

# User acceptance of one-way off-street Electric Car-Sharing services

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# First report: User acceptance of one-way off-street Electric Car-Sharing services

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15.07.2020

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## 1. Introduction

This report presents the first-round analysis results for WP3 Business Modeling in the OSCAR project, funded by the European Institute of Innovation & Technology (EIT) Urban Mobility. The research activities take place at the Urban Planning and Transportation Group, Eindhoven University of Technology (TU/e for short hereafter). The first-round analysis aims to investigate the user acceptance of a one-way off-street Electric Car-Sharing service (ECS hereafter). The specific objective of this study is threefold: (1) to understand respondents' intention to use the ECS; (2) to identify the characteristics of people with higher acceptance of the ECS; (3) to exploit the importance of several psychological factors as drivers of intention to adopt the ECS.

### 1.1. The one-way off-street ECS

Different from free-floating carsharing, in the one-way off-street ECS the users need to pick-up and drop-off the shared electric cars (e-cars hereafter) at designated off-street parking areas, not necessarily the same places. The e-cars of the fleet are automobiles propelled by one or more electric motors, using energy stored in rechargeable batteries. Typically, if fully charged, an e-car has the maximum travel range of around 400 km. In the ECS, e-cars are provided by the service provider.

### 1.2. Structure of the report

The structure of the report is as follows. Chapter 2 illustrates the theoretical model that explains the relationship between psychological factors and intention to use the ECS. Chapter 3 shows the survey design and data collection procedure. Chapter 4 entails the characteristics of the sample, descriptive statistics of their behavior and acceptance of the ECS, and the relationship between psychological factors and intention to use the ECS. Chapter 5 provide managerial implications and Chapter 6 summaries the conclusions.

### 1.3. Preliminary results

Due to COVID-19, the survey design was delayed and only administered in the Netherlands. The first-round analysis results show that there is a niche of the population interested in the service, with young and highly educated people presenting higher intention to use the ECS. The willingness to use the ECS is heterogeneous across the population and can be explained by psychological factors such as performance expectancy, social influence, attitude towards sustainability, and the desire for an anxiety-free experience.

## 2. The theoretical model

As a first step to understanding the determinants of people's intention, we developed a theoretical model to identify a dependent variable, which represents the intention to use the ECS, and six independent psychological variables, which might have an impact on the behavioral intention. The dependent variable of our model is the intention to use the ECS.

- **Behavioral Intention (BI)** BI represents the degree to which respondents believe that they will use the ECS.

To identify the psychological factors, we take advantage of one popular behavioral theory in social science literature – the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT has been proven to be one of the best theories to explain consumers acceptance of technological innovations (Venkatesh et al., 2003, 2012), and has been identified as a valuable instrument in transportation research (Fleury et al., 2017; Hartwich et al., 2019; Madigan et al., 2017). In this report, we consider three psychological factors of the UTAUT model and three innovative psychological factors as explanatory variables of behavioral intention. The independent explanatory variables of our model are the following.

- **Performance expectancy (PE)** PE represents the degree to which respondents believe that the ECS will be able to satisfy their mobility needs – already present in the UTAUT.
- **Effort expectancy (EE)** EE represents the degree to which respondents consider it easy and intuitive to use the ECS – already present in the UTAUT.
- **Social influence (SI)** SI represents the degree to which respondents perceive a positive impact from their social network to use the ECS – already present in the UTAUT.
- **Attitude (AT)** AT represents the degree to which respondents have a positive attitude towards the use of ECS due to their orientation towards sustainability – not present in the UTAUT, added in this project.

- **Anxiety-free experience (AE)** AE represents the degree to which respondents perceive the experience with the ECS as free from anxiety – not present in the UTAUT, added in this project.
- **Trust (TR)** TR represents the degree to which respondents rely on the ECS. – not present in the UTAUT, added in this project.

A summary of all the variables considered in the theoretical model is presented in Table 1.

*Table 1 - Description of all the variables considered in the theoretical model*

<i>Psychological factor</i>	<i>Description</i>
<i>Explanatory variables:</i>	
Performance expectancy (PE)	The degree to which respondents believe that ECS will be able to satisfy their mobility needs.
Effort expectancy (EE)	The degree to which respondents consider it easy and intuitive to use the ECS.
Social influence (SI)	The degree to which respondents perceive that members of their social network believe they should use the ECS.
Attitude (AT)	The degree to which respondents have a positive attitude towards the use of ECS due to their orientation towards an environmentally-economically-socially sustainable system.
Anxiety-free experience (AE)	The degree to which respondents perceive the experience with the ECS as free from anxiety.
Trust (TR)	TR represents the degree to which respondents rely on the ECS.
<i>Dependent variable:</i>	
Behavioral intention (BI)	The degree to which respondents intend to use the ECS.

A graphical representation of the theoretical model is depicted in Figure 1. The six psychological factors on the left-hand side are the independent explanatory variables, while the dependent variable “behavioral intention” is on the right-hand side.

