Drivers and Barriers of Households' Carsharing Decisions

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Abstract

Based on a survey of 2106 individuals, this study aims to get a better understanding of the attitudes towards carsharing in Flanders (Belgium). We identify several drivers and barriers that influence household decisions to participate in a carsharing system. An ordinal logit model reveals that highly educated, younger males with high ecological concerns are more likely to share cars. We show that living in a rural environment or owning a company car are important barriers. A parking policy aimed at discouraging private car use while stimulating sustainable mobility choices appears to be an interesting avenue for future research.

Keywords: Carsharing; Attitudes; Intentions; Flanders (Belgium); Survey

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Author contributions

The authors confirm contributing to the paper as follows: study conception: JE, SR, KVA; survey design: RC, DC, SR; stakeholder consultation: LA, RC; data collection (interviews): KB, LVO; data collection (survey): RC; analysis of results: RC; interpretation of results: All authors; draft manuscript preparation: RC, DC, SR; revised manuscript preparation: RC, SR. All authors reviewed the results, helped with revisions and approved the final version.

1. Introduction

Mobility is a key urban priority as it majorly impacts the quality of life. A sustainable urban mobility system has to allow for a wide variety of transportation modes, and addresses other urban challenges such as adaptation to climate change and air quality. To reduce some detrimental aspects of car use, electrification, public transport, and multi-modal mobility solutions are put forward (*1*). The current study focuses on carsharing systems as a tool towards a more sustainable transport system. Carsharing is a membership-based system that allows individuals to rent a car on an 'as needed' basis and thus to gain the benefits of private vehicle use without the costs and responsibilities of vehicle ownership (*2*, *3*). Claimed beneficial effects of carsharing include reducing the environmental impact of mobility through lower air pollution and material use (*4*, *5*). Yet, the uptake of carsharing systems is slower than expected with an average of 0.52 shared cars in Western European cities (*6*) compared to 503 passenger cars per 1000 inhabitants in the EU (*7*). Moreover, the estimated environmental benefits are criticized for having a biased view of behavioural changes or for not looking at the full life cycle of cars and other systemic effects (*8–10*). Attitudes and behavioural responses of households are thus important in determining the effectiveness and desirability of carsharing.

Thus, this research's main aim is to better understand the position of carsharing in Flanders, attitudes towards carsharing and (perceived) barriers to enter a carsharing system. Flanders is the Dutch-speaking region in the North of Belgium. Flanders' congestion situation is problematic: Flanders covers an area of only 13,522 km^2 with about 6.5 million inhabitants owning 3.5 million cars that led to a traffic jam severity of 772 kilometer hours per day in 2019 (*11, 12*). (*13*) links mobility and parking problems to bad spatial planning; many live in rural areas and depend heavily on cars for transportation. Bringing public transportation close to everyone's home is difficult due to urban sprawl and ribbon development. Besides spatial planning, mobility as a service (MaaS) is viewed as a more efficient and interesting means to reduce car ownership, car usage, and ultimately resource use and CO_2-emissions in Flanders. Carsharing may be part of a MaaS solution (*14*).

The current study focuses on the main barriers and drivers in the adoption of carsharing systems in Flanders. A largescale survey has been developed to provide a quantitative empirical assessment of the households' attitudes, intentions and motivations towards carsharing initiatives. Interviews with carsharing organisations provide an exploratory view of carsharing organisations' concerns related to factors that drive or discourage the use of carsharing.

In line with neighbouring countries, Belgium has seen a rise in the number of carsharing businesses and peer-to-peer carsharing platforms in the last years (supplementary material). An important feature of a carsharing system is the flexibility in the location where the car can be picked up or left after use (*15*). Free-floating systems allow the user to leave the car in a different place than where it was picked up. Station-based systems require the car to be returned to where it was picked-up. Approximately 75,000 individuals are using carsharing services in Flanders (situation in 2019) and up to 104,000 in Brussels (*16*). The station-based system Cambio has the largest market share in Flanders with an estimated 21,600 users and 831 cars. Free-floating systems represent the fastest growing segment with about 20,000 frequent users (910 cars). The commercial peer-to-peer systems such as Drivy list 25,800 registered users (1,380 cars), while private peer-to-peer systems such as Dégage and Cozycar have 7,625 users (849 cars) (*16*).

2. Literature review and conceptual model

A person's choice to start carsharing may be influenced by a number of factors. Based on the existing literature, we have separated these factors into three distinct groups: individual factors (itself consisting of four sub-groups), contextual factors, and carsharing system specific factors (Figure 1). Firstly, personal characteristics or demographics can be related to carsharing

membership. Previous research found that carsharers tend to be younger and more highly educated (*17–22*) than the average population. The relationship between gender and carsharing membership is less clear: (*19*) found that males are more willing to share cars, (*23*) saw more willingness to share in women, while (*22*) found no significant effect of gender on carsharing interest or membership. A study in Norway (*21*) found that while females were more likely to show an interest in carsharing, males were more likely to join carsharing and to already be a carsharing member. Households with at least two adults, and especially those with children, are more likely to have a carsharing membership as this might help them to get by with only one instead of two privately owned cars (*17*, *18*). Regarding employment status, both (*17*) and (*21*) found that full-time employment increased the likelihood of sharing.

