

*Proceedings of 7th Transport Research Arena TRA 2018, April 16-19, 2018, Vienna, Austria*

## Community-based mobility: a transport option for rural areas?

Fabian Dorner a\*, Martin Berger a

*aTechnische Universität Wien, Department for Spatial Planning, Karlsplatz 13, 1090 Vienna, Austria*

### **Abstract**

A high dependence on cars characterizes rural regions when it comes to everyday travel. Community-based carsharing offers a solution for places where commercial operators of sharing systems are not present. However, people not able or willing to drive a car on their own are still dependent on poor public transport or close persons giving them a lift. Integrating community-based carsharing and spontaneous, short-distance ridesharing could offer a solution for this challenge. A quantitative online-based survey conducted among members of carsharing communities in Austria and Germany reveals user characteristics and potentials. This paper presents personal and household characteristics of members and their influence on (1) motives to participate in carsharing, (2) usage of shared cars and travel behaviour and (3) attitudes towards ridesharing and preferences regarding the arrangement, realization and different conditions of the ride (e. g. time of the day, requested detour). Finally, we identify needs for future research in this field.

*Keywords:* community-based carsharing; ridesharing; environmental attitudes, motives

---

\* Fabian Dorner. Tel.: +43-1-58801-280503.  
E-mail address: fabian.dorner@tuwien.ac.at

## 1. Introduction

### 1.1. Car-dependency in rural areas and new chances

Mobility in rural areas relies largely on the usage of private cars. This can be traced back to poor public transportation quality caused by low population density (Canzler and Knie 2009, Kagermeier 2004) and greater average distances between origin and destination caused by the lower density of utility services making walking and cycling less useful (Perschl and Posch 2016). Moreover built structures in rural areas tend to be stronger oriented towards motorized traffic (Litman 2015). Reliance on private motorized vehicles leads to various challenges including use of non-renewable resources, emission of greenhouse gases and air pollutants, high costs for private and public households and low accessibility for some social groups, which can lead to (partly) exclusion from social life (Herget 2016, Higginbotham 2000).

Changing values and rapid diffusion of ICT in western societies enable growth of collaborative consumption (Botsman and Rogers 2011). In the field of transportation, sharing seems to be a promising way to a more sustainable travel behaviour and improved accessibility in rural areas (Shibayama et al. 2013). So far big players in the field of shared mobility focus on transportation within and between metropolitan areas. Currently, rural regions are far less promising for business cases. Reasons are lower pressure on abolishing car ownership along with less attractive opportunities to use alternative modes of transportation. Underlying reasons are lower density, land-use mix, parking pressure, and availability of complementary modes of transport on the countryside (Stillwater 2009, Celsor and Millard-Ball 2007). The share of users among the total population also reflects this, which is higher in cities (Dorner and Berger 2017).

### 1.2. Community-based carsharing and ridesharing

A common characteristic of community-based carsharing are locally organized, non-commercial initiatives that form groups, which share one or more cars or other vehicles (Gugg 2015, Shibayama et al. 2013, Meaton and Low 2003). Organizational structures, tariff models, degree of formalization, ownership and maintenance models for cars vary. In some cases, the municipality backs the private initiative organizationally or financially or even has a leading role. Due to the local character, cars are located at designated places, so one-way rental is not possible. Groups exist in big cities as well as on the countryside. However, their role in bringing carsharing to rural areas is especially remarkable.

In the field of ridesharing, some companies (e.g. Comovee) provide software solutions for communities to build ridesharing networks for spontaneous, occasional trips. According to the authors' knowledge, there are no reports of successful implementations of community-based ridesharing, although supposedly informal practices of ridesharing are very common among friends, relatives and neighbours. Additionally, many employers encourage their employees to carpool on the way to work.

Community-based carsharing has shown to be a useful way to bring carsharing into rural communities. One major limitation is that it works only as a mobility solution for people able and/or willing to drive a car. Others still rely on public transportation and close persons giving them a ride. Combining carsharing with ridesharing by opening trips undertaken with a shared car to other users could contribute to enhance rural mobility for those not driving by themselves. In a further step, volunteers could also provide rides which otherwise would not have taken place, if demanded by community members. Examples in Austria and Japan show that community members are not only willing to share rides but also offer voluntary taxi-services.

In general, the idea of integrating carsharing and ridesharing is not new. For example, Vosselman and Klieverik (2009) developed the concept 'ShareLease' that aims at encouraging peer-to-peer sharing of cars and rides among users of leased cars. A survey carried out among employees of companies using leased cars shows that 20% are willing to participate in this model. Attitudes towards sharing rides are more positive than just sharing the car. For most participants financial benefits would be the major reason to join.

## 2. Combining community-based carsharing with ridesharing

Initiatives providing community-based carsharing are a promising starting point to implement this new transport option, as the community-spirit and trust connected with it seem to be important preconditions. Therefore, focus of the research project MICHAEL is to develop tools to support the implementation of ridesharing practices in carsharing communities (see fig. 1). Besides developing web-based tools for arranging rides, the main objective of the project is to encourage new habits in travel behaviour. A crucial success factor for rural sharing solutions is

if users adapt routines in travel behaviour to be able to use new mobility solutions based on social innovation (Jaeger-Erben et al. 2013).

