

THE MOBILITY CHOICES IN POLAND: IS THERE A CHANCE TO TRANSITION FROM OWNED CARS TO A SHARED ONES?

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Abstract

Car-oriented mobility produces externalities that disrupt the quality of life, especially for urban residents. New national and EU-funded projects are dedicated on improving sustainable mobility and raising the ecofriendliness of transport. In our paper, we aim to answer if Poland has a chance to foster ecofriendliness in drivers and mobility users. The survey results (n=3094) illustrate how intergenerational differences between mobility users depends on their place of living. We conclude that in large cities, opportunities for changing the mobility patterns are higher. In order for the local authorities to achieve succeed, they should prioritize promoting private and shared micromobility.

Key words: *Urban Mobility, Micromobility, Car Culture, Mobility Choices, Mobility Patterns, Sustainable Mobility*

INTRODUCTION

For decades, the car symbolized various features and characteristics, occupying a central place in societies' interests. Car culture and car-oriented mobility choices have already reached their peak period – this is the sentence most frequently appearing in the literature on this topic. On the other hand, at no other time in the past has sustainable development been discussed so much in transport and mobility. The car has now become a symbol of the brown economy, air pollution and civilization diseases. However, in developed countries, car culture remains strong. How can we address this, and compromise comfort, convenience and an eco-friendly lifestyle? In our study, we aim to explore if there is a chance of transition from a car-oriented society into one that prioritizes sustainable mobility. We analyze current mobility data in Poland and data from the survey conducted in November 2022.

The transportation landscape in Poland is a mix of contradictory and inconsistent information. The issue of transport exclusion is visible, especially in the countryside and areas of cities in need of revitalization. The highest levels of transport exclusion are recorded in small commune cities where public transportation is in poor shape or non-existent and mobility is mainly car-based. In small and medium sized cities, the situation is better but still not sufficient enough – they experience some slow changes but still focus on car mobility. In these areas, the negative externalities of transportation is reduced with the congestion and air pollution being limited. On the other hand, the number of cars for per 1000 residents is the highest in Central and Eastern Europe, and continues to grow each year. Moreover, local authorities and the European Commission are promoting sustainable mobility, especially through the use of bikes and e-scooters, while also building the framework for multimodal mobility patterns.

The other situation can be observed in large cities across Poland. According to the TomTom congestion analyses conducted for 12 Polish cities in 2022, the average travel time per 10 km by car is the highest in Wroclaw (25 min), Lodz (22 min) and Krakow (22 min). In these cities, the time spent in traffic during rush hour is at least 208 hours (8,67 days) per year, translating to over one week lost per year for individuals commuting to work or school by car daily. This also exacerbates more problems associated with the air pollution from traffic According to European Air Quality Index provided by European Environmental Agency, the air quality in those cities is poor or very poor, especially in rush hours every day, even in summer. The solution for these cities would be transitioning from car-oriented mobility to multimodal mobility or as a utopian idea, zero-emission mobility.

Therefore, there is a question: is Polish society prepared for changes in mobility and ready stop to development of car culture? Have we witnessed a peak in car usage , or will it occur in the future? Is there a potential for a shift from car ownership to co- sharing in big cities? We estimated the relationships between mobility variables within Polish society, including urban residents, to answer these questions.

In order to achieve our research goal, we divided the paper's content into several sections. The remainder of the paper is as follows. Firstly, we provide a literature review to provide context in people's mobility in Poland. Subsequently, the methodology and characteristics of the respondents is shown, to present the opinions of the Polish society about car usage. At the end, they are discussed, and final conclusions are drawn.

1. LITERATURE REVIEW

1.1. Car culture and its intergenerational inheritance

The world's most popular mode of transport is the private car. It is a material possession that bears economic status and is also characterized with symbolic significance [Arcimowicz, 2019]. The number of private cars per resident in Poland is increasing, a trend explained by the poor quality of public transportation and the the intent to demonstrate social status. Although cars are gradually being removed from city centres in many European cities, the use of public transportation is still perceived as socially stigmatizing [Heinonen i in., 2021]. The purchase of a private car defines economic success in society, while public transport is associated with the poorer percentage of the population.

Car ownership is perceived as a symbol of freedom defined as unrestricted mobility [Arcimowicz, 2019]. For instance, timetables don't impose time constraints, allowing them to freely manage their time [Leśniak-Moczuk, 2020]. The car is plays a vital role for the functioning of families. The modern family often owns more than one car. However, if a family owns one car it is most often managed by the man [Arcimowicz, 2019]. Consequently, the car reinforces traditional stereotypes of the male role in the family. The car can also be considered as part of a masculinized culture in which a 'road ethos' is important [Falkowski, 2010]. Among young people, subcultures associated with pleasure driving are also noticeable [Carrabine & Longhurst, 2002].

