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Öörni, Risto

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Paper #125

Acceptance of mobility as a service by car users

Risto Öörni^{1*}

1. risto.oorni@vtt.fi, VTT Technical Research Centre of Finland Ltd, P.O. Box 1000, 02044 VTT, Finland

Abstract

New mobility services such as MaaS are expected to reduce the need to own a private car, to make mobility more sustainable and to be better able to answer travellers' needs. The objective of the study was to analyse the willingness of car users to replace their cars with a MaaS service package. An online survey (N=1135) aimed at active car users in the Helsinki region was carried out. About one in eight car users who participated in the study were willing to give up his or her private car and replace it with a MaaS service package. For most variables describing the demographic characteristics of the car user, no statistically significant association with willingness to switch to MaaS was found. Exceptions to this were car user's age and type of dwelling.

Keywords:

Mobility as a service, acceptance, car ownership

Introduction

New mobility services such as mobility as a service (MaaS) have been expected to reduce the need to own a private car [1]. There are also other expectations towards MaaS such as more sustainable mobility, more efficient use of the resources of the transport system and increased ability to answer travellers' needs [2, 3]. While multiple definitions have been proposed for MaaS, a few key characteristics of the service such as integration of multiple transport modes, availability of tariff options (e.g. package or pay as you go) and use of a single platform for service implementation have been identified [4]. The user acceptance of MaaS by travellers has been studied in several European countries [5, 6, 7]. However, much less studies have focused on the acceptance of MaaS services by existing car users and its potential to directly substitute car ownership even though many of the impacts of MaaS are dependent on the potential of MaaS to replace trips previously carried out with a private car. For this reason, it was important to analyse to what extent current car users would be willing to replace their private vehicles with a MaaS service package and in which car users groups this would be most likely.

Objectives

The objective of the study was to analyse the willingness of current car users to replace their cars with a MaaS service package. Related to this objective, three research questions were identified:

- RQ1: to what extent are existing car users willing to substitute private cars for MaaS services in the Helsinki region
- RQ2: what is the profile of a car user willing to give up his or her personal car and switch to a MaaS service package in the Helsinki region
- RQ3: what are the most important reasons for not willing to switch to a MaaS service package and give up car ownership?

Methods

Data collection

The data set used in the analysis was collected with an online survey. The online survey was targeted to car users living in the Helsinki region and who had driven at least 1500 km during the last 12 months. The online questionnaire was implemented by a marketing research company, and the respondents were recruited from a panel maintained by the company. The data collection took place in late 2021, and the questionnaire was available in Finnish language.

The first part of the questionnaire focused on the mobility behaviour and car use of the respondent. The second part of the questionnaire included questions on perceptions and practices related to vehicle maintenance and repair. The third part included questions on new vehicle propulsion technologies. Fourth part of the questionnaire covered user's perception of new mobility services and car use in future. The fifth and final part included questions related to respondent's background such as demographic variables such as number of persons in respondent's household. In addition to the information obtained from questionnaire, information on respondent's background was obtained from the database of the marketing research company (e.g. socio-economic status and level of education).

All the questions in the online survey were not asked from all respondents or analysed for all respondents (N=1135). The question on the willingness to replace private car with a MaaS was analysed only for respondents who used their own car, car owned by a family member, a company car or a leased car (N=1128). The question on the willingness to replace a car with MaaS service package included three response options: Yes, No and Do not know [kyllä, ei, en osaa sanoa].

The question on reasons for not switching from private car to a MaaS service package was presented only to respondents who had answered negatively to question "Would you be ready to give up your own car and start using a service package including shared vehicles and other mobility services (e.g. taxi and public transport)? When analysing the barriers for switching from private car to MaaS, the focus of the study was on barriers for using a shared vehicle. In total, seven statements related to barriers for using a shared vehicle were presented, and the respondent was asked why he or she would

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not be willing to replace a private car with MaaS and how important each of the presented reasons are his or her decision making (Likert scale from 1 to 5, 1: very little, 5: very much).