To develop a ridesharing network based on community-based carsharing, insights into user groups, their travel behaviour and attitudes towards ridesharing are needed. To our knowledge, no in-depth analysis of community-based carsharing user behaviour exists so far. Therefore, a multi-method approach including quantitative and qualitative analysis was applied to gather insights into individual characteristics of cooperative carsharing users and their carsharing usage. This paper presents results of a quantitative survey conducted among community-based carsharing groups in Austria and Germany between March and July 2017.

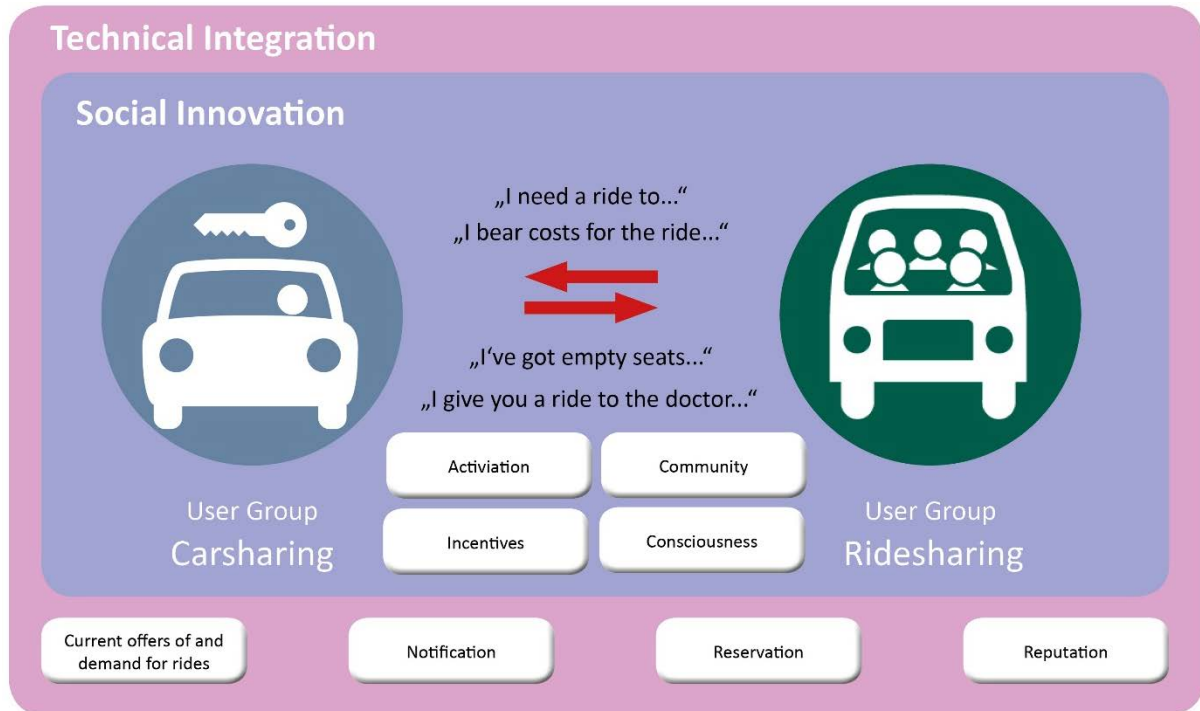


Fig. 1: Sketch of MICHAEL project

### 3. Evidence from literature

Research focus in the field of carsharing lies on estimation of environmental and traffic-related effects, supporting (spatial) preconditions for carsharing and insights into user groups especially focusing on motives, attitudes, values of carsharing members. Findings suggest that behaviour is closely attached to the actual form of carsharing, especially the question free-floating vs. station-based seems to be a decisive factor (Becker et al. 2017). A study in Munich and Berlin revealed considerable differences in usage behaviour between station-based and free-floating carsharing, especially considering duration and distance driven during an average rent (Schmöller and Bogenberger 2014). Around free-floating carsharing, a controversial discussion is going on regarding the effects on travelled vehicle mileage (e.g. Firnkorn and Müller 2011, Kopp et al. 2015). Consequently, this question received considerable academic attention. On the other side, there is few evidence for station-based carsharing and community-based models. In addition, research tended to focus rather on cities than on the countryside as survey results suggest that rural areas not a viable ground for carsharing (Celsor and Millard-Ball 2007). The following literature overview focuses on station-based carsharing models, as recent literature about community-based carsharing is rare.

#### 3.1. Who are users of station-based carsharing?

A considerable amount of studies examines the characteristics of carsharing users in comparison to the total population. Persons with high education and aged under 40 are strongly overrepresented among carsharing participants (Schreier et al. 2015, Martin and Shaheen 2011, Loose 2010, Wilke et al. 2007, Koch 2001). The average income level of carsharing users is higher than the one of the total population (Schreier et al. 2015), though

other sources did not find a clear tendency (Martin and Shaheen 2011, Koch 2001). Martin and Shaheen (2011) found that female users are slightly overrepresented among users whereas other studies conclude the opposite (Schreier et al. 2015, Loose 2010, Wilke et al. 2007). The majority of carsharing users live in households with one or two persons (Martin and Shaheen 2011, Celsor and Millard-Ball, Loose 2010), though results of Schreier et al. (2015) show that average households are above average. Vehicle holdings in carsharing-households are low, leading to the effect that other means of transport (public transit, walking, cycling) are used more often (Nobis 2006, Wilke et al. 2007, Celsor and Millard-Ball 2007). Additionally Wilke et al. (2007) identified a strong attachment of carsharing users to higher social milieus, especially to educated liberals.