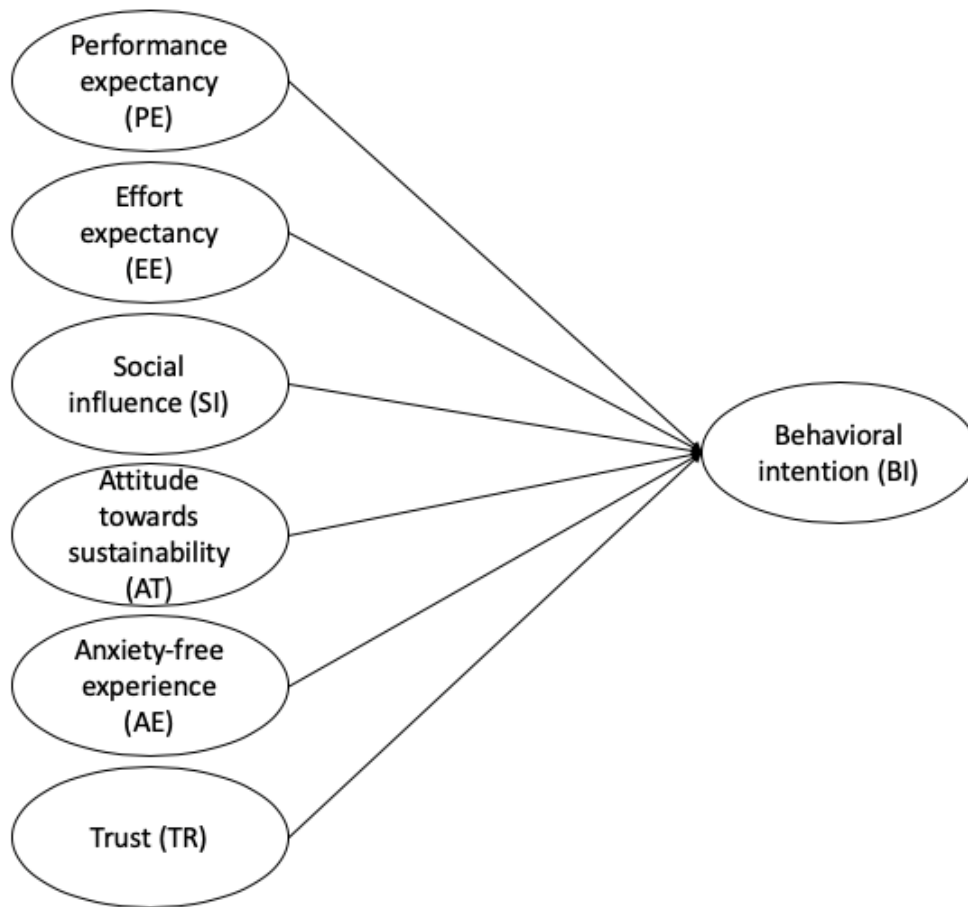


Figure 1 - Psychological factors determining the intention to use the electric car-sharing system.

### 3. Questionnaire and data collection

To measure the psychological factors and behavioral intention of respondents, we opted for an online questionnaire, designed by the Urban Planning and Transportation Group of TU/e and administered by the online market research company PanelClicx.

#### 3.1. The questionnaire

The psychological factors and the behavioral intention of respondents are technically known as latent variables. Different from observable variables (such as age, gender, etc.), these latent variables cannot be observed, but are measured through a set of items, known also as measurement variables. Therefore, to understand the user acceptance to the e-car and ECS, the respondents are invited to express their degree of agreement with a series of statements through a *seven-point Likert scale*, with “1” representing “strongly disagree” and “7” representing “strongly agree”. A full list of statements is reported in Table 2.

*Table 2 - Statements of the questionnaire, used to measure respondents' intention to use the ECS and the psychological factors affecting it*

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**Performance Expectancy (PE)**

- PE1 The e-car of the ECS would be safe and comfortable.
- PE2 The ECS would help me save travel time.
- PE3 The ECS would help me transfer to other transport modes.
- PE4 The ECS would enhance my engagement in activities at the destinations.

---

**Effort expectancy (EE)**

- EE1 The procedure would be simple for using the ECS.
- EE2 It would be easy to learn how to use the e-car.
- EE3 My interaction with the e-car would be clear and understandable.
- EE4 My interaction with the ECS would be clear and understandable.

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**Social influence (SI)**

- SI1 People who are important to me think that I should use the ECS.
- SI2 People whose opinions I value think that I should use the ECS.
- SI3 It seems that the ECS is getting popular around.
- SI4 It seems that my friends/colleagues are using it.

---

**Trust (TR)**

- TR1 The e-car would be clean and free of unwelcome smell.
- TR2 The e-car would satisfy the hygiene requirements.
- TR3 The e-car would be in the optimal condition without hidden damages
- TR4 The ECS would cover the necessary insurance to cope with uncertainties

---

**Anxiety-free experience (AE)**

- AE1 I would find the ECS has transparent payment and privacy-protection policies.
- AE2 I would find the ECS easy to make and cancel reservations without any costs.
- AE3 I would find the ECS easy to park or displace the e-car after use.
- AE4 I would find the ECS user-favored when a conflict of interest occurs.

---

**Attitude (AT)**

- AT1 I prefer to use environmental-friendly vehicles.
- AT2 The ECS would reduce traffic congestion and improve air quality.
- AT3 I would like to be well integrated with the sharing economy.
- AT4 The e-car and the ECS are innovative transport solutions

---

**Behavioral intention (BI)**

- BI1 I intend to use the ECS occasionally.
- BI2 I intend to use the ECS when there are promotions.
- BI3 I intend to use the ECS when I do not have other options.



- BI4 I intend to use the ECS for my regular trips.  
 BI5 I Intend to be a member of the ECS.  
 BI6 I would encourage my friends/colleagues to use the ECS.
- 

In addition to the statements, we also collected a set of questions identifying the socio-demographic characteristics and mobility behavior of the respondents.

### 3.2. Data collection

The data collection has been conducted between June 22<sup>nd</sup> and July 9<sup>th</sup> of 2020. The target population refers to adults living in the Netherlands and owning a driving license. Every respondent received instructions on how to complete the survey and filled a consent form before participating in the survey. The data collection has been conducted in four waves, each one followed by data analysis of the sample's characteristics to ensure the representativeness of the Dutch population.

## 4. Results

### 4.1. Sample characteristics and mobility behavior

The final sample is composed of 688 respondents, who present heterogeneous socio-demographics characteristics (Table 3). Overall, the sample is representative of the Dutch population except that the female and high-educated are slightly over-representative, but the ratios are still acceptable and in line with other studies conducted in the Netherlands.

