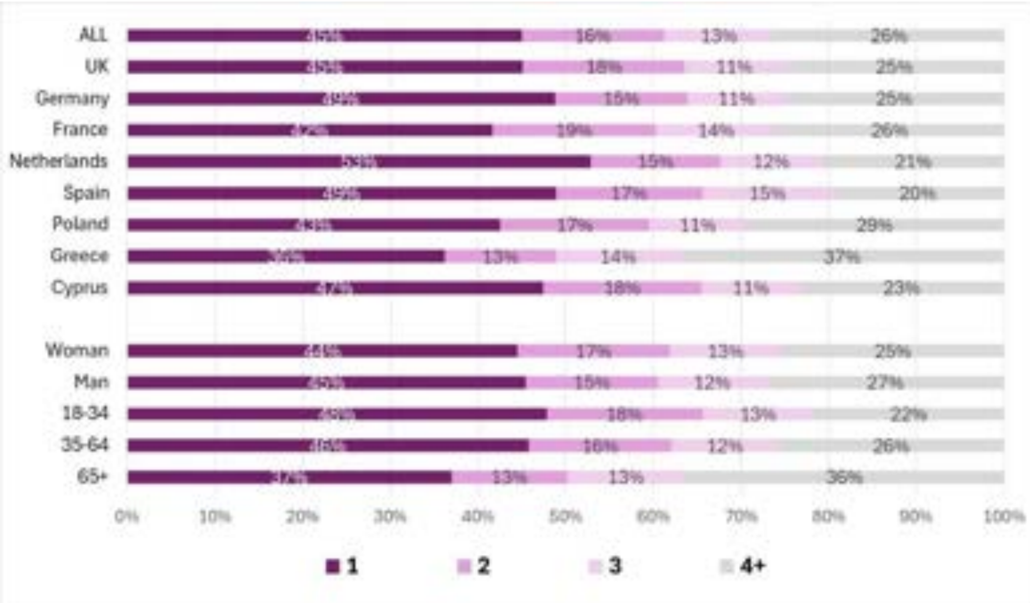

Notes: Excludes participants who stated they would not use any of the vehicles

Figure 160. Rank position of private car, by country, gender, and age

5.12.2 Activities while travelling in a self-driving vehicle

Figure 161 shows the activities that participants would engage with while travelling in self-driving vehicles. Among the three most frequent ones are activities that currently public transport users usually engage with: surf the web (43%) and talk on the phone (41%).

However, the other frequent activity is simply “focus on the road” (41%). This could be for relaxation, but it could also be because individuals do not fully trust the software driving the vehicle. This was indeed mentioned by some participants in the open-ended question at the end of the questionnaire as we will see later in Section 5.15 (even though the question was about impacts, some participants mentioned that they would still monitor the road and hoped there could be a way to regain control of the vehicle in emergency situations).

The preference for “focus on the road” is also consistent with the results obtained through the survey conducted at the beginning of the project, with smaller samples of participants in each country. This other survey was implemented when recruiting participants to join the project “satellites” network and join project activities (e.g. the qualitative assessment of impact, demonstration and virtual reality experiments reported in previous chapters of this report). In that survey, the most common activity participants mentioned was “look outside window” (51%, across all countries).

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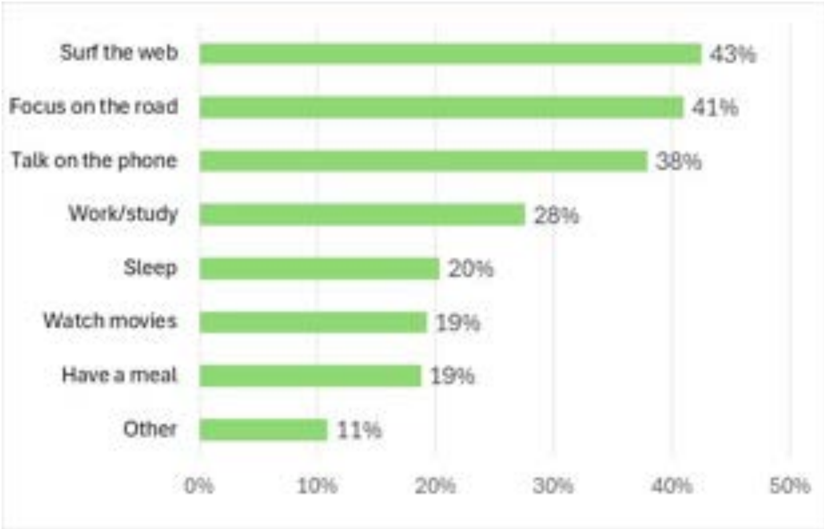