### *3.2. User motives and attitudes of station-based carsharing users*

With growth of carsharing user numbers along the past 20 years motives shifted from mainly ecological to rather egoistic than altruistic (Koch 2001, Loose 2010). For example, users of commercial carsharing operator Zipcar in the US reported motives of self-interest and utilitarianism (Bardhi and Eckhardt 2012). Similar findings from a qualitative survey conducted in Germany reveal that financial motives are the primary reason to join a carsharing scheme (Gossen 2012). However, literature from other fields of sharing, for example from toy libraries (Ozanne and Ballantine 2010) and goods sharing (Hamari et al. 2016) suggests that user-motives vary depending on the role of participants (e. g. consumer or peer) and the kind of good or service being shared. Therefore, motives of members in community-based carsharing might be different from those of users in commercial carsharing systems.

### *3.3. User behaviour and effects of station-based carsharing*

Findings reveal that users of car sharing are driving less kilometers and walk, cycle and use public transportation more often than comparable user groups who own a car. Participation in carsharing leads to a reduction of 9 to 13 private cars for each carsharing vehicle (Martin et al. 2010). In San Francisco, carsharing members reduced vehicle miles travelled and gasoline consumption compared to non-members. This effect was especially strong during the first years of the program whereas it stabilized or slightly reversed on the intermediate-to-longer term periods (Cervero et al. 2006). Although the ability to use a car from time to time leads to a small increase of emissions in car-free households, in total carsharing leads to a emission reduction due to more environment-friendly travel behaviour of households reducing or abolishing car-ownership after joining a carsharing program (Martin and Shaheen 2011). Similar results come from a study based in the Montreal area. Modal share of cars in carsharing households without private car is higher than in households not owning a car and not participating in carsharing; however, they never reach the level of households owning a car (Sioui et al. 2013). A comparative study in Switzerland reveals that station-based carsharing triggers a shift towards active modes and public transport; whereas effects of free-floating are less clear (Becker et al. 2017). Bonsall et al. (2002) suggests that joining might be only part of a wider decision to adopt a multi-modal lifestyle with carsharing being just one useful tool among others.

## **4. Theoretical background and methodology**

This paper presents results of a quantitative online survey conducted between March and July 2017 in course of the research project MICHAEL aiming to integrate carsharing and ridesharing at the community level. Goal of the survey is to analyse user behaviour and underlying psychologic factors of carsharing users as well as their attitude towards ridesharing.

Based on the assumption that environmental attitudes are a significant factor for participation in carsharing questions dealing with respondents positions towards environment were included. Attitudes are estimations of objects, persons, situations and prospects and result from experiences but can also contain cognitive, affective and behavioural elements. They have a strong influence on behaviour by structuring information in decision processes. In the special case of environmental attitudes, links to actual behaviour are weaker (Hunecke 2015). To test linkages between environmental attitudes and carsharing participation question were derived from the International Social Survey Program Environment III survey conducted in 2010. This allows comparison of our result to this representative examination.

Based on the assumption that participants in community-based carsharing have a positive attitude towards carsharing, we wanted to identify underlying motives. We developed items representing community, social norm, personal environmental norm, symbolism and instrumental motives and included them in questionnaire in combination with Likert scales.

Some respondents probably were confronted to the topic of ridesharing, which might have influence on their attitude towards sharing car trips. To test the degree of how far respondents dealt with ridesharing we included question based on the model of self-regulated behavioural change. Based on the model of action phases (Heckhausen and Gollwitzer 1987), the stage model of self-regulated behavioural change integrates constructs from the norm-activation model (Schwartz and Howard 1981) and the theory of planned behaviour (Ajzen 1991) to analyse stage membership on behavioural change. It divides behaviour change towards more environmental-friendly travel into five steps. The first two steps are pre-decisional during which the goal intention is formed. The pre-action step develops behavioural intention, which is implemented in the action step. Finally, the new behaviour is settled in the post-action step (Bamberg 2013). Bamberg (2012) provides items suitable for questionnaires to identify stage membership of respondents. To gain insights into stage membership regarding ridesharing, we adapted these items for our needs differentiating between ridesharing as driver and passenger.

In addition to the above-mentioned parts, the questionnaire contains questions about social-demographic and household characteristics, carsharing usage, willingness to participate in ridesharing including some questions about various aspects of arrangement of rides, expectation of rewards and necessary familiarity to people participating in the shared ride. To keep the questionnaire in acceptable length respondents were assigned to different questions based on their general attitude towards ridesharing as passenger and driver. Those being open towards ridesharing received questions about offering lifts or joining lifts offered depending on which preference was stronger. Respondents who are sceptical about either form of ridesharing received questions for their reasons not being willing to share rides.

Participants of the survey are local carsharing group members in Austria and Germany. Among Austrian respondents Caruso Carsharing, a company that supports carsharing groups in organizational matters, spread the access link for the survey among communities by their email-newsletter, social media presence, website, and email to group administrators. In Germany, we contacted group administrators by email asking them to share the access link among members. E-Mail contacts from German groups were gathered in course of a master thesis (Gugg 2015).

Results from descriptive analysis were compared the sample to the total population. As the analysed factors show similar mean among total population values in Austria and Germany we do not differentiate between these two countries. Effect size of ordinal-scaled variables including attitudes, motives and usage frequency are measured with Spearman's rank correlation coefficient. Other variables presented here are nominal-scaled. Therefore, we use cross-tabulation to identify links and Pearson Chi<sup>2</sup>-Test to measure significance.