*Table 3 - Frequency distribution of socio-demographic characteristics of the sample*

<i>Variable</i>		<i>Percentage</i>
<b>Gender</b>	Male	46.9%
	Female	53.1%
<b>Age</b>	<30	20.8%
	30-60	56.7%
	>60	22.5%
<b>Gross monthly income</b>	low (< 2500 €)	41.6%
	medium (2501 - 4500 €)	43.1%
	high (>4500 €)	15.3%
<b>Education level</b>	low	12.2%
	medium	36.3%
	high	51.5%

Regarding mobility preferences (Table 4), the majority of the respondents own at least one private car (94%), with 29.1% owning two or more cars. This result might be higher than the Dutch population, but it is acceptable as the selection procedure screened for people owning a driving license. Respondents select private car as the most preferred mean of transport for urban trips (54.5%), followed by bike (36.3%), public transport (7.1%), and others (2%). The most favorite means of transport for long trips is car (85.3%), followed by train (11.3%) and others (3.3%). Respondents, in general, seem to be satisfied with their current means of transport for both urban trips (93.2% is “satisfied” or “very satisfied”) and long trips (93.4%). The majority of the sample has no experience with car-sharing (70.9%), while 29.1% has had at least a one-time experience. The probability of using the ECS in the future is considered low or very low by 64.2% of the sample while neutral or high by the remaining 35.8%.

*Table 4 - Frequency distribution of transportation-related characteristics*

<i>Variable</i>		<i>Percentage</i>
<b>Car ownership</b>	0	6.0%
	1	65.0%
	2	26.9%
	more than 2	2.2%
<b>Most used mean of transport for urban trip</b>	own car	54.5%
	bike	36.3%
	public transport (bus, tram, metro, etc.)	7.1%
	other	2.0%
<b>Satisfaction with actual mean of transport for urban trip</b>	1 - very low	0.1%
	2	0.4%
	3 - neutral	6.3%
	4	46.7%
	5 - very high	46.5%
<b>Most used mean of transport for long trip (&gt;100 km)</b>	own car	85.3%
	train	11.3%
	other	3.3%
<b>Satisfaction with actual mean of transport for long trip</b>	1 - very low	0.0%
	2	0.1%
	3 - neutral	6.5%
	4	44.6%
	5 - very high	48.7%
<b>Car sharing experience</b>	1 - 2 months	5.4%
	3 - 6 months	6.8%
	> 7 months	16.9%
	no experience	70.9%
<b>Probability of using car sharing</b>	1 - very low	37.5%
	2	26.7%
	3 - neutral	29.4%
	4	5.5%
	5 - very high	0.9%

Based on the descriptive statistics, we find some variability concerning socio-demographic characteristics in the probability of using the ECS (Figure 2). The probability of using the ECS is negatively correlated with age and positively correlated with education level, meaning that younger and highly educated people are more willing to use it.

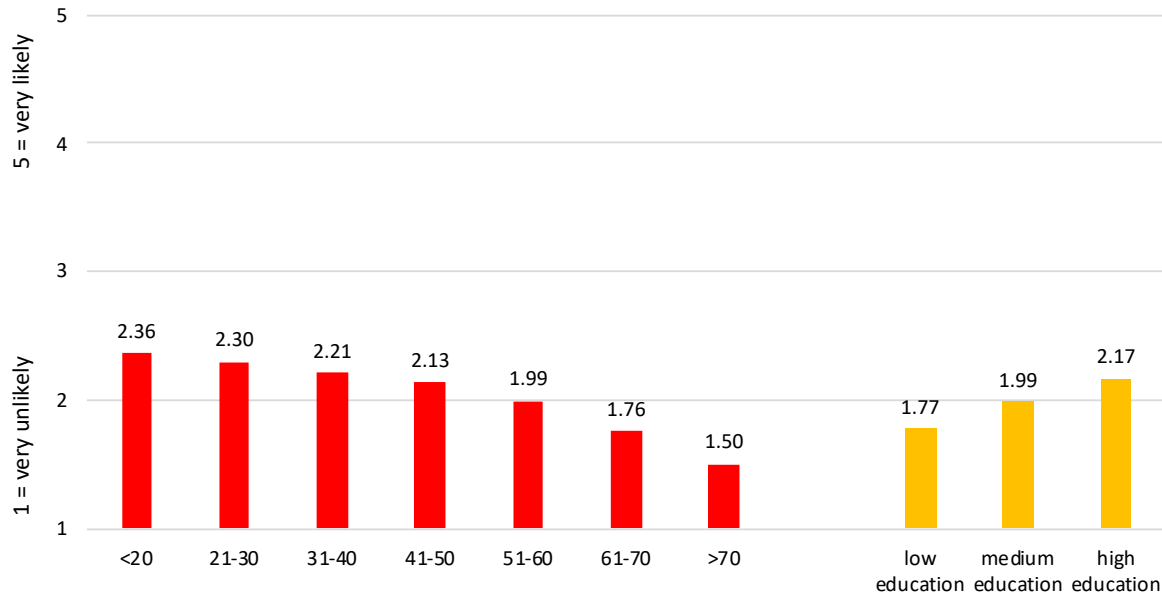


Figure 2 - Ratings of using an electric car-sharing system in the future (from 1 = very low to 5 = very high)

#### 4.2. Perception of the ECS

Respondents declared their level of agreement with 30 statements describing the ECS with a scale from 1 = “totally disagree” to 7 = “totally agree”. The statements refer to seven different psychological factors: performance expectancy (PE), effort expectancy (EE), social influence (SI), trust (TR), anxiety-free experience (AE), personal attitude (AT), and behavioral intention (BI). Average values and standard deviations of all the statements are reported in Table 5, in which the column “dropped items” identifies the statements dropped in the model estimation due to low consistency with other statements in their factors.