Figure 161. Activities while travelling in self-driving vehicles (% of whole sample)

As seen in the chart above, "work and study" was indicated as an activity by 28% of participants across the whole sample. The chart in Figure 162 and map in Figure 163 show this proportion varies within sub-sets of the sample. Intention to work or study while travelling on self-driving vehicles is stronger in Cyprus (48%) and Greece (38%) and among the 18-34 age group (42%). This intention is homogeneously strong across all Greek regions (Figure 163). It is also strong in several Spanish regions.

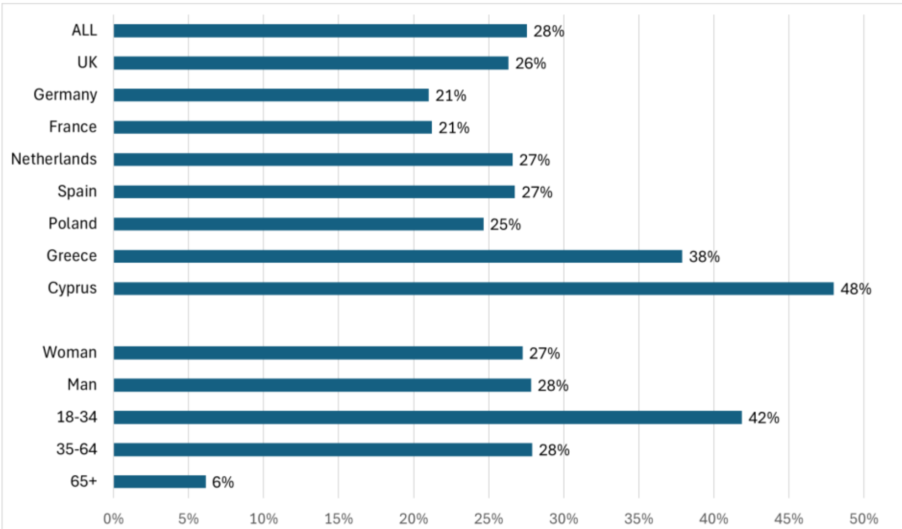

Figure 162. Activities while travelling in self-driving vehicles, by country, gender, and age: work/study (%)

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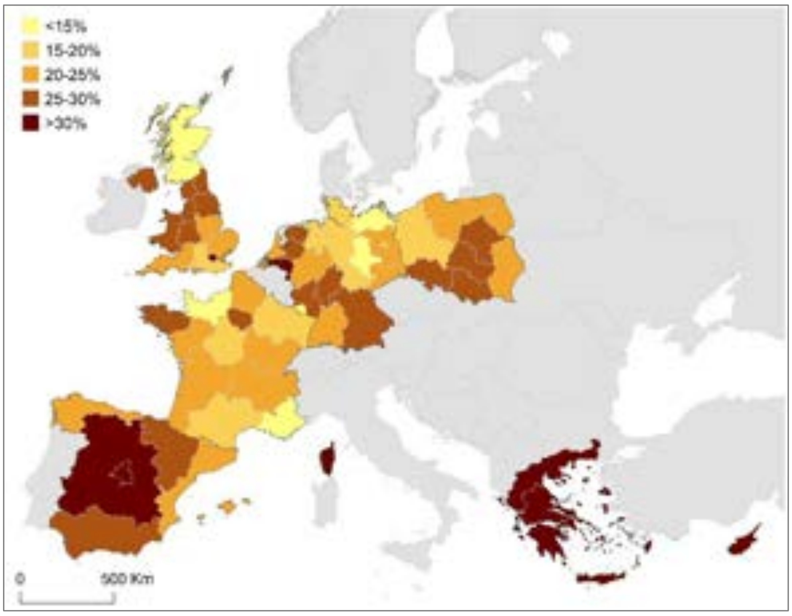

Figure 163. Activities while travelling in self-driving vehicles: work/study (%), by region

The following three figures show variations in intention to engage in the three main activities.