Secondly, attitudes towards mobility and the environment matter. A recent survey with one-way carsharing users in France revealed that only 6% of the respondents mention ecological concerns and most use shared cars because it is more practical than public transport (*24*). However, in a Norwegian survey, environmental consciousness was a strong predictor of interest in, intention to join, and enrolment in carsharing (21). In the Netherlands, green party membership was correlated with being a carsharing member, but not with the intention to adopt carsharing (*22*). Attitudes towards mobility are also important: (*25*) and (*26*) showed that positive attitudes towards public transport and high use of public transport encourage carsharing in Greece.

Thirdly, financial factors are likely to play a role in the decision to join carsharing. Access-based business models may allow increased access to goods for people who are financially struggling (*27*). For example, many carsharers state that it is cheaper than owning a car (provided the car is rarely used): some calculations find that a shared car would be cheaper for people who drive less than 6.500 to 12,000 kilometres per year, depending on the type of car (*17*, *28*). Additionally, students (with low incomes) may be attracted to carsharing as a more practival alternative to public transport (*24*). Moreover, (*29*) found that respondents in Seoul (South Korea) with higher incomes were less likely to change their behaviour, i.e. to dispose of a current vehicle.

Fourthly, carsharing membership is related to contextual factors such as an individual's living environment and mobility situation. Carsharing is mostly present in larger cities (*6*). A higher population density implies that shared cars are used more intensely in urban areas and fewer cars are needed to get a shared car close to many sharers. This makes for a more profitable and easier business for carsharing firms (*18*). Also, research has shown that people in urban areas are more open to carsharing and sharing in general (*18*, *20*, *21*, *24*). Moreover, an urban environment often has better public transportation and expensive parking space which makes carsharing more attractive than owning a car (*18*). However, (*21*) found that being near to public transport facilities led to less interest in carsharing, with no effect on intention to join or carsharing membership. Lastly, private mobility benefits of car ownership tend to be higher in a rural or suburban setting than in an urban setting (*30*).

Finally, the characteristics of the carsharing system and its fleet may matter. (*31*) found that free floating systems attracted different user groups and are used differently compared to station-based systems. In contrast, (*32*) concludes that people's choice to replace private car trips and reduce car ownership was only influenced to a small extent by the carsharing system characteristics.

Thus, the findings from these previous studies allow us to create a conceptual model representing the main factors that are correlated with individuals' intentions to adopt carsharing (Figure 1). Evidence to support the relation of individual and contextual factors with carsharing intentions in Flanders is collected using a household survey. Carsharing system factors are taken as given and a generic carsharing system is used to assess individuals' openness to carsharing.

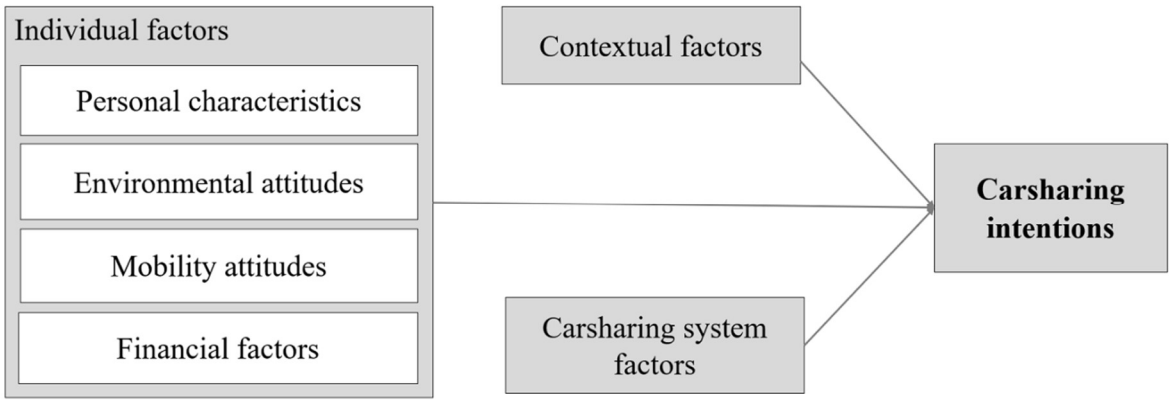

Figure 1: Carsharing intentions

3. Methods

3.1 In-depth interviews

To explore the main characteristics of the carsharing market, to get an insight into factors that influence the use of carsharing and to prepare (the design of) a survey, we started with four semi-structured interviews of two hours with three carsharing companies and autodelen.net. Autodelen.net is an umbrella organization for carsharing firms in Flanders. The three carsharing firms were selected based on their size and the type of carsharing system they offer. Dégage is a peer-to-peer carsharing firm. Partago is a business-to-consumer initiative (a cooperative) with a fully electric fleet. Cambio has a station-based system and includes the most members on the Belgian market.