Table 5 - Average level of agreement with the statements of every psychological factor, from 1 = totally disagree to 7 = totally agree

Variables		average	st. dev.	dropped items
<b>Performance Expectancy (PE)</b>				
PE1	The e-car of the ECS would be safe and comfortable.	4,26	1,24	dropped
PE2	The ECS would help me save travel time.	3,64	1,28	
PE3	The ECS would help me transfer to other transport modes.	3,84	1,26	
PE4	The ECS would enhance my engagement in activities at the destinations.	3,62	1,26	
<b>Effort expectancy (EE)</b>				
EE1	The procedure would be simple for using the ECS.	4,24	1,20	dropped
EE2	It would be easy to learn how to use the e-car.	4,68	1,21	
EE3	My interaction with the e-car would be clear and understandable.	4,65	1,18	
EE4	My interaction with the ECS would be clear and understandable.	4,65	1,14	
<b>Social influence (SI)</b>				
SI1	People who are important to me think that I should use the ECS.	3,02	1,38	
SI2	People whose opinions I value think that I should use the ECS.	3,10	1,43	
SI3	It seems that the ECS is getting popular around.	3,59	1,42	dropped
SI4	It seems that my friends/colleagues are using it.	3,02	1,44	
<b>Trust (TR)</b>				
DROPPED				
TR1	The e-car would be clean and free of unwelcome smell.	5,55	1,31	
TR2	The e-car would satisfy the hygiene requirements.	5,62	1,34	
TR3	The e-car would be in the optimal condition without hidden damages	5,63	1,32	
TR4	The ECS would cover the necessary insurance to cope with uncertainties	5,66	1,32	
<b>Anxiety-free experience (AE)</b>				
AE1	I would find the ECS has transparent payment and privacy-protection policies.	4,84	1,26	
AE2	I would find the ECS easy to make and cancel reservations without any costs.	4,79	1,19	
AE3	I would find the ECS easy to park or displace the e-car after use.	4,77	1,23	
AE4	I would find the ECS user-favored when conflict of interests occurs.	4,30	1,16	dropped
<b>Attitude (AT)</b>				
AT1	I prefer to use environmental-friendly vehicles	5,00	1,31	
AT2	The ECS would reduce traffic congestion and improve air quality.	4,52	1,23	
AT3	I would like to be well integrated with the sharing economy.	4,25	1,25	
AT4	The e-car and the ECS are innovative transport solutions	4,83	1,20	
<b>Behavioral intention (BI)</b>				
BI1	I intend to use the ECS occasionally.	3,48	1,46	
BI2	I intend to use the ECS when there are promotions.	3,69	1,56	
BI3	I intend to use the ECS when I do not have other options.	4,29	1,46	dropped
BI4	I intend to use the ECS for my regular trips.	3,23	1,47	
BI5	I Intend to be a member of the ECS.	3,67	1,38	
BI6	I would encourage my friends/colleagues to use the ECS.	3,20	1,42	

The average value of the items within every psychological factor (Figure 2) shows that trust (TR) is the factor with the highest level (5.61), meaning that respondents believe that the e-car of the ECS will be in good condition, clean, free of smell, and satisfy the hygiene requirements and the ECS will cover the necessary insurance to cope with uncertainties. Respondents believe that using the car-sharing will be an anxiety-free experience (AE = 4.68), they expect privacy-protection policies by the ECS company, and they expect it easy to park and displace cars, to reserve and cancel reservations without any cost and to be preferred by the company when a conflict of interest occurs. Respondents are in general favorable of environmental-friendly vehicles and consider the ECS an innovative solution that can reduce traffic congestion (AT = 4.65), they expect no particular effort to use and understand the functioning of the ECS (EE =

4.56) but do not think that the ECS will be very effective in saving travel time, helping to transfer to other means of transport or enhance the engagement in activities at destination (PE = 3.84). Finally, respondents present a low intention to use it (BI = 3.59), with a higher propensity when there is no other option (BI3 = 4.29 – Table 5) and low social influence on using the ECS (SI = 3.18).

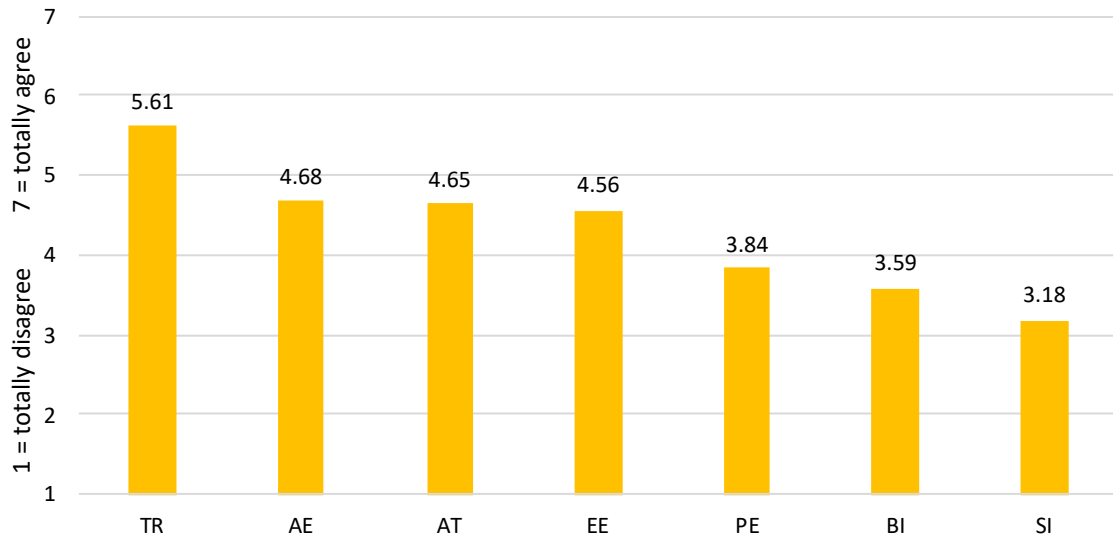


Figure 3 - Average levels of the psychological factors. (from 1 = strongly disagree to 5 = strongly agree)

### 4.3. Model estimation

To estimate whether the data collected confirm the theoretical model proposed in chapter 2, a data cleaning process has been applied. From the total sample of 688 respondents, 656 have been considered for the final estimation as the discarded 32 presented no variation across the statements.