"Surf the web" and "talk on the phone" are more popular options in Spain and Cyprus (Figure 164 and Figure 165). In the United Kingdom and France, there is a stronger preference for talking on the phone than surfing the web, while in other countries, there is a stronger preference for surfing the web. The older age group has much weaker intention to engage in the two activities (26-27%) than the younger groups (between 39% and 47%). Women and slightly less likely to engage in the two activities than men are.

These age and gender patterns change for the "focus on the road" alternative. The older age is much more likely to indicate they would "focus on the road" (56%) than engaging in phone-related activities (Figure 166). In addition, women are more likely than men to intend to focus on the road. Greece is the country where this activity is more likely to happen.

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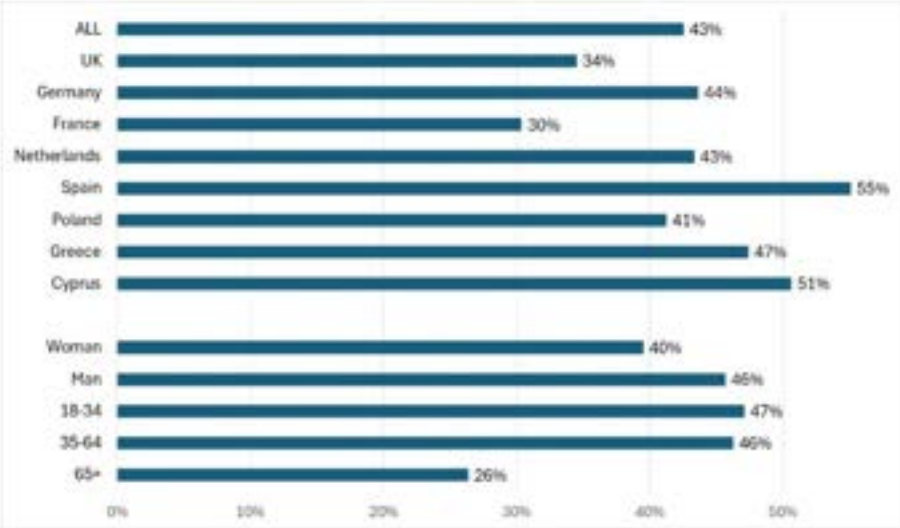

Figure 164. Activities while travelling in self-driving vehicles, by country, gender, and age: surf the web (%)

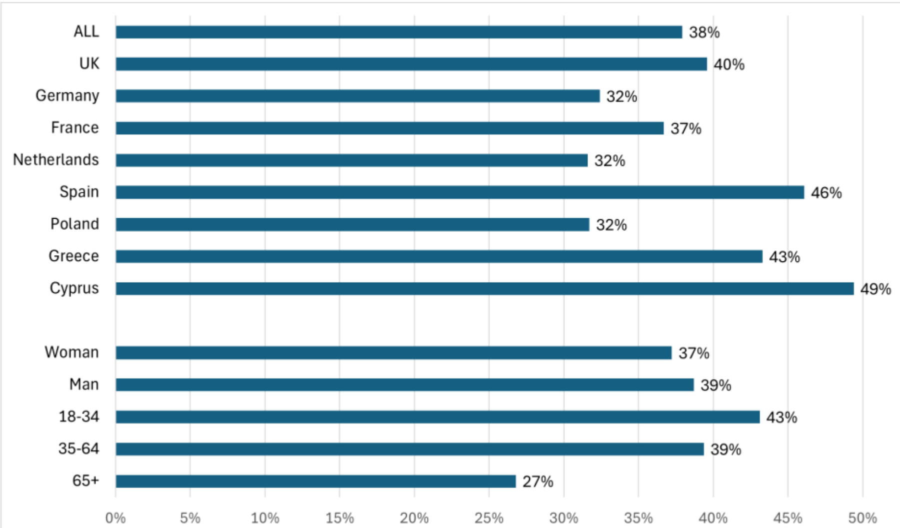

Figure 165. Activities while travelling in self-driving vehicles, by country, gender, and age: talk on the phone (%)