#### 4.1. Sample description

We collected 416 responses (143 from Germany, 273 from Austria) of which 298 were regarded as useful for further analysis. Criteria was that respondents are users of community-based carsharing (partly using also other forms of carsharing). Applying a t-test for independent samples, we compared the German and Austrian sample. Results show that there are only few significant differences listed in table 1.

Table 1: Significant differences between Austrian and German sample

Question	Respondents from	N	Mean	Std. dev.	df	t	Sig.																																																								
Level of education	Austria	145	2,62	1,555	265	3,559	,000																																																								
	Germany	122	1,96	1,462				Household net income	Austria	127	4,83	1,220	233	5,287	,000	Germany	108	3,99	1,219	Number of cars per adult household	Austria	146	1,05	0,850	267	4,143	,000	Germany	123	0,64	0,737	Availability of car for private use	Austria	145	1,68	0,772	265	-3,621	,000	Germany	122	2,04	0,876	Number of carsharing members per adult in household	Austria	147	0,64	0,288	268	-5,155	,000	Germany	123	0,83	0,305	Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009
Household net income	Austria	127	4,83	1,220	233	5,287	,000																																																								
	Germany	108	3,99	1,219				Number of cars per adult household	Austria	146	1,05	0,850	267	4,143	,000	Germany	123	0,64	0,737	Availability of car for private use	Austria	145	1,68	0,772	265	-3,621	,000	Germany	122	2,04	0,876	Number of carsharing members per adult in household	Austria	147	0,64	0,288	268	-5,155	,000	Germany	123	0,83	0,305	Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009	Germany	112	4,75	0,678								
Number of cars per adult household	Austria	146	1,05	0,850	267	4,143	,000																																																								
	Germany	123	0,64	0,737				Availability of car for private use	Austria	145	1,68	0,772	265	-3,621	,000	Germany	122	2,04	0,876	Number of carsharing members per adult in household	Austria	147	0,64	0,288	268	-5,155	,000	Germany	123	0,83	0,305	Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009	Germany	112	4,75	0,678																				
Availability of car for private use	Austria	145	1,68	0,772	265	-3,621	,000																																																								
	Germany	122	2,04	0,876				Number of carsharing members per adult in household	Austria	147	0,64	0,288	268	-5,155	,000	Germany	123	0,83	0,305	Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009	Germany	112	4,75	0,678																																
Number of carsharing members per adult in household	Austria	147	0,64	0,288	268	-5,155	,000																																																								
	Germany	123	0,83	0,305				Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009	Germany	112	4,75	0,678																																												
Many of the claims about environmental threats are exaggerated	Austria	133	4,45	1,019	243	-2,650	,009																																																								
	Germany	112	4,75	0,678																																																											

About the constitution of members in local carsharing communities little is known. For users in Germany no data are available, for Austrian users Caruso provided some basic data including gender and place of residence. 74,8% of total users in Austria are male whereas in the Austrian sample their share is 68,6%. The comparison of this data with the four-step urban-rural classification according to Statistik Austria (2016) shows that respondents from bigger cities are clearly overrepresented while on the other side participants from rural regions, especially peripheral ones are underrepresented.

Descriptive analysis of personal and household characteristics of respondents show the following results. There is a clear majority of male respondents (61,5%), supporting the findings of other surveys that carsharing users are rather male. The biggest age group among respondents is 50-59 (32,8%) followed by the age group 40-49 (26,1%). People younger than 30 (6,5%) or older than 69 (4,8%) make up only a small share of participants. Respondents tend to be well educated with more than half (51,9%) holding an academic degree. People with lower household income are underrepresented compared to total population: only 9,2% of the respondents belong to each of the two lower income quintiles, whereas the three upper quintiles are overrepresented. A share of 13,2% didn't report their income. Two thirds of respondents are employees (65,1%) with self-employed (19,5%) and retired (13,1%) being the other two relevant groups. People not working for several reasons make up for only a small share. Average household size of respondents is 2,81 which is above average of total population. 48,3% of respondents live in households with just one or two persons; 39,1% live in households with one or more persons under the age of 18. By the type of region they live in can also distinguish participants. We used Austrian and German urban-rural typology frameworks (Statistik Austria 2016, BBSR 2012) to define four types of regions, among which respondents split as follows: Urban central 59,2%, rural central 19,1%, rural intermediate 20,6% and rural peripheral 1,1%. German respondents tend to be more often from urban centres and rural intermediate regions.

Clear results could be found for environmental attitudes. As table 1 shows in every single item users of community-based carsharing have considerably different environmental values compared to total population. Awareness of environmental problems and values towards environmental protection are remarkably high. Only when it comes to accepting higher expenditure of money or time results are less clear. Questions were presented to respondents as statements with 5-point Likert scale. Lower values represent a higher degree of agreement with the statement.