The characteristics of the sample obtained with the online survey are presented in Table 1. When looking at the table, it is possible to see that respondents older than 60 years and those who reported “pensioner” as their socio-economic status were overrepresented in the sample. For this reason, the analysis presented in the paper was carried out separately for respondents younger than 60 years, respondents who have turned 60 years and all age groups.

Table 1 – Characteristics of respondents

Gender	N	Share [%]	Cumulative share [%]
Male	727	64.1	64.1
Female	408	35.9	100.0
Total	1135	100.0	
Age group	N	Share [%]	Cumulative share [%]
<30 years	39	3.4	3.4
30–39 years	70	6.2	9.6
40–49 years	126	11.1	20.7
50–59 years	221	19.5	40.2
60–69 years	316	27.8	68.0
70v+ years	363	32.0	100.0
Total	1135	100.0	
Socio-economic status	N	Share [%]	Cumulative share [%]
Managerial position [Johtavassa asemassa toisen palveluksessa]	53	4.7	4.7
Upper non-manual employee [Ylempi toimihenkilö]	188	16.6	21.2
Lower non-manual employee [Alempi toimihenkilö]	106	9.3	30.6
Manual worker [Työntekijä]	126	11.1	41.7
Entrepreneur or self-employed [Yrittäjä tai yksityinen ammatinharjoittaja]	75	6.6	48.3
Unemployed [Työtön]	25	2.2	50.5
Student [Koululainen tai opiskelija]	15	1.3	51.8
Pensioner [Eläkeläinen]	528	46.5	98.3
Homemaker [Kotiäiti tai koti-isä]	4	0.4	98.7
Other [Muu]	13	1.1	99.8
Cannot tell [Ei osaa sanoa]	2	0.2	100.0
Total	1135	100.0	

The data set used in the analysis was collected as a part of the CLEMET project (Cleantech Mobility Education for Tomorrow) [8]. The aim of the CLEMET project was to develop vocational and tertiary education in automotive sector. The CLEMET project included a consumer study whose aim was to study the user acceptance of greener propulsion technologies, car users’ practices related to vehicle maintenance and repair, acceptance of purchasing vehicle as a service and willingness to replace a

private car with MaaS service package. The results presented in this paper have earlier been discussed in a technical report published by the CLEMET project [9]. The results of the CLEMET consumer study on acceptance of fully electric vehicles have been included in another paper [10].

Statistical methods

Respondents who used their own car, a car owned by a family member, a company car or a leased car (N=1128) were selected for analysis. The analysis was then carried out separately for respondents younger than 60 years (N=435), respondents 60 years or older (N=657) and for all age groups (N=1128). The analysis was started by calculating the shares of different answers to the question whether the respondent was ready to replace his or her private car with a MaaS service package.

The next phase of the analysis was crosstabulation of answers to the question on the readiness to replace car with a MaaS service package with the demographic variables of respondents (age, gender, socio-economic status, pre-tax household income, education level, marital status, household size and type of dwelling). Chi-square test of independence [11] was then calculated to find out whether the car users willing to substitute their private vehicles with a MaaS service package were different from other car users participating in the study.

The results of a Chi-square test indicate whether there is a statistically significant association between two categorical variables. However, it does not tell which groups being analysed differ from each other and how much. For this reason, odds ratios and confidence intervals for odds ratios [11] were calculated for certain combinations of willingness to replace private car with MaaS and demographic variables related to demographic characteristics of respondents. Cramer's V [11] was also calculated for each Chi-square test to measure the strength of association between categorical variables. The analysis was carried out with SPSS statistical package.

In case of Chi-square test of independence, there is no universally accepted criterion or criteria for minimum values of expected frequencies in the contingency table [11]. The criteria mentioned by statistics textbooks [11, 12] (the table of expected frequencies should not contain frequencies less than 1 and more than 20% of the cells should not contain frequencies less than 5) was used in the study. For this reason, some columns and rows were combined in the contingency tables between willingness to replace private car with MaaS and demographic variables describing the respondents. First, answers "No" and "Do not know" to the question "Would you be ready to give up your own car and start using a service package including shared vehicles and other mobility services (e.g. taxi and public transport)?" ["Olisitko valmis luopumaan omasta autosta ja siirtymään yhteiskäyttöisiä autoja ja muita liikumispalveluita (esim. taksi ja joukkoliikenne) sisältävän palvelupaketin käyttäjäksi?"] were combined to the same category, leaving only two categories "Yes" and "No or do not know". Then, categories were combined for demographic variables describing the respondents when needed to satisfy the criteria for minimum expected frequencies in contingency tables.