3.2 Data collection and survey design

Based on the in-depth interviews and the literature review (Section 2), a draft version of the survey was designed. This initial survey was reviewed by a test group with a balanced mix of experienced carsharers and people unfamiliar with carsharing. After several iterations, the final survey was online during September and October 2018. The survey was in Dutch, created with Qualtrics, and shared as a clickable link through several mailing lists, social media, and newsletters to reach a broad and varied audience. Besides several carsharing, mobility and environmental organisations[1], the survey was also shared by 36 municipalities with their inhabitants[2]. We decided to oversample carsharers to have sufficient observations for meaningful comparisons between carsharers and non-carsharers. This sampling approach implies that the sample is not representative of the Flemish population. On average, respondents are more likely to be higher-educated, younger and have clearer attitudes regarding mobility. Thus, we are likely to estimate an upperbound of carsharing intentions in Flanders.

To measure carsharing intentions – the dependent variable – we ask respondents whether they are already carsharing, and if not, whether they would consider becoming a member of a (generic) carsharing system. This allows us to distinguish five classes of carsharing intentions ranging from ‘no intention at all’ to ‘already being a carsharer’.

To measure relevant individual factors, respondents were asked about their socio-demographic background and their mobility choices. Financial factors were proxied by education and job status. We asked respondents whether they have a drivers’ license, private or company cars[3], public transport passes, bicycles, motorcycles, and scooters. Carsharers got additional questions regarding their experiences, while non-carsharers were asked about possible motivators to share cars. Respondents’ environmental and mobility attitudes were measured through a set of 40 statements for all respondents and 6 additional statements only for carsharers (Supplementary material). These statements were based on previous literature on the motivation for car use and carsharing. To fit the carsharing setting, we adapted 10 scale questions used by (*33*) to

investigate instrumental, symbolic, and affective motives for car use, 18 questions used by (*24*) measuring affective adjectives associated with transportation modes, and 14 statements (incl. 6 only for carsharers) used by (*34*) to identify the drivers for sharing. We also added 4 statements related to environmental and congestion externalities of road traffic in Flanders. A 5-point Likert scale was used to measure respondents' attitudes towards these statements.
To increase the response rate, respondents could win one of several 20-euro vouchers. Each respondent gave us his/her informed consent before starting the survey and data collection was anonymous.

3.3 Econometric estimation

3.3.1 Factor analysis

Factor analysis is a multivariate statistical technique designed to reduce the number of variables and produce uncorrelated factors that adequately describe the data (*29*). We use an exploratory factor analysis to classify responses to statements regarding cars and carsharing into factors capturing underlying respondents' attitudes.
The factor analysis model is formulated by expressing variables X_i with mean μ_i as a linear function of the factors F_k as follows *(35)*:

$$X_i - \mu_i = a_{i1}F_1 + \cdots + a_{ik}F_k + U_i$$

With a_{ik} representing the factor loadings and U_i representing the uniqueness, i.e. the variance that is 'unique' to the variable and not shared with other variables.
First, we test, using the R-package REdaS (*36*), whether a factor analysis is sensible using the Measure of Sampling Adequacy for individual statements and the Kaiser-Meyer-Olkin measure that both rely on the Anti-Image-Correlation Matrix.
Next, we determine the appropriate number of factors, which can be challenging, and several methods exist to make an appropriate choice (*37*): the Very Structured Criterion, scree test, Minimum Average Partial, and the simple but effective method of adding factors as long as they seem to have a logical interpretation. For the analysis, a minimum residual factor analysis was conducted with oblimin rotation. Variables with high (low) factor loadings (the maximum value is one) are thought to be highly (less) influential in describing the factor.

3.3.2 Ordinal logistic regression

To explain respondents' intentions towards carsharing, an ordered logistic model was estimated. Let Y_i be an ordinal response variable with C categories for the i-th respondent, alongside with a vector of covariates X_i (*38*). An ordered logit model for an ordinal response Y_i with C categories is defined by a set of C−1 equations where the cumulative probabilities

$$g_{ci} = Pr(Y_i \leq Y_c | X_i) \; with \; c = 1, \ldots, C-1$$

are related to a linear predictor

$$\beta' X_i = \beta_o + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots$$

through the logistic function:

$$logit(g_{ci}) = log\left(\frac{g_{ci}}{1-g_{ci}}\right) = \alpha_c - \beta' X_i \; with \; c = 1, \ldots, C-1$$

where α_c are called thresholds. To identify the model, we set the threshold of the first class equal to zero ($\alpha_1 = 0$).
The cumulative probability for category c is:

$$g_{ci} = 1/\left(1 + exp(-\alpha_c + \beta' X_i)\right)$$

This cumulative logit model with proportion odds was estimated using iteratively reweighted least squares and specifically by using the *vglm* function from the R-package VGAM *(39)*.