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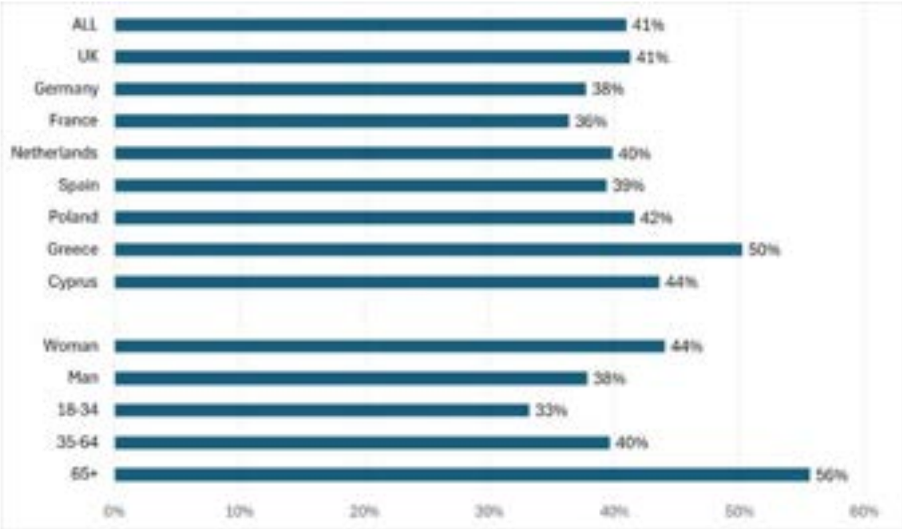

Figure 166. Activities while travelling in self-driving vehicles, by country, gender, and age: focus on the road (%)

Analysis of variations in intention to engage in other activities (not shown in any chart) revealed considerable age differences: the 18-34 age group is much more likely to sleep, watch movies, or have a meal (29%-31%), followed by the 36-64 group (17%-20%) and the 65+ group (6%-9%).

5.13 Implementation timeline of self-driving passenger transport vehicles

Participants were asked for their perception about the time when several types of self-driving passenger vehicles would be deployed in their region. Again, this considered five types of vehicles and not only the three vehicles presented in the impact questions presented in Section 5.7 of this report.

Figure 167 compares the participants' perceived implementation timelines of the five vehicles, across the whole sample. The perceptions vary little from vehicle to vehicle and there is a fairly equal distribution of participants across the five years shown as options and the "never" option. The most frequent time mentioned was 2040 (20-22% of participants), except in the case of the on-demand shuttle, which more people believe that it will never be implemented (22%). There is also a fair amount of scepticism regarding the other four vehicles, which 17-20% of participants think they will never be implemented. Between 11-14% of participants think self-driving passenger vehicles will be implemented before 2030.

Figure 168 to Figure 172 show how perceptions in the implementation timeline of each type of vehicle differ by country, gender, and age. Perceptions do not vary much from vehicle to vehicle. Participants in Spain are more optimistic regarding the timeline of implementation of all vehicles. Those in Greece are also more optimistic than other countries but tend to point to a slightly delayed timeline than in Spain. In both countries, the proportion of participants believing the vehicles will never be implemented is lower than in other countries, as 11-13%, compared to 17-20%, apart from the on-line shuttle, which has higher proportion of people believing it will never be implemented, in all countries.

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Perceptions vary little between men and women, but there is always a higher proportion of women believing the vehicles will never be implemented, for all vehicles, but especially the on-demand shuttle. Differences by age are also mainly on the proportion believing the vehicles will never be implemented, which increases steadily with age.