Preliminary exploratory and confirmatory factor analysis has been obtained to check the psychological factors' validity. To optimize the model fit, we discarded the trust psychological factor due to the lack of correlation with behavioral intention. To maximize internal psychological factor reliability, a reduction of items has been applied, dropping those presenting less consistency with the psychological factor (dropped items can be seen in Table 5). Internal consistency is measured by an indicator, namely Cronbach's alpha, the higher the better, which should be above 0.70. All the considered psychological factors have a value of alpha larger than 0.80, as depicted in the first column of Table 6. Behavioral intention is the factor with the highest internal consistency (0.94), followed by social influence (0.92), performance expectancy (0.86), anxiety-free experience (0.85), effort expectancy (0.82), and attitude (0.80). Hence, all psychological factors are reliable.

Subsequently, a structural Equation Modeling (SEM) has been performed to estimate the impact of the psychological factors on the intention to use the ECS. Results of the SEM show that our model fits the data with a CFI = 0.959 (acceptable above 0.9, excellent above 0.95), a RMSEA = 0.061 (acceptable below 0.08, excellent below 0.05) and a SRMR = 0.046 (acceptable below 0.08, excellent below 0.05). These indicators show that the suggested model has an acceptable goodness-of-fit. Excluding EE, all the remaining psychological factors have a role in explaining BI. In general, 68.8% of the variability of BI (reported by the R2 value in Table 6) is explained by the variation in the levels of PE, SI, AT, and AE. SI is the psychological factor with the major impact on BI (0.48 – Table 6, Figure 4), followed by AT (0.39), PE (0.36), and AE (0.11).

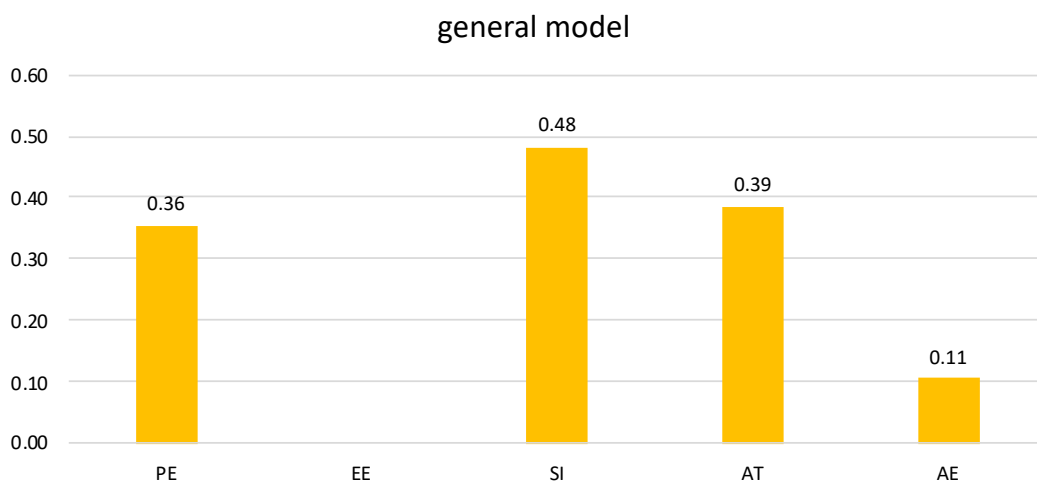


Figure 4 - Impact of psychological factors on intention to use the ECS, general model. A higher value on the y-axis reflects a higher impact of the psychological factor on BI (standardized). EE is maintained in the chart to be consistent with the UTAUT formulation, but it has no significant impact on BI.

As the impact of psychological factors on behavioral intention might be different depending on the socio-demographic characteristics of the users, a group analysis has been performed for gender, age, income, and education level.

#### 4.3.1 Gender

It is found that 71.4% of the variability of BI for the male subsample is explained by the PE, SI, AT, and AE psychological factors. PE has the highest impact on BI (0.47 - Table 6, Figure 5), followed by SI (0.40) and AT (0.35). 67.5% of the variability of BI for the female subsample is explained by the remaining psychological factors. SI has the highest impact on BI (0.54), followed by AT (0.43), PE (0.27), and AE (0.18). Hence, males' behavioral intention is more influenced by performance expectancy compared to females, who consider social influence, attitude, and anxiety-free experience as more important drivers of behavioral intention.