Barriers for switching from a private cars to a MaaS service package (and shared vehicle) were analysed by summarising the distribution of responses regarding the importance of different barriers and calculating basic statistical figures (mean and standard deviation).

Results

Readiness to give up a private car and replace it with a MaaS service package

Results on car users' willingness to give up their private cars and replace them with a MaaS service package are presented in Table 2. Only about 12% of the car users who participated in the online survey were willing to give up their own cars and replace it with a service package with potential elements of MaaS (shared vehicles, public transport and taxi).

Table 2 – Answers to question “Would you be ready to give up your own car and start using a service package including shared vehicles and other mobility services (e.g. taxi and public transport)?”, results for respondents younger than 60 years, respondents 60 years or older and all age groups

	Yes	No	Do not know	Total
<60 years	71 (15.7%)	327 (72.2%)	55 (12.1%)	453 (100%)
60 years or older	64 (9.5%)	519 (76.9%)	92 (13.6%)	675 (100%)
All age groups	135 (12.0%)	846 (75.0%)	147 (13.0%)	1128 (100%)

Profile of a car user willing to give up his or her personal car and switch to a MaaS service package

The results of Chi-square tests between demographic variables of car users and the willingness to substitute a private car with MaaS service package are summarised in Table 3. A statistically significant association was found for two of the analysed variables (age and type of dwelling) to the willingness to give up a private car and replace it with a MaaS service package.

Table 3 – Results of Chi-Square tests – Readiness to replace car with a MaaS service package, association with age, gender, socio-economic status, household income, education level, marital status, number of cars in household, household size and type of dwelling

Readiness to replace car with a MaaS service package, association with age, gender, socio-economic status, household income, education level, marital status, number of cars in household, household size and type of dwelling			
	Respondents <60 years (N=453)	Respondents 60 years or older (N=675)	All age groups (N = 1128)
	only respondents who use their own car, car owned by a family member, a company car or a leased car		
Age (13 classes)	p=0.001 Chi-square = 24.929 df=7 Cramer's V = 0.235	p=0.825 Chi-square=0.903 df=3	p<0.001 Chi-square = 41.872 df=11 Cramer's V = 0.193
Age (6 classes)	p=0.001 Chi-square = 15.967 df=3 Cramer's V = 0.188	p=0.533 Chi-square=0.388 df=1	p<0.001 Chi-square = 30.359 df=5 Cramer's V = 0.164
Gender	p=0.480 Chi-square=0.499 df=1	p=0.727 Chi-square=0.122 df=1	p=0.844 Chi-square = 0.039 df=1
Social group	p=0.203 Chi-square = 8.516 df=6	p=0.298 Chi-square=2.424 df=2	p=0.201 Chi-square = 11.012 df=8
Pre-tax household income	p=0.138 Chi-square=11.016 df=7	p=0.496 Chi-square=4.379 df=5	p=0.135 Chi-square = 11.094 df=7
Education	p=0.295 Chi-square=6.114 df=5	p=0.515 Chi-square=3.260 df=4	p=0.173 Chi-square = 7.703 df=5
Marital status	p=0.657 Chi-square = 2.429 df=4	p=0.213 Chi-square=3.092 df=2	p=0.444 Chi-square = 3.731 df=4
Number of cars in household	p=0.065 Chi-square = 5.479 df=2	p=0.141 Chi-square=3.914 df=2	p=0.076 Chi-square = 5.156 df=2
Household size	p=0.308 Chi-square=5.983 df=5	p=0.454 Chi-square=1.580 df=2	p=0.097 Chi-square = 9.305 df=5
Type of dwelling	p=0.282 Chi-square=3.819 df=3	p=0.025 Chi-square=9.373 df=3 Cramer's V=0.118	p=0.024 Chi-square = 11.233 df=4 Cramer's V = 0.100

For three variables with a statistically significant relationship for all age groups (age expressed as 13 classes, age expressed as 6 classes and type of dwelling), odds ratios and confidence intervals for odds ratios are presented in Figures 1–3. In general, the willingness to replace car with a MaaS service package seems to decrease with the age of the respondent (Figure 1). The only exception seems to be respondents who are 30–34 years old, but this may also be due to random variation and limited number of respondents in this age group in the data. For the type of dwelling, the only statistically

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significant difference was between respondents who live in an apartment building and respondents who live in a detached house.