4. Results

4.1 In-depth interviews with carsharing organisations

We focus on the results that relate to the interviewed organisations' perceptions regarding the factors that may influence the demand-side (drivers and barriers) of the carsharing market. These insights are then integrated in the survey. The interviewees agree that the main goal of carsharing is to facilitate sustainable mobility by reducing the number of cars produced and the number of car kilometres driven, as well as by increasing the use of public transportation, walking, cycling and other alternative transportation modes. Individuals valuing a transition towards sustainable mobility would then be more open towards carsharing. The only issue on which the interviewees showed some disagreement was whether electric or fossil fuel vehicles are preferred. They fear that an electric-only fleet might deter some people to share if they are not comfortable with, for instance, the limited driving distance of electric cars or the low density of charging stations.

Carsharing is and remains a mostly urban phenomenon. Here, public transport and bicycles provide credible alternatives for cars. Owning a car becomes less attractive and sharing more appealing. Therefore, local (city) governments are the main potential partners for carsharing organisations. According to interviewees, policymakers may stimulate carsharing by helping out with communication, improving logistics such as dedicated parking spots, purchase guarantees, bringing in capital and creating mobihubs. Mobihubs are physical centres with (shared) bikes, public transport, shared cars, electric charging stations, and taxis (*40*). The Belgian tax benefits for company cars are criticized because these company cars are an attractive mobility option for many households. A mobility budget is proposed as an alternative; it can be used for any mode of transport and may be designed to incentivize carsharing.

The interviewees identify several barriers to adopt carsharing. Firstly, the current materialistic way of life stands out; cars are seen as status symbols and the convenience of having a car at your disposal at all times is hard to give up. Secondly, a lack of information may deter people from carsharing. The financial comparison of private car use and carsharing is not straightforward and may act as a deterrent. Carsharing may seem expensive since the total price for a carsharing ride is very visible while the total cost of ownership is hard to calculate and therefore less salient. Another underrated benefit of carsharing is that "one is really carefree if one shares cars". Thirdly, users fear a lack of clear information on car availability. Potential sharers fear they will not have a car where and whenever they want. Therefore, if the perception of people can be shifted toward the idea "that shared cars should be chosen for convenience", the group of possible customers may become larger.

4.2 Survey results comparing carsharers with non-carsharers

4.2.1 Description of the dataset

In total, 3,433 individuals accessed the survey online. For further analysis, we focus on the 2,106 respondents that provided enough information for the empirical analysis in this study. On average, respondents needed 25 minutes to complete the survey, which likely contributed to the significant drop-out rate. Due to the non-probabilistic sampling method, the sample is not representative of the population in Flanders.

The majority in the sample do not share cars: 1,815 respondents are classified as non-carsharers and 291 respondents as carsharers. Of these carsharers, 40% have been sharing cars for over three years. The top three carsharing systems are Cambio (118 users), Dégage (81), and Cozycar (26). Table 1 describes socio-demographic characteristics of the sample and reports the p-values of the Fisher's exact test used to compare non-carsharers with carsharers for categorical variables and of Mann-Whitney t-test for continuous variables. The mean age of carsharers is significantly lower than the mean age of the non-carsharers in the sample (38.4 vs 41.1 years old), but gender distribution did not significantly differ. Carsharers in our sample

are relatively higher educated. Further, we observe a statistical difference regarding employment status between carsharers and non-carsharers, with fewer unemployed and more full-time and part-time employed people among the carsharers. Finally, relatively more carsharers live in an urban environment, while more non-carsharers live in a rural environment.

Table 1: Description of respondents (source: own data / statistiekvlaanderen.be)

		non-carsharers		carsharers		full sample		population Flanders
		N	**%**	**N**	**%**	**N**	**%**	**%**
Total number respondents		1815	86.2	291	13.8	2106	100	
Gender	Male	688	38.1	112	38.6	800	38.2	49.5
(p=0.96)	Female	1109	61.5	177	61	1286	61.4	50.5
	X	7	0.4	1	0.3	8	0.4	
	Missing	11		1		12		
Education	Secundary school	486	26.8	16	5.5	502	23.9	40
(p=0.0005)	Bachelor degree	611	33.7	77	26.5	688	32.7	41
	Master degree	530	29.3	154	52.9	684	32.5	(all higher education)
	>Master	184	10.2	44	15.1	228	10.8	(% of 25-64 year old residents)
	Missing	8		0		8		
Employment	Student	198	10.9	14	4.8	212	10.1	
(p=0.0005)	Part time job	291	16.1	71	24.5	362	17.2	
	Full time job	1076	59.5	184	63.5	1260	60	
	Not working (incl. retired)	245	13.5	21	7.2	266	12.7	
	Missing	5		1		6		
Degree of urbanisation	Rural	756	41.8	27	9.3	783	37.3	
(p=0.0005)	Suburban	598	33.1	75	25.8	673	32.1	
	Urban	454	25.1	189	64.9	643	30.6	
	Missing	7		0		7		
Age (in years)	min	18		18		18		
(p=0.03)	mean	41.1		38.4		40.8		41.2
	max	85		73		85		
	missing	1		0		1		
Number of adults in household	min	1		1		1		
	mean	2.2		1.9		2.2		
	max	9		6		9		
(p<0.0001)	missing	17		1		18		