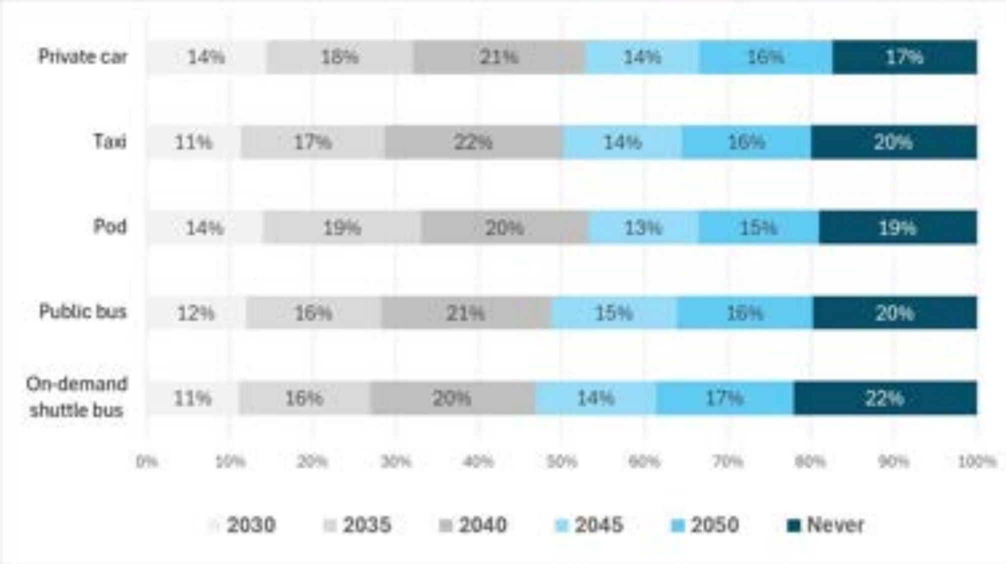

Figure 167. Perception of when self-driving vehicles will be implemented in one's region (whole sample)

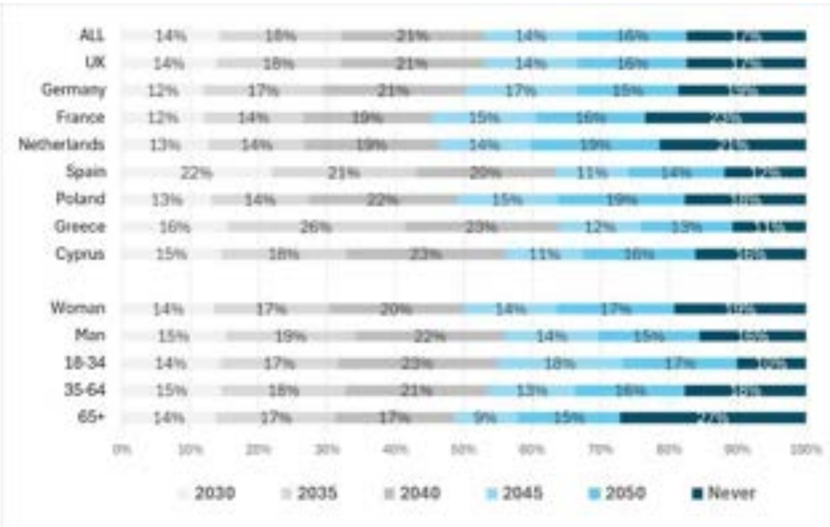

Figure 168. Perception of when self-driving cars will be implemented in one's region

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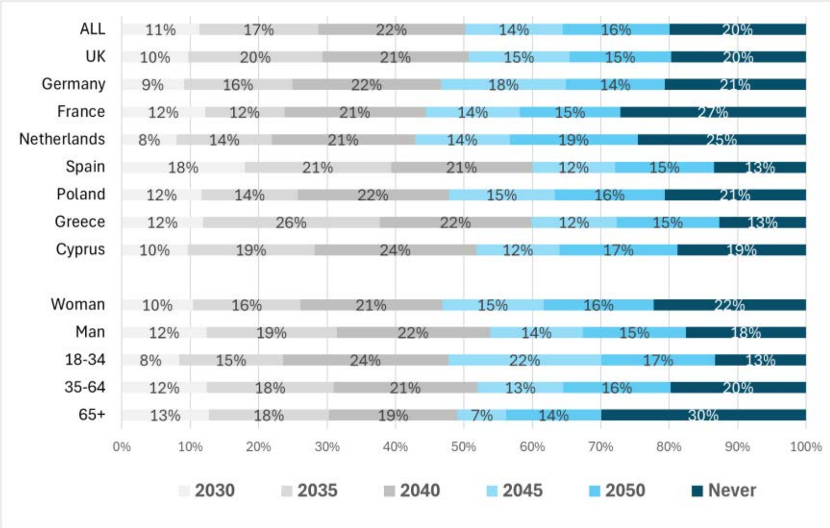