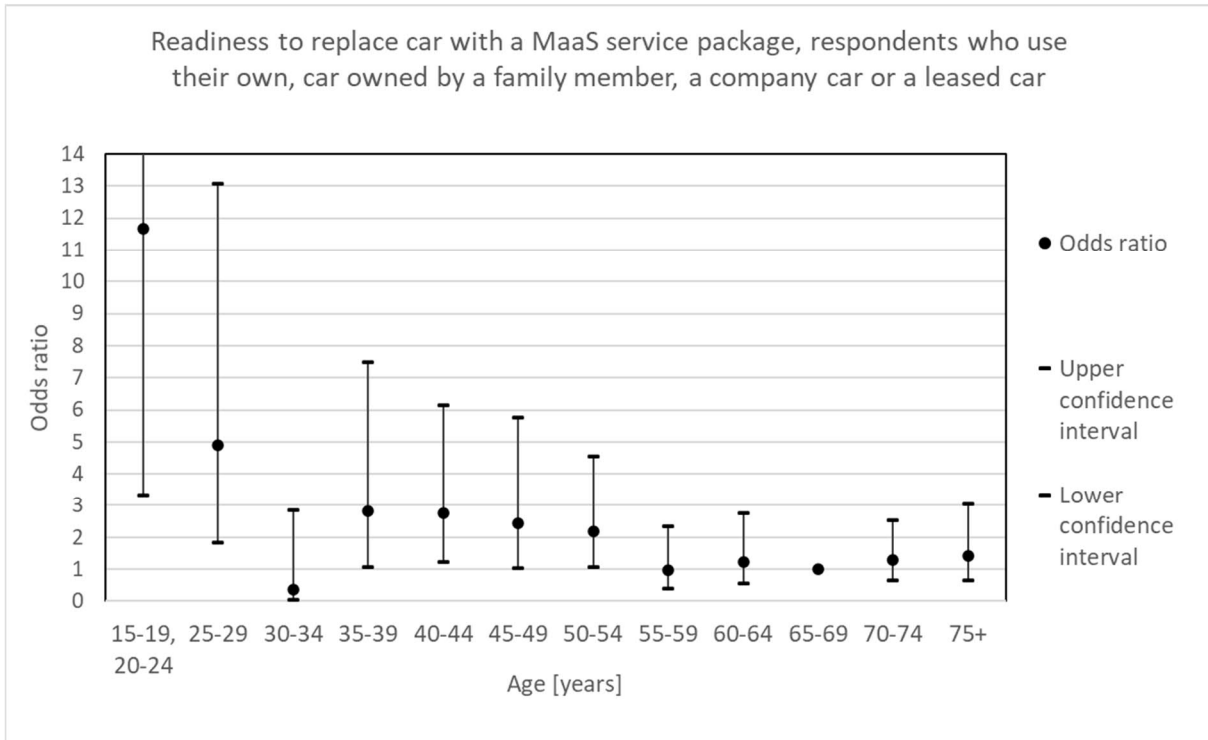


Figure 1 – Readiness to replace car with a MaaS service package – odds ratio as a function of age (13 categories)