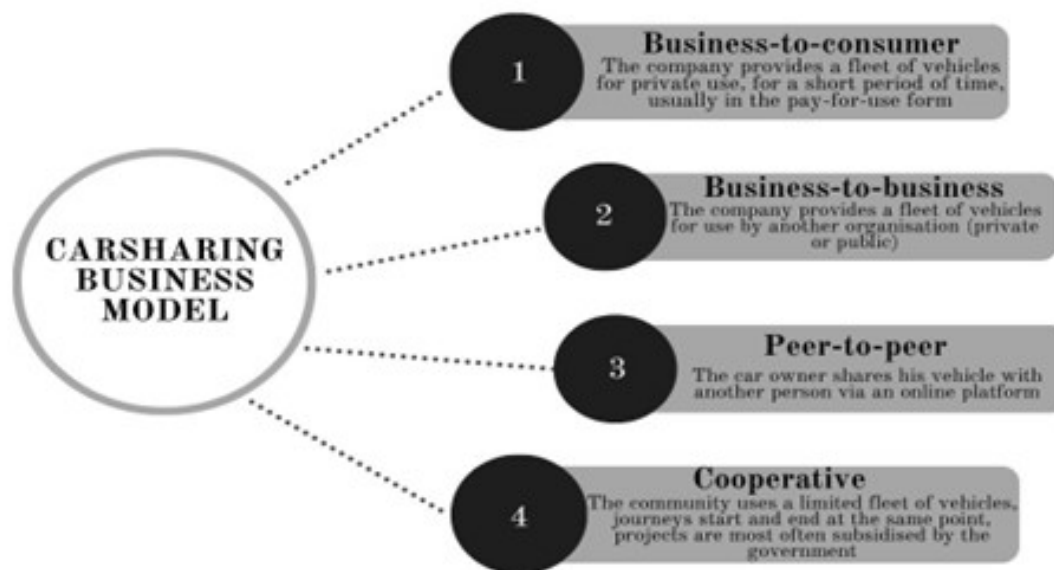
Car culture is associated with the USA and its sprawling suburbs. Despite the smaller scale of suburbanization, car culture is also noticeable in Europe. This is fostered by suburbanization, a lack of investment in suburb infrastructure development, and advertising campaigns that to emphasize the non-material values of cars [Jóźwiak, 2017]. Modern cities have developed in a car-centric way, generating additional problems between mobility users, especially among car drivers, cyclists and pedestrians [Kallenbach, 2020]. This conflict mainly relates to space, a limited resource in in cities [Zajac i in., 2014].

1.2. Carsharing and changing the car-oriented mobility patterns

The sharing economy can be defined as the concept where resources are shared, usually with the support of modern technologies [McLean, 2015]. In fact, this sharing economy fits aligns with the principles of sustainable development. Mainly due to its

circular, multi-user utilization of recourses [Hendel, 2020; Waškiewicz, 2022]. Sharing itself can be viewed as the initial stage of the post-growth era [Waškiewicz, 2022]. However, its worth noting that sharing can be a specific marketing strategy and business model [Vith i in., 2019]. The success of companies such as Uber or Airbnb exemplify this. One of the more popular examples of sharing is the carsharing concept, where cars are shared among different users [Kawa & Nesterowicz, 2022; Münzel i in., 2020]. Although this service is relatively new in Poland, such systems are already in operation in Western European cities [Pomianowski, 2018]. The development of carsharing (see Figure 1) depends on the city's conditions and the development of other forms of mobility, such as bikesharing or micromobility [Garus i in., 2022].

Figure 1. Carsharing business model



Source: own elaboration based on [Nansubuga & Kowalkowski, 2021].

Carsharing encompasses multiple business models and combines different sales channels including; B2C, B2B, P2P and at the same time, their cooperation. In the business-to-consumer model, a company provides several cars to the market, which individual users utilize. Payment is typically made on a per-use basis (pay-for-use formula) and the journeys themselves are round-trip, allowing the vehicle to be left anywhere other than where the starting point. The same principles apply for the business-to-business model. The type of user is different, as the offer is aimed at private and public organizations, and payments are made through a monthly subscription. In the peer-to-peer model where private vehicle owners share their vehicle via an online platform or mobile app. The final model is cooperation, which closely resembles non-commercial sharing. However, the fleet of vehicles is limited to a specific fleet, usually requiring for the start and end point for the journey to be the same. Co-operative projects are often co-financed by the local government.