In brackets p-value of Fisher's exact test to compare NCS with CS for categorical variables and of Mann-Whitney t-test to compare NCS with CS for continuous variables

The general household composition of both groups was similar although carsharing households contained fewer adults on average. Carsharing households have significantly fewer private cars, company cars, and motorcycles but more public transport subscriptions and bicycles (Supplementary material). There is a substantial difference in the kilometres that are driven with several transportation modes in an average week (Table 2). Carsharers walk, bike, and

use public transportation more. 95% (and 75%) of carsharers never drive a company (or private) car, and if they do, they tend to drive it for shorter distances. Many users combine a carsharing trip – at least occasionally – with some other transportation mode: 60% with walking or biking, 30% with the train and 20% with bus or tram.

Table 2: Weekly kilometres travelled by individuals in households with(out) access to carsharing

Transport modes used by an individual		**Households without carsharing**	**Households with carsharing**
walking	Min (% subsample)	0 (36.4%)	0 (19.8%)
	Mean	9.1	9.6
	Max	200	60
bike	Min (% subsample)	0 (39.4%)	0 (13.2%)
	Mean	28.7	51.1
	Max	800	300
public transport	Min (% subsample)	0 (65.5%)	0 (29.8%)
	Mean	52.9	112.3
	Max	1000	1200
company car	Min (% subsample)	0 (81.6)	0 (95.0%)
	Mean	65.9	6
	Max	1700	560
private car	Min (% subsample)	0 (22.2%)	0 (75.2%)
	Mean	195	31.6
	Max	2600	800
shared car	Min (% subsample)	0 (99.5%)	0 (34.1%)
	Mean	0	26.5
	Max	0	500
as passenger in a car	Min (% subsample)	0 (68.8%)	0 (86.8%)
	Mean	15.1	10.1
	Max	500	250

Non-carsharers were asked what deters them from carsharing (Figure 2). The two most important barriers were not knowing any shared cars in the neighbourhood and the many uncertainties about responsibilities. Uncertainty and unfamiliarity thus seem important factors holding back the adoption of carsharing systems.