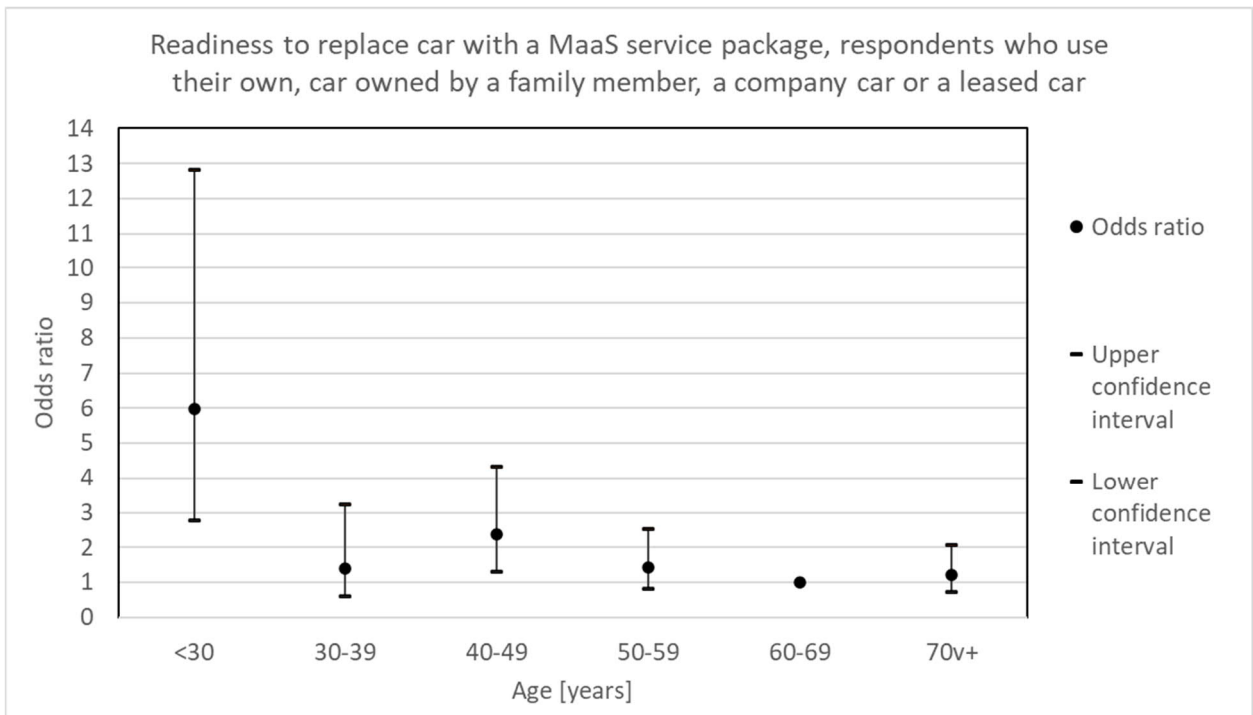


Figure 2 – Readiness to replace car with a MaaS service package – odds ratio as a function of age (7 categories)