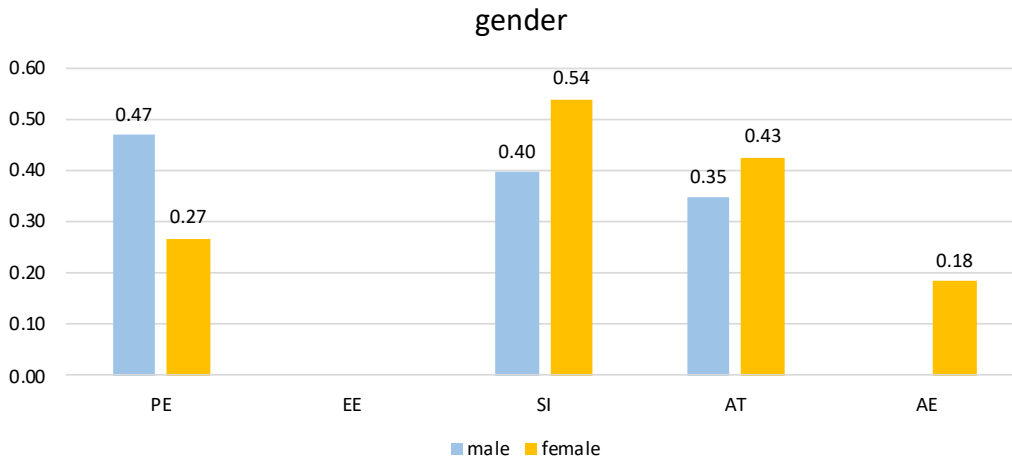


Figure 5 - Impact of psychological factors on intention to use an ECS, subgroup model: gender. A higher value on the y-axis reflects a higher impact of the psychological factor on BI (standardized). EE is maintained in the chart to be consistent with the UTAUT formulation, but it has no significant impact on BI.

#### 4.3.2 Age

The variability of BI for the subsample of people younger than 30 years old is explained by 73.3% by the PE, SI, AT, and AE psychological factors. SI has the highest impact on BI (0.56 - Table 6, Figure 6), followed by PE (0.36). The variability of BI for the subsample of those between 30 and 60 years old is explained by 70.1% by the psychological factors. SI has the highest impact on BI (0.48), followed by AT (0.44) and PE (0.29). The variability of BI for the subsample of older than 60 years old is explained by 63.5% by the remaining psychological factors. PE has the highest impact on BI (0.54), followed by AT (0.51) and SI (0.36). Hence, the impact of social influence on behavioral intention is decreasing with respect to age, performance expectancy is relevant for all ages but has higher importance for people older than 60 years old, while attitude toward sustainability is a driver of behavioral intention only for people older than 30 years old.

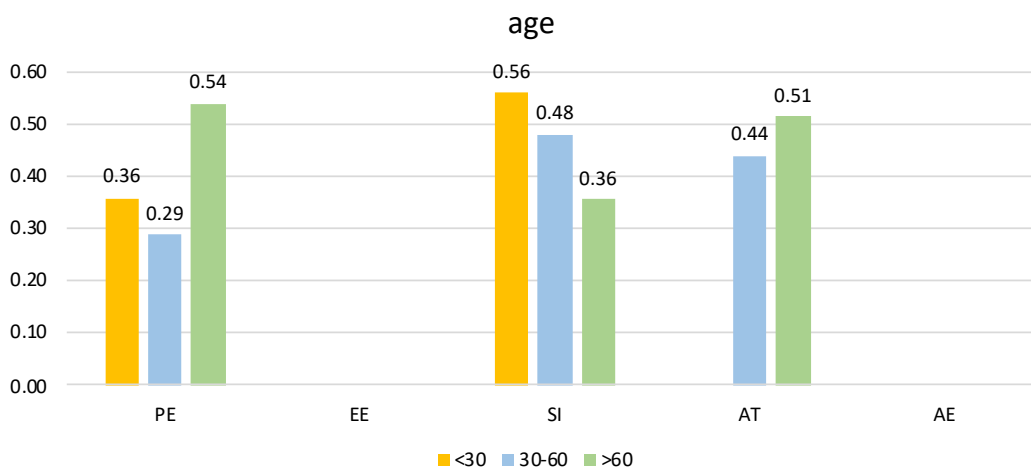


Figure 6 - Impact of psychological factors on intention to use an ECS, subgroup model: age. A higher value on the y-axis reflects a higher impact of the psychological factor on BI (standardized). EE and AE are maintained in the chart to be consistent with the UTAUT formulation, but they have no significant impact on BI.

### 4.3.3 Income

74.5% of the variability of BI for the low-income subsample is explained by the PE, SI, AT, and AE psychological factors. SI and AT have the highest impact on BI (0.50 - Table 6, Figure 7), followed by PE (0.27) and AE (0.20). The variability of BI for the medium-income subsample is explained by 66.7% by the psychological factors. SI has the highest impact on BI (0.52), followed by PE (0.33) and AT (0.29). The variability of BI for the high-income subsample is explained by 74.6% by the remaining psychological factors. PE is the only meaningful factor affecting BI (0.90). Hence, performance expectancy plays a very important role for the high-income group, while its effect is weaker for the other categories, social influence is an important driver of behavioral intention for low and medium-income. Attitude toward sustainability is more relevant for the low-income group but has also an impact for the medium-income group, anxiety-free experience is a driver of behavioral intention only for low-income.

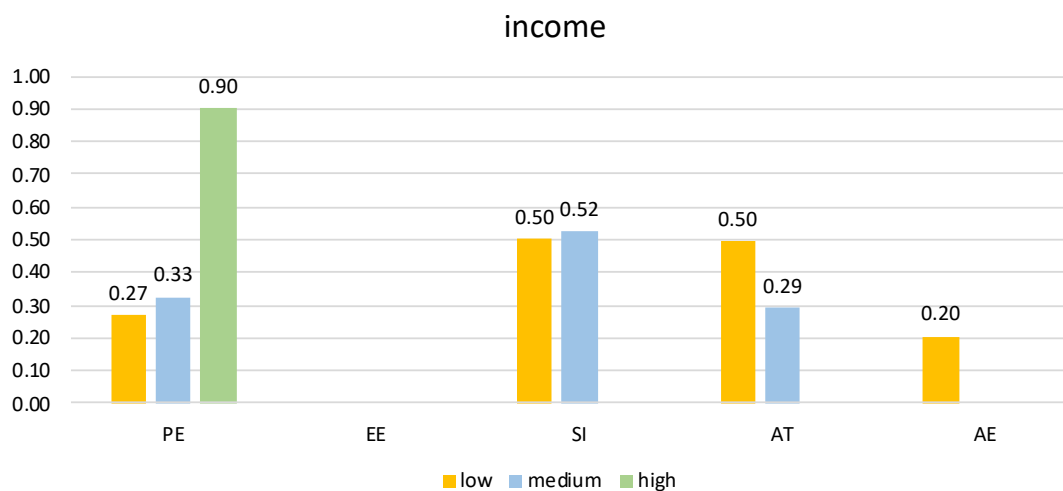


Figure 7 - Impact of psychological factors on intention to use an ECS, subgroup model: income. A higher value on the y-axis reflects a higher impact of the psychological factor on BI (standardized). EE is maintained in the chart to be consistent with the UTAUT formulation, but it has no significant impact on BI.