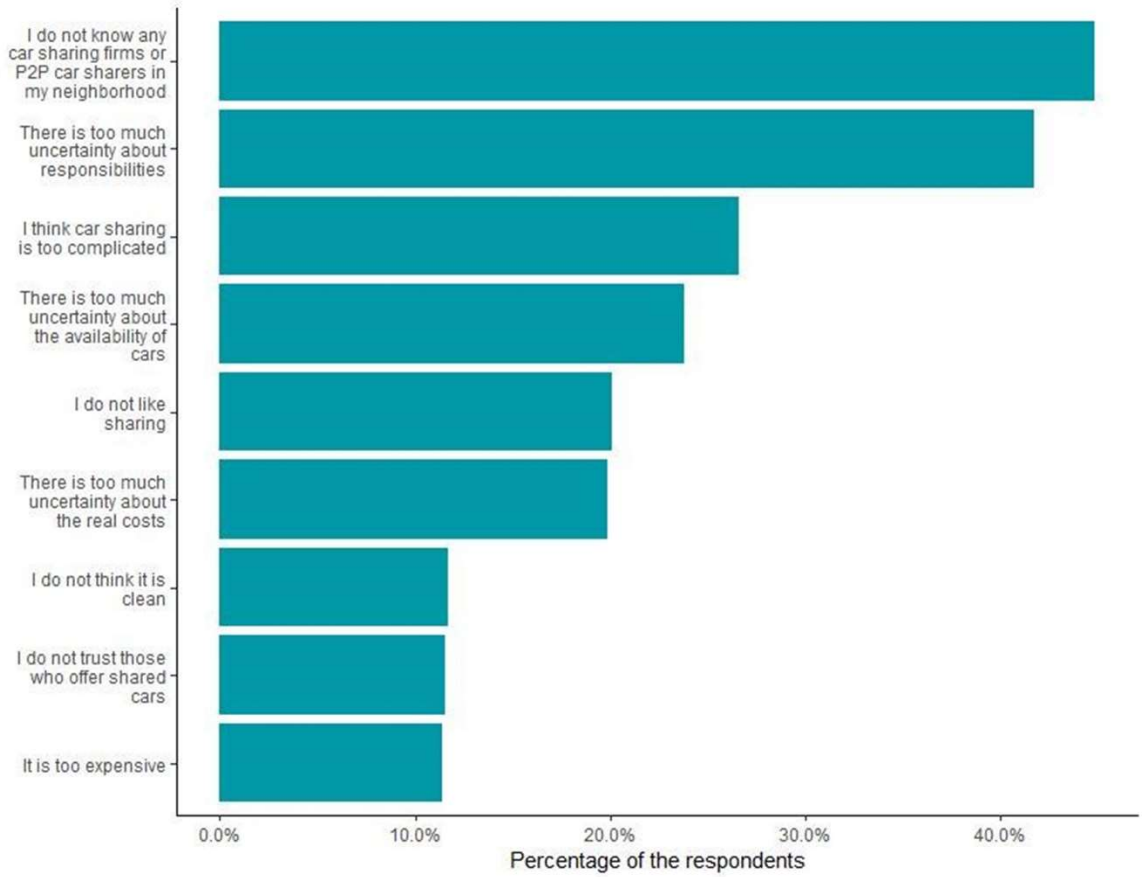

Figure 2: Barriers towards carsharing

4.2.2 Results of the factor analysis

For the factor analysis, we focus on the 40 statements that were presented to all respondents (Section 3.2). The KMO-measure is 0.889 and all statements had a MSA-value above 0.5. We added one factor at a time as long as the factors seem to have a clear interpretation, which leads to four factors with a Cronbach alpha above 0.7 (Table 3).

The first factor was named *Ecological concern* because factor loadings were high on statements related to concerns about the climate, traffic, and fine dust pollution and low on the environmental friendliness of private cars. Secondly, for some, a private car is a status symbol with a more than instrumental function; it forms the owner's identity. This factor is called *Car-dependent identity*. The third factor is labelled *Public transport (PT) positivism* as all relevant statements look positively at PT; it is flexible, reliable, clean and not stressful. The last factor was named *Driving enjoyment* because the relevant statements describe driving as not stressful and as making one feel free and independent.

We find that ecological concern is positively correlated with PT positivism (0.458), but negatively with car-dependent identity (-0.495) and driving enjoyment (-0.256). Likewise, high car-dependent identity is positively correlated with driving enjoyment (0.420) and negatively with PT positivism (-0.311). Driving enjoyment and PT positivism are not found to be correlated (0.063). Correlations between factors and respondents' characteristics are included as supplementary material. Next, the individual factor scores are used as explanatory variables to explain carsharing intentions.

Table 3: Factors, factor loadings and Cronbach alpha

Statements	Major factor loading	Cronbach alpha
Factor 1 – Ecological concern		
I'm worried about climate (change)	0.711	0.833
Carsharing fits the current time	0.698	
I'm worried about fine dust pollution	0.686	
Carsharing helps to save natural resources	0.579	
I think there's too much traffic in Belgium	0.555	
I get satisfaction from sharing cars	0.514	
I think road pricing is a good idea	0.498	
Private cars are environmentally friendly	-0.495	
Factor 2 – Car-dependent identity		
I feel free and independent while driving	0.545	0.749
I like driving a car	0.544	
Driving a private car is stressful	-0.569	
Factor 3 – PT positivism		
Public transportation is reliable	0.683	0.754
Public transportation is flexible	0.641	
Public transportation is clean/neat	0.549	
Travelling with public transportation is stressful	-0.593	
Factor 4 – Driving enjoyment		
My car reflect who and what I am	0.698	0.774
A car brings status and prestige	0.628	
There's a dream car that I would like to own	0.531	
For me, a car only has an instrumental function	-0.626	
It doesn't matter which brand of car I'm driving	-0.619	

4.2.3 Logistic regression: Intention to start carsharing

We distinguish five classes of carsharing intentions: never (12.3% of full sample), don't think so (22.9%), perhaps in far future (35.9%), definitely (12.4%) and already a carsharer (13.8%). This ordinal categorical variable is the dependent variable in an ordinal logistic regression in which we look for significant factors that determine carsharing intentions. Variables that were not significant at the 10% level were excluded from the models presented in Table 4 to avoid redundancy and minimize multicollinearity. Table 4 include one model with attitudinal factors (Model 1) and one without those factors (Model 2). Based on the informational criteria (BIC and AIC) model 1 is strongly preferred over model 2. Moreover, the use of an ordinal regression model is valid as the General Variance Inflation Scores are below two and point to absence of multicollinearity (Supplementary material). Furthermore, with a p-value of 0.1319, we cannot reject the null hypothesis that the proportional odds assumption is true using a chi-squared test. The factors capturing respondents' attitudes are good predictors for the carsharing intention. People with a higher car-dependent identity have a lower carsharing intention. High scores on any of the other three factors increase carsharing intention. Looking at demographics, we find that males are more likely to share cars. Education is incorporated into four dummy variables. Primary or secondary education is the baseline. The higher the education, the higher the carsharing intention. For the five employment categories, the model only shows a significant effect for retired people who are less likely to share cars. Households with more private or company cars are less likely to share cars. Furthermore, the model shows that people living in

urban areas are more likely to share cars compared to people living in a suburban or rural area. Finally, respondents' satisfaction with the quality of public transport as well as walking and cycling infrastructure in their neighbourhood was not significantly correlated with carsharing intention, while respondents who were less satisfied with parking facilities were more likely to start carsharing (Table 4).