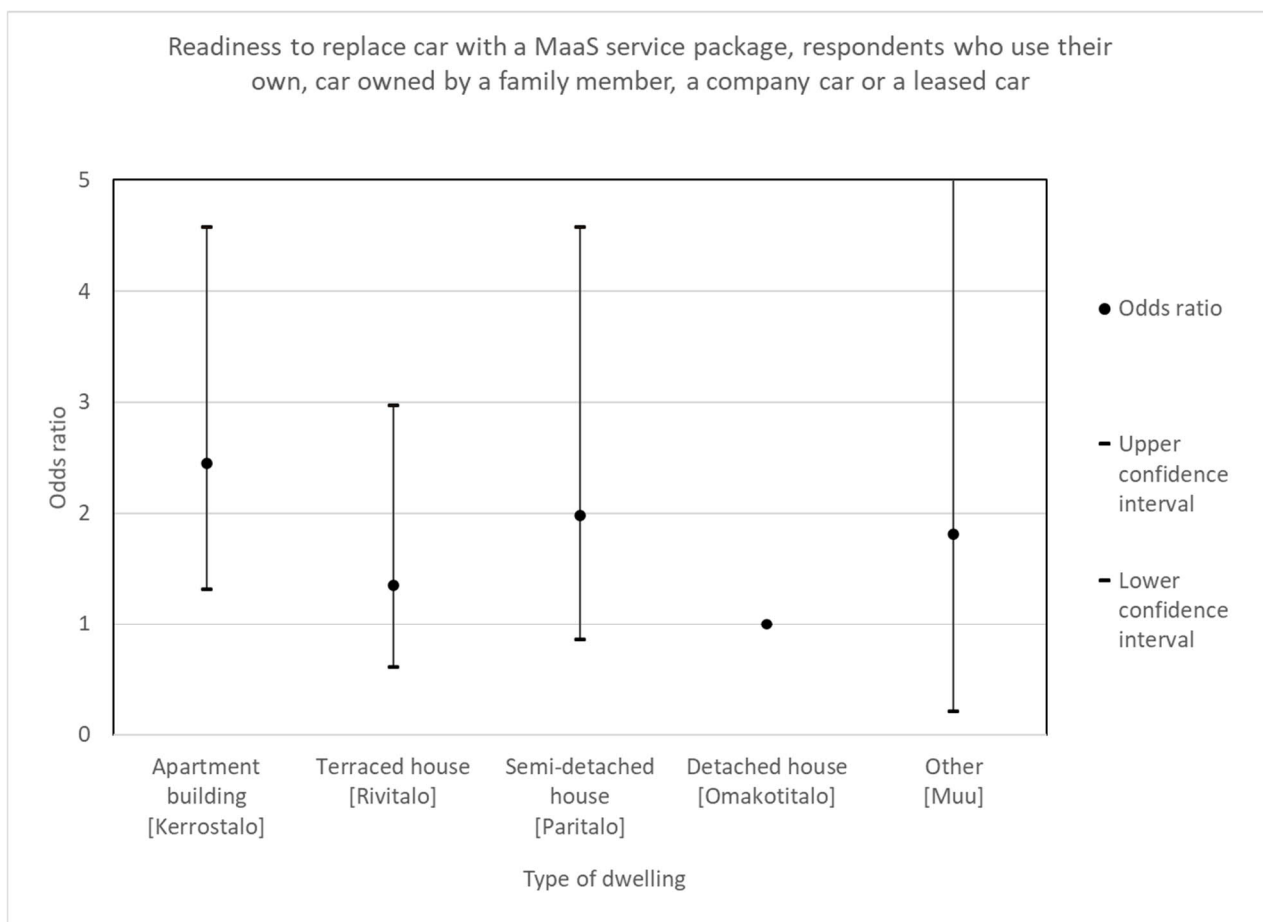


Figure 3 – Readiness to replace car with a MaaS service package – odds ratio as a function of type of dwelling

Reasons for not switching to a MaaS service package and giving up car ownership

The perceived importance of different reasons for not giving up vehicle ownership and switching to a MaaS service package is presented in Table 4. In this study, only barriers for using a shared vehicle, which may be a part of the service package, were covered.

Table 3 – Reasons for not giving up private car and switching to a MaaS service package (all age groups, N=846)

	Distribution of responses [N]					N	Mean	Standard deviation
	1	2	3	4	5			
All shared vehicles may be reserved or in use, and a vehicle will not be available when one needs it. [Kaikki yhteiskäyttöiset autot voivat olla varattuina, eikä autoa saa käyttöön silloin, kun sitä tarvitsee]	18 (2.1%)	28 (3.3%)	66 (7.8%)	222 (26.2%)	512 (60.5%)	846 (100%)	4.40	0.922
A shared vehicle needs to be picked up from a defined place [Yhteiskäytössä oleva auto on erikseen noudettava määrätystä paikasta]	17 (2.0%)	24 (2.8%)	79 (9.3%)	226 (26.7%)	500 (59.1%)	846 (100%)	4.38	0.914
A shared vehicle needs to be reserved in advance [Yhteiskäytössä oleva auto pitää varata etukäteen]	16 (1.9%)	20 (2.4%)	91 (10.8)	234 (27.7%)	485 (57.3)	846 (100%)	4.36	0.903
A shared vehicle needs to be picked up and returned at agreed time [Yhteiskäytössä oleva auto pitää noutaa ja palauttaa sovittuun aikaan]	13 (1.5%)	26 (3.1%)	76 (9.0%)	216 (25.5%)	515 (60.9%)	846 (100%)	4.41	0.890
Unclear liability issues regarding wear or damage of a shared vehicle [Vastuukysymykset yhteiskäyttöisen auton kulumisesta ja vaurioista ovat epäselviä]	43 (5.1%)	74 (8.7%)	198 (23.4%)	226 (26.7%)	305 (36.1%)	846 (100%)	3.80	1.168
It is cheaper to use one's own car [Oman auton käyttö on halvempi vaihtoehto]	74 (8.7%)	119 (14.1%)	311 (36.8%)	149 (17.6%)	193 (22.8%)	846 (100%)	3.32	1.217
A person with my social status must have his or her own car [Sosiaalisessa asemassani olevalla ihmisellä on oltava oma auto]	465 (55.0%)	152 (18.0%)	124 (14.7%)	49 (5.8%)	56 (6.6%)	846 (100%)	1.91	1.232