Table 2: Comparative analysis of environmental attitudes between members of community-based carsharing, Austria and Western Germany

Question	Respondents from	N	Mean	Standard deviation
It is just too difficult for someone like me to do much about the environment	Austria	1010	3,43	1,247
	Western Germany	950	3,13	1,204
	Community-based Carsh.	268	4,47	0,905
I do what is right for the environment, even when it costs more money or takes more time	Austria	995	2,69	1,037
	Western Germany	946	2,64	0,999
	Community-based Carsh.	283	2,54	1,158
There are more important things to do in life than protect the environment	Austria	985	3,57	1,097
	Western Germany	944	3,60	1,063
	Community-based Carsh.	271	4,50	0,860
There is no point in doing what I can for the environment unless others do the same	Austria	1009	3,50	1,296
	Western Germany	949	3,31	1,274
	Community-based Carsh.	267	4,58	0,912
Many of the claims about environmental threats are exaggerated	Austria	967	3,34	1,187
	Western Germany	922	3,38	1,157
	Community-based Carsh.	269	4,59	0,866
Environmental problems have a direct effect on my everyday life	Austria	976	3,14	1,188
	Western Germany	916	3,16	1,103
	Community-based Carsh.	284	2,47	1,311

#### 4.2. Carsharing participation motives

To gather information about user motives we developed items for personal environmental norm, social norm, comfort and flexibility, financial, and symbolic motives and asked respondents to rate their importance on a Likert

scale (1 very important, 6 not important). Personal environmental norm shows the lowest mean value, which is in line with our findings about environmental attitudes (above). Other important motives regard to aspects of cost saving, comfort and flexibility – so they are very practical and egoistic reasons.

Table 3: Descriptive analysis of motives for participation in community-based carsharing

Item (motive)	N (valid)	Mean	Standard deviation
Carsharing is cheaper than owning a car (instrumental)	285	2,32	1,629
Carsharing enhances travel flexibility (instrumental)	281	2,99	1,932
Carsharing means less responsibility than owning a car (instrumental)	281	3,18	1,838
It is important to me to be part of the carsharing community (community)	280	4,37	1,775
I enjoy interchange with other members of the carsharing community (community)	261	4,82	1,527
Close persons care about environmental sound mobility (social norm)	262	4,05	1,905
I use carsharing because close persons use it as well (social norm)	259	5,39	1,120
Carsharing makes a contribution to the protection of environment and resources (personal norm)	290	1,90	1,408
I get recognized as carsharing user and people ask about it (symbolism)	272	4,24	1,718

We tested correlations between user motives and personal as well as household-characteristics of respondents applying Spearman Correlation Tests (if not stated otherwise). Before summarizing our findings below it is to say the rather fragmented set correlations, we could identify between motives for participation in carsharing and respondents' individual and household characteristics makes it difficult to integrate them into a broader picture. Additionally, effects are rather weak. For women personal environmental norm is more important than for men (Pearson-Chi<sup>2</sup>-Test (5) = 17,919, p=,003, n=280, Cramers V=,0253).

Table 4: Correlations between community-based carsharing user motives and personal and household characteristics

	Number of cars in household	Level of education	Distance to next public transport stop	Household income level	Year of birth	Availability of car	Urban-rural classification type
Carsharing is cheaper than owning a car	,233**	-,090	,035	-,173**	,011	-,221**	,089
Carsharing enhances travel flexibility	,106	-,053	-,037	,032	-,044	-,188**	,031
Carsharing means less responsibility than owning a car	,170**	-,044	-,012	,044	,037	-,180**	-,029
It is important to me to be part of the carsharing community	-,198**	-,055	-,191**	-,095	,244**	,113	-,138*
I enjoy interchange with other members of the carsharing community	-,167**	-,055	-,146**	-,016	,117	-,003	-,157*
Close persons care about environmental sound mobility	-,091	-,073	-,123*	-,012	,141*	,081	-,048
I use carsharing because close persons use it as well	-,122	-,113	-,019	-,008	,059	,023	-,079
Carsharing makes a contribution to the protection of environment	,094	-,093	,055	-,004	,085	-,101	-,088
I get recognized as carsharing user and people ask about it	-,092	-,138*	-,126*	,011	,170**	,000	-,025

\* p ≤ 0,05; \*\* p ≤ 0,01

### 4.3. Carsharing Usage

To describe carsharing user behaviour show numbers about use frequency and compare use of carsharing towards other modes for different everyday activities.

Results about use frequency show that only 22,9% of respondents report use carsharing weekly or more often. The majority uses it only occasionally: 36,0% 1-3 days per month and 29,6% less than monthly, leaving the conclusion, that they arrange their daily live without a shared car. 10,4% of members of carsharing communities do not use carsharing at all, which leads to the question why they participate in a community-based carsharing initiative. To identify factors explaining the ordinal-scaled frequency of carsharing use, we applied ordinal regression (logit) to identify relevant factors and co-variants. The model explaining carsharing use frequency best includes number of persons in household, number of carsharing members per adult in household, availability of private car, availability of train services at a close public transport stop, and strength of mobility routines.

Table 5: Ordinal regression analyses carsharing use frequency

	Estimated coefficient	Standard error	Sig.
Number of Carsharing users in household per adult	1,119	,373	,003
Number of persons in household	,300	,091	,001
Private car always available (1)	-1,400	,291	,000
Private car sometimes available (2)	-,431	,310	,165
Private car never available (3)	0	.	.
Railway service at next public transport stop	,481	,239	,045
Routines (very strong)	1,301	,431	,003
Routines (strong)	1,226	,364	,001
Routines (neutral to strong)	,893	,393	,023
Routines (neutral to weak)	,352	,389	,366
Routines (weak)	,107	,341	,753
Routines (very weak)	0	.	.