Table 4: Ordinal logistic regression explaining carsharing intention

	MODEL 1			MODEL2		
	Coeff.	Odd ratios	P-value	Coeff.	Odd ratios	P-value
Intercept1: No, probably not	2.757	15.75	0.000 ***	2.239	9.38	0.000 ***
Intercept2: Yes, perhaps	0.651	1.917	0.000 ***	0.675	1.965	0.000 ***
Intercept3: Yes, definitely	-2.077	0.125	0.000 ***	-1.251	0.286	0.000 ***
Intercept4: Carsharer	-3.423	0.033	0.000 ***	-2.246	0.106	0.000 ***
Male	0.371	1.449	0.000 ***	0.29	1.337	0.001 **
Urban	0.525	1.691	0.000 ***	0.968	2.632	0.000 ***
Parking facilities	0.161	1.174	0.000 ***	-0.019	0.981	0.642
Bachelor	0.299	1.348	0.013 *	0.775	2.171	0.000 ***
Master	0.602	1.825	0.000 ***	1.396	4.038	0.000 ***
>Master	0.673	1.96	0.000 ***	1.627	5.089	0.000 ***
Student	-0.313	0.731	0.071	-0.768	0.464	0.000 ***
Parttime	0.303	1.354	0.409	0.492	1.636	0.160
Fulltime	-0.115	0.891	0.308	-0.324	0.723	0.002 **
Retired	-0.782	0.458	0.000 ***	-0.629	0.533	0.000 ***
Nb Private cars	-0.578	0.561	0.000 ***	-0.983	0.374	0.000 ***
Nb company cars	-0.673	0.51	0.000 ***	-1.057	0.348	0.000 ***
FA Car-dependent identity	-0.147	0.863	0.014 *			
FA Driving enjoyment	0.193	1.213	0.001 ***			
FA PT positivism	0.581	1.788	0.000 ***			
FA Ecological concern	1.587	4.888	0.000 ***			
AIC	4517			5498		
BIC	4630			5588		
Log likelihood	-2239			-2733		
Residual df	8028			8032		
Total df	8048			8048		
deviance	4478			5466		

//***: statistically significant at 0.05/ 0.01/0.001 level*

5. Discussion

According to the conceptual model in Figure 1, a number of factors can influence carsharing intention. First, some personal characteristics may be correlated with higher carsharing intention. Age – either as a continuous or a categorical variable - was not found to be significant (supplementary material), (although retired respondents had significantly lower intentions to start carsharing). This contrasts with past findings that being younger increases the likelihood of carsharing (*17*, *19*, *20*). Table 4 reveals that males are more likely to share cars in our sample. This confirms some other evidence (*19*), though it may seem counter-intuitive given that materialism has often been found to be higher for men than women (*41*, *42*). Our econometric

model corrects for these attitudes through the four factors and thus gender effects can be interpreted more precisely, i.e. males have a stronger intention to join carsharing amongst than females with similar attitudes. The analysis of our sample also confirms that higher educated respondents are more likely to share cars (Table 4), confirming other studies (*20*, *21*). Lastly, we did not find significant effects for household composition: we tested a continuous variable for the total number of family members, the total number of minors, or a dummy variable that was one for families with minors. None of the attemps delivered significant effects (supplementary material).

The results show that the second and third groups of individual factors, i.e. environmental and mobility attitudes, are significantly correlated with carsharing intentions. Table 4 shows that respondents with high environmental concerns are more likely to share cars, in line with several past studies (*25*, *26*, *43*). Secondly, respondents' mobility attitudes are also linked to carsharing intentions: table 4 shows that respondents that score high on the factor 'PT positivism' also have higher carsharing intentions. This confirms other studies that show a link between public transport use or attitudes and carsharing intentions (*22*, *26*). Additionally, our findings reveal that attitudes towards cars are also good predictors for carsharing intention. People who enjoy driving have higher carsharing intentions, and respondents who score high on car-dependent identity are less willing to participate in carsharing systems. The latter respondents are more likely to associate cars with status and prestige and thus less willing to give up their private car.

The influence of the last individual factor, i.e. financial factors, could not be estimated directly, since one in four respondents indicated that they did not want to share information about their household income. However, education may be a (imperfect) proxy for income and financial factors relevant to carsharing, revealing that carsharing might be positively related to income in our sample.

Some contextual factors are also significant. Table 4 shows that households with more private cars have lower carsharing intention, a pattern also found by (*21*); similarly, households that have a company car also have lower carsharing intention, an effect that, to the authors' knowledge, has not been previously documented. The wide availability of company cars in Belgium can thus be seen as a contextual factor that is likely to slow down the adoption of carsharing systems, an observation also supported by the interviewed organisations. Additionally, carsharing respondents drive fewer kilometres if private or company cars are present in the household (Table 2). Finally, the residential context is important: people living in an urban environment are more likely to share cars (Table 1, Table 4), confirming past findings (*19*, *21*).