### 4.3.4 Education level

71.8% of the variability of BI for the low education-level subsample is explained by the PE, SI, AT, and AE psychological factors. SI is the only meaningful factor affecting BI (0.59 - Table 6, Figure 8). The variability of BI for the medium education-level subsample is explained by 63% by the remaining psychological factors. AT has the highest impact on BI (0.53), followed by SI (0.51). The variability of BI for the high education-level subsample is explained by 74.1% by the remaining psychological factors. PE has the highest impact on BI (0.49), followed by SI (0.43) and AT (0.31). Hence, social influence has a positive impact on



behavioral intention, which decreases as education level increases, performance expectancy is a driver of behavioral intention for highly educated people, while attitude toward sustainability has a positive impact on the behavioral intention for medium and high education level.

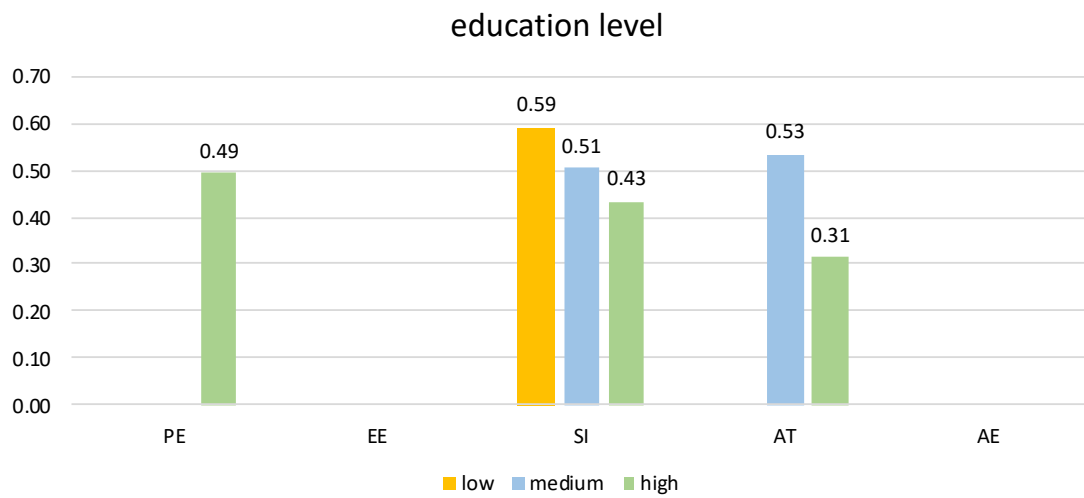


Figure 8 - Impact of psychological factors on intention to use an ECS, subgroup model: education level. A higher value on the y-axis reflects a higher impact of the psychological factor on BI (standardized). EE and AE are maintained in the chart to be consistent with the UTAUT formulation, but they have no impact on BI.

Table 6 - Regression results. Values in the table represent the impact of the psychological factor (on the left) on behavioral intention, for the specific subsample (on top), parameters in bold are significant at a 95% level. Values in parentheses report the internal consistency of the psychological factors, n.obs is the number of observations for every subsample, R2 is the percentage of variability in BI explained by other psychological factors, CFI, RMSEA, and SRMR are goodness-of-fit measures.

dependent variable: BI (alpha = 0.94)	gender			age			income			education level		
	general	male	female	<30	30-60	>60	low	medium	high	low	medium	high
PE (alpha = 0.86)	<b>0.36</b>	<b>0.47</b>	<b>0.27</b>	<b>0.36</b>	<b>0.29</b>	<b>0.54</b>	<b>0.27</b>	<b>0.33</b>	<b>0.90</b>	0.40	0.14	<b>0.49</b>
EE (0.82)	-0.02	0.03	-0.05	-0.14	0.02	-0.02	<b>-0.15</b>	0.07	0.03	0.02	0.00	-0.04
SI (0.92)	<b>0.48</b>	<b>0.40</b>	<b>0.54</b>	<b>0.56</b>	<b>0.48</b>	<b>0.36</b>	<b>0.50</b>	<b>0.52</b>	0.21	<b>0.59</b>	<b>0.51</b>	<b>0.43</b>
AT (0.80)	<b>0.39</b>	<b>0.35</b>	<b>0.43</b>	0.20	<b>0.44</b>	<b>0.51</b>	<b>0.50</b>	<b>0.29</b>	0.42	0.10	<b>0.53</b>	<b>0.31</b>
AE (0.85)	<b>0.11</b>	0.00	<b>0.18</b>	0.19	0.04	0.14	<b>0.20</b>	0.06	0.21	0.01	0.14	0.15
n.obs	656	304	352	141	367	148	242	248	90	77	237	342
R2	68.8%	71.4%	67.5%	73.3%	70.1%	63.5%	74.5%	66.7%	74.6%	71.8%	63.0%	74.1%
CFI	0.959	0.952		0.941			0.936			0.93		
RMSEA	0.061	0.066		0.074			0.077			0.081		
SRMR	0.046	0.049		0.054			0.058			0.051		