The estimation model ( $\text{Chi-Quadrat}(726) = 848,54, p = .001$ ) for predicting frequency of carsharing usage has a Nagelkerke R-square of .223, which is a satisfactory model fit. It shows that more carsharing users in household and low availability of a private car has a positive effect on carsharing use frequency. Persons who report that their travel behaviour is determined by routines to a higher degree use car sharing more often. Minor positive effects result from close access to railway service and high numbers of persons in household. Railway access is probably rather given in places with.

Spearman correlation could reveal a series of correlations between frequency of carsharing usage and variables mostly connected to the household vehicle holdings and public transport service quality. A high frequency in carsharing use is related to a low number of private cars in households and low availability of private cars but it rises with the number of season tickets for public transportation. Respondents living in households with more people with carsharing membership tend to use carsharing more often as well. People who report that their travel behaviour is determined by routines to a higher degree use carsharing more often.

We also found a strong and highly significant relation between number of different activities carsharing is used for (among other modes) and frequency of use. Relative location of the household towards shopping facilities – place to buy groceries for the week and next shopping mall or city centre – as well as to the next railway station have minor effects. The closer households are located towards these facilities the less often carsharing is being used. Although we could show that, there is a strong link between pro-environmental attitudes and carsharing membership there is no significant correlation with frequency of carsharing use. Findings also do not show any relations between frequency of carsharing use and socio-demographic variables and household income.

### 4.4. Attitudes towards Ridesharing

As mentioned above part of our research project is integrating carsharing and ridesharing to provide additional transport options for people not able or willing to drive a car. Therefore, we asked a series of questions regarding the attitudes of car sharers towards ridesharing. Respondents rated their willingness to participate in ridesharing



on a 7-point Likert scale for ridesharing as driver and passenger respectively. Results show a neutral to open attitude to participate in ridesharing. Mean value for ridesharing as driver is 3,33 (standard deviation: 1,912; variance: 3,655), whereas for passengers it is 3,35 (standard deviation: 1,986; variance: 3,946) with 1 marking strong willingness for participation and 4 the neutral position.

Correlation analysis indicate a relationship between the step on the self-regulation model and openness towards ridesharing as driver ( $r_s=.295$ ,  $p=.000$ ,  $n=295$ ) but no respective correlation to ridesharing as passenger ( $r_s=.171$ ,  $p=.105$ ,  $n=91$ ). Results also show a high correlation between attitudes towards offering a ride and joining a ride offered by someone else ( $r_s=.721$ ,  $p=.000$ ,  $n=298$ ). Additionally, willingness to offer rides is linked to frequency of carsharing use ( $r_s=-.184$ ,  $p=.001$ ,  $n=297$ ) and mean of pro-environmental attitudes ( $r_s=-.254$ ,  $p=.000$ ,  $n=252$ ). For joining ridesharing as passenger we found significant correlations with frequency of carsharing use ( $r_s=.164$ ,  $p=.005$ ,  $n=297$ ) and mean of pro-environmental attitudes ( $r_s=-.239$ ,  $p=.000$ ,  $n=252$ ). Table 4 shows the respective share of respondents of each step.

Table 6: Distribution of respondents along the steps of the self-regulation model

Step	Offering rides as a driver		Joining rides as a passenger	
	Number of respondents	Share of respondents	Number of respondents	Share of respondents
Pre-decision I	40	26,1%	24	29,6%
Pre-decision	20	13,1%	6	7,4%
Pre-action	37	24,2%	20	24,7%
Action	10	6,5%	4	4,9%
Post-action	46	30,1%	27	33,3%

In case of offering a ride 41,5% would expect a consideration from the passenger, of whom 64,8% would prefer it in financial form and 35,2% in some other way. 56,3% of those expecting a consideration prefer to arrange it via a digital platform, 32,1% face-to-face and 11,3% in some other way. As security is an often-discussed topic when it comes to sharing rides, this issue was included in our survey. Therefore, we used a six point Likert scale to gain insights into attitudes about sharing rides with different groups of persons depending on familiarity and after 10pm. Results show the importance of familiarity and community when it comes to sharing rides. Social media can compensate trust built by face-to-face contact only to a small degree. This shows that our approach to implement ridesharing in existing communities is a promising approach.

Table 5 presents means, variances and standard deviations of responses with lower number representing higher acceptances for sharing rides. Readiness to share rides with strangers and after 10pm show high correlations for ridesharing as driver ( $r_s=-.561$ ,  $p=.000$ ,  $n=142$ ) as well as ridesharing as passenger ( $r_s=-.533$ ,  $p=.000$ ,  $n=80$ ). This leads to the conclusion that both variables are an indication for a higher cautiousness.