Figure 169. Perception of when self-driving taxis will be implemented in one's region

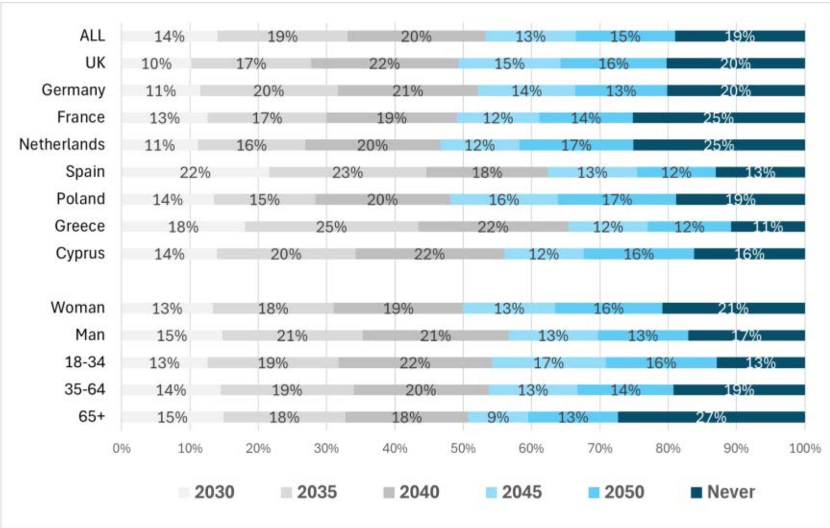

Figure 170. Perception of when self-driving pods will be implemented in one's region

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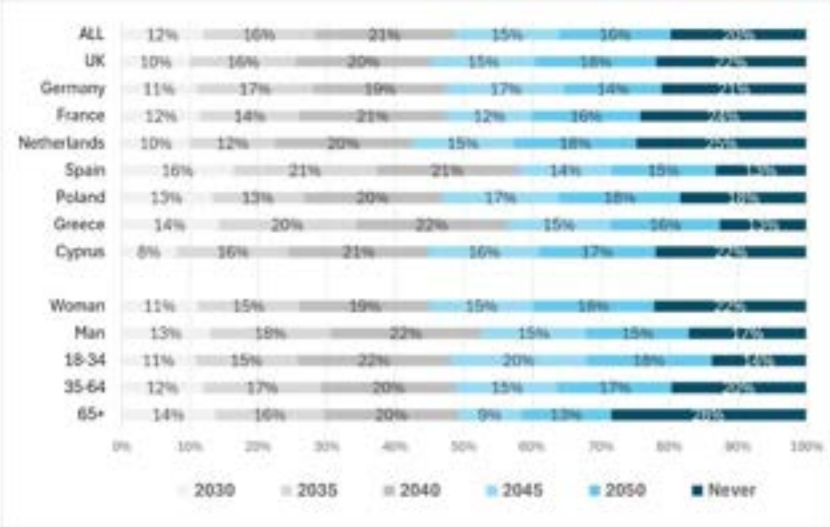

Figure 171. Perception of when self-driving buses will be implemented in one's region