Discussion of results

The results presented in Table 2 look relatively similar for respondents younger than 60 years and respondents 60 years or older. The results also showed that about 12% of the car users who participated in the study were ready to replace a private car with a MaaS service package. While the

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data set used in the study was to some extent self-selected and not a truly random sample of car users in Helsinki region, the magnitude of the result (about one in eight car users) is most likely correct. Respondents older than 60 years were overrepresented in the data set. For this reason, the analysis was carried out separately for respondents younger than 60 years, respondents 60 years or older and all age groups. The study results were also analysed with methods (chi-square test and odds ratios) which are not particularly sensitive to overrepresentation of certain groups in the sample.

Only few statistically significant associations were found between the demographic background of the car user and his or her willingness to replace private car with a MaaS service package. The only variables with a statistically significant association were car user's age and type of dwelling. On average, younger age groups are more proficient with the use of information technology and digital services, and this has possibly contributed to the result. On the other hand, there may be differences between age groups in values and opinions regarding mobility and its impacts on environment. The connection between the willingness to replace a private car with a MaaS service package and the type of dwelling was not very strong, but the difference between two groups (car users living in an apartment building and car users living in a detached house) was statistically significant. A likely explanation for this difference is the availability of public transport services and shared vehicles in different parts of the city, consisting of mainly apartment blocks or detached houses.

The number of respondents who expressed willingness to replace a private car with MaaS service package was relatively small in the study (135 car users). This involves the possibility of type II errors, in other words, that all relevant associations between the willingness to switch from private car to MaaS and the variables describing the background of the respondent were not recognised when the Chi-square tests, odds ratios and confidence intervals for odds ratios were calculated. The data collection was also carried out in autumn 2020 in Helsinki region during the Covid-19 pandemic. It has probably had an impact on the results, due to fear of infection in public transport and possibly also via changes in travel demand and travel patterns.

The most important barriers for switching from a private car to use of a shared vehicle (potentially a part of a MaaS service package) seem to be the uncertain availability of a shared vehicle, need to pick up the vehicle from a defined place, the need to make a reservation in advance and the need to pick up and return the vehicle at agreed time (mean: 4.40, 4.38, 4.36 and 4.41). Unclear liability for wear and accidents and the perceived lower cost of using one's own vehicle were also important barriers for many respondents (mean: 3.80 and 3.32) while the social status of owning a car was reported to have less importance (mean: 1.91). In future research, further analyses should be carried out to determine which of the barriers reported by car users differ from each other in a statistically significant way.

Conclusions

The results indicate that most car users living in the Helsinki region would not be ready to replace their private cars with a MaaS service package. The group of car users, who are willing to give up their private cars and switch to a MaaS service package, exists but it is relatively small at least at the moment (about one in eight car users). However, this does not necessarily mean a negative outlook for MaaS services, if new users can be attracted from age cohorts reaching the minimum age required to obtain driver's license, travellers considering to purchase a car or if the attractiveness of the service to existing car users can be increased. For most variables describing the demographic characteristics of the car user, no statistically significant association with willingness to switch to MaaS was found. Exceptions to this were car user's age and type of dwelling. According to the car users who participated in the study, the most important barriers for switching from a private car to use of a shared vehicle, potentially provided by a MaaS package, are uncertain availability of a shared vehicle, need to pick up the vehicle from a defined place, the need to make a reservation in advance and the need to pick up and return the vehicle at agreed time.

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