Table 7: Openness towards ridesharing depending on familiarity of involved person and time of day

Familiarity of person	Offering rides as a driver			Joining rides as a passenger		
	N	Mean	Standard deviation	N	Mean	Standard deviation
Family	155	1,11	0,450	88	1,19	0,623
Circle of acquaintances	159	1,16	0,484	89	1,21	0,464
Members of the carsharing community	158	1,58	0,751	86	1,79	0,869
Social media contacts (no personal contact)	154	3,16	1,299	86	3,45	1,252
Strangers	153	3,57	1,271	83	3,70	1,329
Time of day						
Sharing rides after 10pm	148	3,52	1,864	83	3,64	1,923

Finally, we wanted to know from respondents who take in a cautious position towards ridesharing about reasons for their attitude. Among reasons against sharing rides as driver the highest share agrees with the statement that it reduces flexibility (74,3%). Exactly for half of respondents the process of arranging shared rides is too complicated. 31,4% feel uncomfortable being in a car with a person they don't know very well or not at all. The car being a place where people prefer to be alone (11,4%) and that it is usually fully occupied anyway (10,0%) are no major reasons for denial of ridesharing. Reduction in flexibility is also the main reason against sharing rides as

passenger, with 66,2% supporting this argument. 36,5% feel uncomfortable sharing a ride with someone they don't really know, 33,8% has no need for it, and 32,4% are afraid that driver could have a dangerous way of driving. Other reasons mentioned against offering lifts were fear of crime, living in a peripheral location where no demand is expected, the unwillingness to take responsibility for a passenger and using cars only on official business. For ridesharing as passenger the reasons are bad experiences with shared rides, fear of crime and basic avoidance of car trips.

## 5. Conclusion

Carsharing is a step stone on the way to sustainable mobility. Especially for station-based carsharing, the effects on reduction of cars and vehicle miles travelled are quite clear and supported by numerous surveys. While in cities a growing number of commercial operators is stepping into the market, areas outside the centres of big cities do not seem to be a good place for commercial carsharing to thrive. Non-commercial carsharing fills this gap and supports the shift to a sustainable transport system. A promising way to organize non-commercial carsharing are carsharing communities. To further promote and develop community-based carsharing it is crucial to understand who members are, why they participate and understand usage-patterns.

The results presented here shed some light on connections between psychological factors and the decision to participate in carsharing. In addition, it was possible to identify some crucial aspects considering ridesharing. Pro-environmental attitudes are an important driver for being member in a carsharing-community. In addition, certain socio-demographic and socio-economic characteristics raise probability of becoming member including high level of education, above average household income and gender. Majority of community-based carsharing members use shared cars only occasionally, with usage frequency being bound to the availability of other modes of transport as well as locational aspects of the place of living.

People who are open towards ridesharing as drivers would also use it as passengers and vice versa. Among those with positive attitude towards ridesharing, we find a group who tends to be more careful regarding people involved and time of day. Another finding is that social media cannot substitute face-to-face contact within communities which seems to be an important pre-condition for sharing rides. People who confronted themselves with the topic of ridesharing before tend to be more open to practise it themselves. In addition, carsharing use frequency and pro-environmental attitudes are linked to openness towards ridesharing as well. However, it has to be kept in mind that people who practice community-based carsharing might be more open towards alternative mobility options. Therefore, transferability of these results is limited.

### 5.1. Limitations and future work

To our knowledge this is the first work providing an analysis of community-based carsharing users. Limitations result from the weak representativeness of the sample. Therefore, its character has to be considered as rather exploratory. The contribution of this paper is that its results indicate some directions and raises questions for future work regarding how to support the diffusion of community-based carsharing. This opens a wide field of future research topics, of which we present here some of the most crucial ones according to our estimation.

- Quantitative approaches have limitations when it comes to understanding user motives. To understand motive structures better a mixed-method approach including qualitative interviews could be a promising way.
- We could prove that there are links between carsharing usage and regional characteristics as well as distance between household and certain facilities. To fully understand these relations, in-depth analysis of daily travel behaviour (e.g. using a travel diary) of carsharing members could lead to a deeper understanding of community-based carsharing usage. Qualitative research could shed some light on routines and decision-making processes regarding mode choice of carsharing users.
- A critical number of members is crucial for community-based carsharing to work. To convince non-users their needs and potential motives to join must be understood and ways to address them be found. Additionally, analysing supporting legal, organisational and policy frameworks for carsharing communities helps developing measures to foster the foundation of new groups.
- So far, comparisons among different carsharing models focused on differences and similarities between station-based and free-floating carsharing. When it comes to motives for participation, the dividing line is probably between peer-to-peer and commercial carsharing offers. We recommend that future work deal with this line when examining motives for participation in shared mobility.

## Acknowledgements

This paper is one of the products of the research project MICHAEL, funded by the Austrian ministry for transportation, innovation and technology.