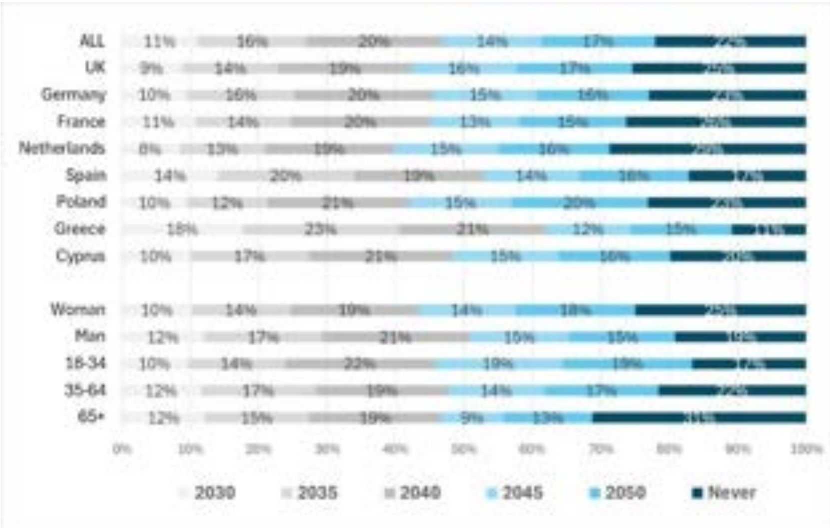

Figure 172. Perception of when self-driving on-demand shuttle buses will be implemented in one's region

The two maps that follow show geographic variations in two extreme positions: thinking that none of the five vehicles will ever be implemented (Figure 173) and thinking that all the five vehicles presented will be implemented in the next 6 years, i.e., by 2023 (Figure 174).

The highest proportions of participants believing none of the self-driving vehicles will be implemented (Figure 173) are higher in some regions of France, Germany, and the United Kingdom, and the lowest proportions in all regions of Spain, Greece, and Cyprus, as well as Norther Ireland (United Kingdom).

The highest proportions of participants believing all the vehicles will be implemented before 2030 (Figure 174) are in some regions of Spain and Greece, and the lowest are in regions scattered across all other countries (except Cyprus).

Comparing these maps with those showing levels of awareness of self-driving vehicles (shown previously in Figure 101 and Figure 102), the conclusion is that while in some regions, optimism

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regarding timeline occurs simultaneously with high levels of awareness (e.g. Madrid, most regions in Greece), and pessimism with low awareness (e.g. some regions in France), there are also regions where such relationships do not occur. For example, participants in the United Kingdom tend to be the most aware of self-driving vehicles, but there is a fair amount of scepticism regarding the implementation timeline of these vehicles in several of its regions.

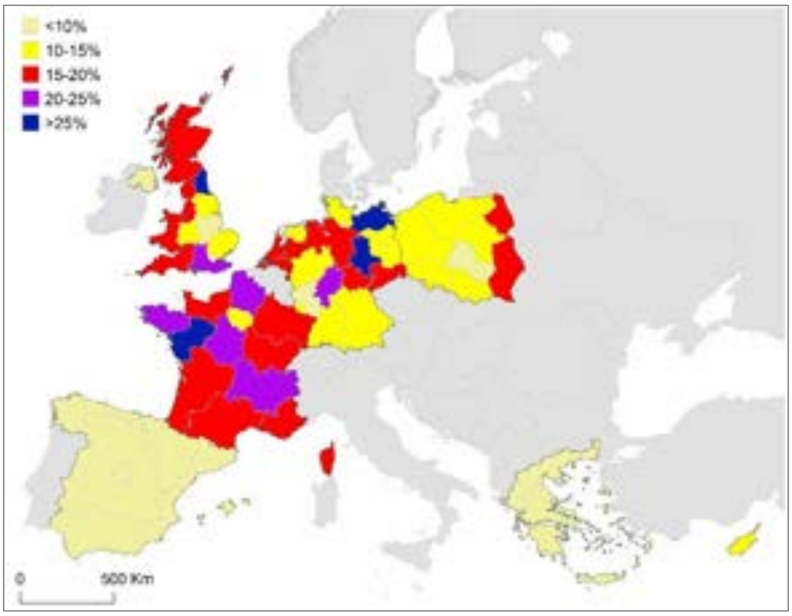

Figure 173. Proportion of participants who think none of the self-driving vehicle types will ever be implemented in their area, by region