Overall, we find support for most of the individual factors in Figure 1, except financial factors, which we were unable to capture. Of all these individual factors, attitudes to both the environment and mobility are strongly linked to higher carsharing intention. Contextual factors are also important, with households who have a company car showing much lower carsharing intention. However, the influence of carsharing specifc factors, the final factor in Figure 1, were not measured in this survey and are thus a promising avenue for future research.

There are some limitations in this study. While the large sample size and the econometric estimation allow us to control for various heterogeneous characteristics of households, the results cannot be generalized to the complete population of Flanders. However, this sampling method provides us with a large enough carsharing group to be able to find statistically valuable results. Moreover, we are using stated intentions, which tend to be positively correlated with actual behavioural intentions but are not perfect proxies as a social desirability bias is likely to have some effect on the measurements.

6. Conclusions

In spite of the fact that our Flemish sample is slightly biased towards younger and more educated people, we can still draw the following conclusions. The factor analysis of our sample revealed that many respondents have strong opinions about cars: cars are part of their identity, and driving a car makes them feel good and happy. Other important factors were environmental concern and a positive perception of public transportation. These attitudinal factors are relevant and significant predictors for someone's carsharing intention.

Profiling people on their high carsharing intention might be important for carsharing companies to expand their business and for governments that want to stimulate sharing. The ordinal model showed that males, people living in urban areas and people with a higher education are significantly more likely to have a high carsharing intention. The explanatory variable with the largest positive effect on the carsharing intention is the factor 'ecological concern'. Thus, information campaigns on the environmental and practical benefits of carsharing are likely to stimulate carsharing.

Our analysis shows that company cars are one of the biggest hurdles for one's carsharing intention which has not been discussed in previous research. Thus, an obvious recommendation for policymakers that want to stimulate carsharing is to reduce fiscal benefits for company cars. However, the regulatory framework for shared cars is currently still underdeveloped, for example, rules are often inconsistent across municipalities.

Many cities in Flanders restrict on-street parking spaces in the city centre using rationing and/or pricing. Almost 40% of the respondents said that they might be more willing to use shared cars if they had significant parking benefits over private cars. Thus, the practice of some cities to reserve parking spaces for station-based systems and/or allow parking permits for shared cars could be generalized.

Results from our survey suggest that non-sharers are often confused about several aspects of carsharing, such as costs and liability. Regarding costs, there is a substantial variation amongst carsharing firms and their cost structures: a mix of membership fees, monthly fees, km costs, time costs, reservation costs etc. This makes it difficult for users to compare different carsharing schemes, and - crucially - to compare it to car ownership. A non-partisan price comparison website and clear guidance regarding responsibilities, especially the procedure in the case of accidents, may help ease concerns of potential users.

One obvious hurdle for people to share cars is unfamiliarity with the concept and the presence of shared cars in their neighbourhood. Active promotion of carsharing by the local government through information campaigns can therefore help to overcome that hurdle. Subsidized test subscription or even simply making the shared cars more visible in the city with clearly signalized parking spaces for shared cars or eye-catching vehicles can also help to improve familiarity and build trust.

Regarding future research, we firstly suggest investigating the possible impact of different local support schemes for carsharing, and different mobility policies in general, in the different cities in Flanders. Examples are a low emissions zone or circulation plan that forces citizens to think more carefully about their mobility (*44*). Some cities pay back (part) of subscription fees for carsharing schemes and most cities and municipalities provide parking benefits to shared cars. To study the effectiveness of such policies, detailed longitudinal studies are necessary to identify causal effects. Second, a general lack of information and trust was identified with respondents in our survey. To remedy this, public authorities could make the existing legal framework more consistent and set up information and promotion campaigns. Finally, it would be interesting to repeat our analysis in other regions to test the generality of our results.

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Notes

[1] OVAM, Vlaanderen circulair, EWI, Touring, Bond Beter Leefmilieu Vlaanderen, Dégage.

[2] Aalst, Alveringem, Avelgem, Berlaar, Beveren, Bierbeek, Brecht, De Pinte, Deinze, Erpe-Mere, Gent, Geraardsbergen, Grimbergen, Harelbeke, Herentals, Hoeilaart, Hulshout, Kampenhout, Laakdal, Ledegem, Lummen, Mechelen, Meeuwen-Gruitrode, Menen, Oostkamp, Oudenaarde, Oudenburg, Roeselare, Schoten, Steenokkerzeel, Temse, Tervuren, Zandhoven, Zele, Zottegem, Riemst.

[3] Company cars are defined as cars provided by employers to their employees as an alternative for a higher wage. These cars can be used for private trips and often come with a fuel card. (*45*) estimated that more than 10% of all Belgian cars are company cars in this sense.