## 6. References

- Ajzen, I. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179e211.
- Bamberg, S. 2012. Wie funktioniert Verhaltensänderung? Das MAX-Selbstregulationsmodell. In: Stiewe, M., Reutter, U.(Ed.) *Mobilitätsmanagement – Wissenschaftliche Grundlagen und Wirkungen in der Praxis*. Essen.
- Bamberg, S. 2013. Changing environmentally harmful behaviors: A stage model of self-regulated behavioral change. *Journal of Environmental Psychology*, 34, 151-159.
- Bardhi, F., & Eckhardt, G. M. 2012. Access-based consumption: The case of car sharing. *Journal of consumer research*, 39(4), 881-898.
- Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) 2012. *Analysen Bau.Stadt.Raum*. Bonn.
- Becker, H., Ciari, F., & Axhausen, K. W. 2017. Comparing car-sharing schemes in Switzerland: User groups and usage patterns. *Transportation Research Part A: Policy and Practice*, 97, 17-29.
- Bonsall, P. Jopson, A., Pridmore, A., Ryan, A., & Firmin, P. 2002. *Car Share and Car Clubs: potential impacts*. Institute for Transport Studies, University of Leeds
- Botsman, R., & Rogers, R. 2011. What's mine is yours: how collaborative consumption is changing the way we live.
- Canzler, W., Knie, A. 2009. Radikales Umdenken im öffentlichen Landverkehr! In: *LandInform - Magazin für ländliche Räume*, H. 3, S. 28-29.
- Celsor, C., & Millard-Ball, A. 2007. Where does carsharing work?: Using geographic information systems to assess market potential. *Transportation Research Record: Journal of the Transportation Research Board*, (1992), 61-69. Cervero et al. 2006
- Dorner, F., & Berger, M. 2017. Kombiniertes Carsharing und Ridesharing: eine gemeinschaftsbasierte Mobilitätslösung für den ländlichen Raum?. In *REAL CORP 2017-PANTA RHEI-A World in Constant Motion. Proceedings of 22nd International Conference on Urban Planning, Regional Development and Information Society* (pp. 319-328).
- Firnborn, J., & Müller, M. 2011. What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm. *Ecological Economics*, 70(8), 1519-1528. Gossen 2012
- Gugg, G. 2015. *Organisation nicht kommerziellen Carsharings* (Master Thesis).
- Hamari, J., Sjöklint, M., & Ukkonen, A. 2016. The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science and Technology*, 67(9), 2047-2059.
- Heckhausen, H., & Gollwitzer, P. M. 1987. Thought contents and cognitive functioning in motivational versus volitional states of mind. *Motivation and Emotion*, 11, 101-120.
- Herget, M. 2016. *Mobilität von Familien im ländlichen Raum*. Springer Fachmedien Wiesbaden.
- Higginbotham, B. D. 2000. *Carsharing: Increasing Rural Transportation Options in the Great Central Valley*.
- Hunecke, M. 2015. *Mobilitätsverhalten verstehen und verändern: Psychologische Beiträge zur interdisziplinären Mobilitätsforschung*. Springer-Verlag. Kagermeier 2004
- Koch, H. (2001). User needs report. MOSES (Mobility Services for Urban Sustainability) Project-Workpackage, 2, 22-24.
- Kopp, J. P. 2015. *GPS-gestützte Evaluation des Mobilitätsverhaltens von free-floating CarSharing-Nutzern* (Doctoral dissertation).
- Litman, T. 2015. *Land use impacts on transport*. Victoria Transport Policy Institute ([www.vtpi.org](http://www.vtpi.org)).
- Loose, W. 2010. *Aktueller Stand des Car-Sharing in Europa*. Endbericht D, 2, 34-114.
- Meaton, J., & Low, C. 2003. Car club development: the role of local champions. *World transport policy and practice*, 9(3), 32-40.
- Martin, E., Shaheen, S., & Lidicker, J. 2010. *Carsharing's Impact on Household Vehicle Holdings* (No. UCD-ITS-RR-10-05).
- Martin, E. W., & Shaheen, S. A. 2011. Greenhouse gas emission impacts of carsharing in North America. *IEEE Transactions on Intelligent Transportation Systems*, 12(4), 1074-1086.
- Perschl, M., & Posch, A. 2016. Carsharing-ein Mobilitätsansatz auch für den ländlichen Raum?. In *Lebensentwürfe im ländlichen Raum* (pp. 243-268). Springer Fachmedien Wiesbaden.
- Jaeger-Erben, M., Rückert-John, J., & Schäfer, M. 2013. *Soziale Innovationen für nachhaltigen Konsum*.
- Ozanne, L. K., & Ballantine, P. W. 2010. Sharing as a form of anti-consumption? An examination of toy library users. *Journal of Consumer Behaviour*, 9(6), 485-498.
- Schmöller, S., & Bogenberger, K. 2014. Analyzing external factors on the spatial and temporal demand of car sharing systems. *Procedia-Social and Behavioral Sciences*, 111, 8-17.
- Schreier, H., Becker, U., & Heller, J. 2015. *Evaluation CarSharing (EVA-CS) Landeshauptstadt München*. Endbericht. Berlin.
- Schwartz, S. H., & Howard, J. A. 1981. A normative decision-making model of altruism. In J. P. Rushton, & R. M. Sorrentino (Eds.), *Altruism and helping behaviour* (pp. 189e211). Hillsdale, NJ: Erlbaum.
- Shibayama, T., Lemmerer, H., Winder, M., & Pfaffenbichler, P. 2013. *Cooperative car sharing in small cities and scarcely populated rural area-an experiment in Austria*. Institut für Verkehrswissenschaften, Technische Universität Wien.
- Sioui, L., Morency, C., & Trépanier, M. 2013. How carsharing affects the travel behavior of households: a case study of Montréal, Canada. *International Journal of Sustainable Transportation*, 7(1), 52-69.
- Statistik Austria 2016. *Urban-Rural-Typologie*
- Stillwater, T., Mokhtarian, P., & Shaheen, S. 2009. Carsharing and the built environment: Geographic information system-based study of one US operator. *Transportation Research Record: Journal of the Transportation Research Board*, (2110), 27-34.
- Vosselman J.J.; Klieverik M. O. 2009. *ShareLease. A new lease-concept combining carsharing and ridesharing*. Enschede.
- Wilke, G., Böhlner, S., Bongardt, D., Schäfer-Sparenberg, C., & Wilke, G. 2007. *Zukunft des Car-Sharing in Deutschland*. Schlussbericht. Wuppertal Institut für Klima, Umwelt, Energie GmbH, Wuppertal.