## 5. Managerial implications

A number of policy implications can be derived from the first-round analysis results. Before showing the details of managerial implications, it is necessary to have a clear picture of current mobility preferences of the potential market, which, in this case, is a population older than 18 years old and owning a driving license. The population of interest is very satisfied with their current means of transport, 93.2% of the respondents report being “satisfied” or “very satisfied” with the current mobility solution for an urban trip, while 93.4% for a trip longer than 100 km. The majority of the population of interest has no experience with car-sharing services (70.1%) and 12.2% has a one-time experience within six months. In such a context, in which the status-quo represents a quasi-optimal mobility solution and only a minority experienced a car-sharing service in the past, it is quite straightforward that a majority foresees “low” or “very low” probability of using the ECS in the future (64.2%). However, there is an evident gap between those having no experience with car-sharing (29.9%) and those foreseeing “neutral”, “high” or “very high” probability of using the ECS in the future (35.8%). The 5.9% gap suggests that, beyond those already having experience with car-sharing, there is a latent market of new potential users. The identification of psychological drivers of intention to use the ECS might help to develop adequate marketing tools and address specific campaigns to attract a larger customer base.

Social influence is the most important anticipator of intention to use the ECS, meaning that the behavioral intention is higher for those having friends, people they consider important or colleagues who are current users of the ECS and promote its usage. Thus, expanding the car-sharing user base is expected to have a snowball effect and attract people who did not consider the use of car-sharing in the beginning. An important user base of ECS might be composed of younger and highly educated people, who seem to be more interested in the ECS compared to the others. Younger people’s intention to use the ECS is affected by social influence and performance expectancy, while highly educated people by performance expectancy, social influence, and attitude towards sustainability. Hypothetical promotional messages to attract the mentioned segment should leverage on (1) the positive impact of using an electric car-sharing system on the environment by reducing traffic congestion and improving air quality; (2) the positive impact of ECS on travel time saving, on transferring to other transport modes and enhancing the engagement in activities at the destinations. Targeted promotional advertising could be integrated by marketing strategies aiming at the increase of word of mouth, such as

referral campaigns or incentives for sharing the experience on social media. Further promotion to a broader audience should be built on ad hoc marketing campaigns. As described in paragraph 4.3, the impact of psychological variables on behavioral intention varies depending on socio-demographic characteristics of the population such as age, gender, income, and education level. Table 7 summarizes the target segments, whose behavioral intention is more affected by specific factors, and proposals for marketing strategies.

*Table 7 - Main drivers of intention to use an electric car-sharing system and respective marketing strategies to increase the adoption of specific segments.*

Factor	Target segment	Marketing strategies
Performance expectancy	<ul style="list-style-type: none"> <li>• Males more than females</li> <li>• All ages</li> <li>• High income</li> <li>• Highly educated people</li> </ul>	Promotional messages stressing the positive impact of ECS on (1) travel time saving (2) transfer to other transport modes (3) engagement in activities at the destinations.
Social influence	<ul style="list-style-type: none"> <li>• Females more than males</li> <li>• Decreasing with age</li> <li>• Low and medium income</li> <li>• Decreasing with education level</li> </ul>	Referral campaigns. Incentives for sharing the experience on social media. Promotion by influencers.
Attitude	<ul style="list-style-type: none"> <li>• Females more than males</li> <li>• Older people</li> <li>• Low and medium income</li> <li>• Medium and high education level</li> </ul>	Promotional messages leveraging on the positive impact of using the ECS on the environment by reducing traffic congestion and improving air quality.
Anxiety-free experience	<ul style="list-style-type: none"> <li>• Females</li> <li>• Low income</li> </ul>	Promotional messages should ensure that (1) the ECS has transparent payment and privacy-protection policies; (2) it will be easy to make and cancel reservations without any costs; (3) it will be easy to park or displace the e-car after use.

## 6. Conclusions and plan of the second-round analysis

This report aimed at identifying user acceptance of one-way off-street electric car-sharing service (ECS). Based on the collected data and UTAUT model, we have identified the determinants of acceptance and the profile of those interested in the services. We tested the relationship between psychological factors and the intention to use the ECS. The main drivers of behavioral intention are Performance Expectancy, Social Influence, and Personal attitude.

Their impact varies depending on socio-demographic characteristics of the population such as age, gender, income, and education level. Therefore, a one-size-fits-all campaign could not be effective to attract new users, but promotional messages and marketing strategies should be targeted to socio-demographic specific segments.

The results of this report represent a first step in the study of people's acceptance of the ECS. They show that it is possible to identify psychological factors as determinants of behavioral intention. Based on that, further analysis will be conducted. The next round analysis will be aimed at (1) testing different SEM models and (2) exploiting travel preferences for ECS in several contexts.

## 7. Bibliography

- Fleury, S., Tom, A., Jamet, E., & Colas-Maheux, E. (2017). What drives corporate carsharing acceptance? A French case study. *Transportation Research Part F: Traffic Psychology and Behaviour*, *45*, 218–227. <https://doi.org/10.1016/j.trf.2016.12.004>
- Hartwich, F., Witzlack, C., Beggiano, M., & Krems, J. F. (2019). The first impression counts – A combined driving simulator and test track study on the development of trust and acceptance of highly automated driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, *65*, 522–535. <https://doi.org/10.1016/j.trf.2018.05.012>
- Madigan, R., Louw, T., Wilbrink, M., Schieben, A., & Merat, N. (2017). What influences the decision to use automated public transport? Using UTAUT to understand public acceptance of automated road transport systems. *Transportation Research Part F: Traffic Psychology and Behaviour*, *50*, 55–64. <https://doi.org/10.1016/j.trf.2017.07.007>
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems*, *27*(3), 425–478. <https://doi.org/10.2307/30036540>
- Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly: Management Information Systems*, *36*(1), 157–178. <https://doi.org/10.2307/41410412>

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