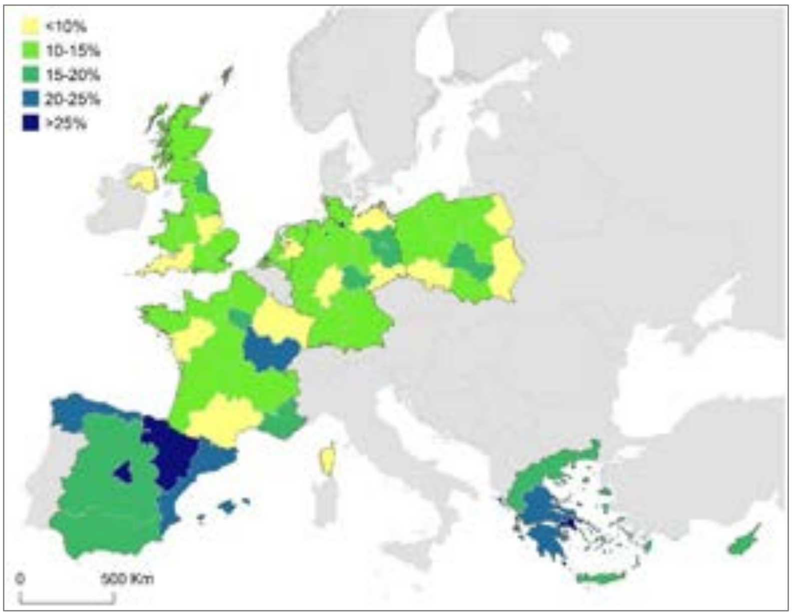

Figure 174. Proportion of participants who think all the self-driving vehicle types will be implemented in their area by 2030, by region

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5.14 Wider impacts

5.14.1 Overview

This section reports the results of participants' stated impacts of self-driving vehicles on their regions, and not on their individual behaviour or circumstances, as in Sections 5.7 and 5.10. The section is split according to the Move2CCAM project impact dimensions presented earlier: Mobility (Section 5.14.2), road network (5.14.3), land use (5.14.4), environment (5.14.5), economy (5.14.6), equity (5.14.7), public health (5.14.8), safety (5.14.9), and security (5.14.10). Each of the impact dimensions is assessed by several impact indicators, as presented earlier in Section 5.2.1. The results are based on participants' perceptions of probable change in the indicators following the implementation of self-driving vehicles, on a 5-point scale from "reduced significantly (50% reduction or more) to "increase significantly" (50% increase or more).

All nine sections follow the same structure, analysing:

- The distribution of participant answers on the 5-point scale, comparing the various indicators across the whole sample.
- The average impacts across the whole sample and disaggregated by country, gender, and age. As done previously, the 5-point scale was converted into a numerical one, assuming values from -2 to +2. The assumption is that participants perceive the original scale as a linear one, i.e. moves from one point to the next one always correspond to the same increase in impact.
- The distribution of participant answers on the original 5-point scale for each indicator, disaggregated by country, gender, and age.

5.14.2 Mobility

Figure 175 compares the results for the eight indicators of mobility impacts and Table 109 shows the average impacts, on a -2 to +2 scale. On average, participants think that number of trips and travel costs will increase (average of 0.20 and 0.14 respectively) (Table 109). More people think that number of trips and travel costs will increase or increase significantly than decrease or decrease significantly, but 49% think number of trips will not change, and 42% think travel costs will not change (Figure 175). The results for participants' perception of change in number of trips in their region are consistent with that they indicated for the change in their own trips. As seen in Section 5.7.4, on average participants thought their number of trips would increase.

Results for number of shopping trips and delivery costs are consistent with the ones for overall number of trips and travel costs. On average, participants think shopping trips will increase (mean score of 0.21), with about half of the sample saying it will not change, but more thinking it will increase (34%) than decrease (15%). This is consistent with opinions about change in personal (for all purposes), as seen in Section 5.7.4. On average, participants think that delivery costs will increase very slightly (mean score of 0.08), with 31% thinking they will increase and 24% think they will decrease. This is consistent with the perceptions about own delivery costs, which as seen in Section 5.10.5, is believed to be slightly negative on average but with most people (62%) having a neutral view. While the sign of the average change in personal and regional delivery costs is different, the magnitudes of the changes are very small, so the results are consistent.

Participants also have a neutral view regarding travel time (Table 109), with half thinking it will not change, and about the same number thinking it will increase and decrease (Figure 175). This

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