A single shared car can replace up to twenty private cars [Jochem i in., 2020]. This has measurable benefits for cities struggling with congestion and air pollution. Car-sharing users are more concerned about the environment than users of services such as Uber [Mouratidis, 2022]. Also, they predominately reside in densely populated (urban) areas, and are prosperous and relatively young [Garus i in., 2022]. However, relying on shared vehicles without developing public transport and micromobility may not be sufficient enough to achieve a satisfactory level of urban transport sustainability [Ramos i in., 2020]. Urban transport planning should be approached in a holistic form, taking into account multiple forms of mobility and user behaviour. Therefore, following the literature review, we have formulated the research questions as follows:

RQ1: Is there currently a peak car phenomenon observed in Poland, or will it occur in future?

RQ2: Are Polish people ready to change their mobility choices from owned cars to sharing, especially in large cities?

2. METHODOLOGY

The study investigates the capacity of the Polish population to transition from car ownership into more eco-friendly transport modes, including carsharing. In order to assess this, and determine if there is a difference between the residents of large, small or medium cities, we employed a random sampling method. This approach enables us to compare the subsamples for different places of living (countryside, small and medium cities, and large cities). The survey was conducted in November 2022 with a sample size of 3094 people. The descriptive statistics of the sample are presented in Table 1. The sample stratification was based on three layers: gender, age and place of living. As shown in Table 1, two-thirds of respondents did not have children 0-15 y.o. in their household. These individuals usually indicated higher personal incomes and exhibited certain characteristics more frequently than those individuals living with children, like living in a big city, being in a relationship, or being single.

Table 1. Descriptive statistics of the surveyed group

Category	Share of respondents
Generation (age groups)	Baby Boomers (born 1946-1962) 25,44% X (born 1963-1980) 30,09% Y (born 1981-1999) 37,23% Z (born after 1999) 7,24%
Gender	Female 52,91% Male 46,93% Other 0,16%

Category	Share of respondents
Employment	Unemployed 12,54% Full-time workers 51,78% Part-time workers 8,05% Pensioners 21,20% Students 6,43%
Place of living	Small or medium city (small up to 20k residents, medium 20-100k residents) 32,68% Big city 29,44% Countryside 37,88%
Housing status	Own flat (without mortgage) 50,97% Own flat (with mortgage) 12,44% Owned by family (parents, grandparents etc.) 21,82% Rented flat 12,48% Commune-owned flat 1,68% Student dormitory 0,61%
Personal status	Married 51,68% Single 19,43% In a relationship 18,58% Divorced 5,53% Widowed 4,78%
Size of household	1 person 12,77% 2 persons 35,88% 3-5 persons 45,57% More than 5 persons 5,78%
Children 0-15 in household	No 67,10% Yes 32,90%
Income per person	Up to 500 PLN/month 5,14% 501-1000 PLN/month 9,82% 1001-1500 PLN/month 13,02% 1501-2000 PLN/month 17,36% 2001-3000 PLN/month 27,15% 3001-5000 PLN/month 20,17% More than 5000 PLN/month 7,34%

3. RESULTS

3.1. Using the transport modes

Firstly, we examined the transport mode choices in general, and considered the sub-groups living in various locations. Generally (see Table 2), the majority of respondents use a car (over 56%). The second most popular mode of transport is walking, while the third option was taking a bus. This was anticipated since buses are the only form of PT available in all categories of residential areas of living including the countryside, small and medium city, large city. However, as mentioned earlier, transport exclusion is visible especially in the countryside. Of course, there are interregional differences as well as disparities between suburbs and regular rural regions which are formally

classified as a countryside. In the traditional countryside (not a suburb), in most cases, there are only 2 or 3 buses a day, if any, and they only operate during workdays or throughout the school year to facilitate the possibility for children to go to school by bus. Moreover, they are usually financed by local authorities due to the high costs associated to ticket revenues.

Almost 1/10 of respondents use bicycles as the primary mode of transportation with the exception of for the car and PT. The other modes are relatively rare, below 1% or slightly more than 1%, such as fast rail or metro (which are available only in a few Polish cities). Regardless, PT or sustainable transport accounts for nearly 44% of the first choice for all respondents, regardless of their place of residence.

Table 2. The main transport mode (general results for sample)

Transport means	No. of respondents	Share (in %)
Bike	250	8,08016
Car	1734	56,04396
On foot	439	14,18875
Fast rail/ metro	35	1,13122
Carsharing	13	0,42017
Regional rail	52	1,68067
Motorbike	14	0,45249
Bus	401	12,96057
Tram/ trolleybus	118	3,81383
Taxi	29	0,93730
Owned e-scooter	5	0,16160
Shared e-scooter	4	0,12928

Source: own preparation (n=3094)

However, mobility services are not available in all types of cities, most notable the smallest ones (with populations up to 50 thousand residents). As shown in Table 3, there are significant differences between the first mode choice of transportation between subgroups living in different living categories. Naturally, in the countryside, the proportion of car users is much higher when compared to large cities, which provide more opportunities to abandon the car and utilize shared mobility or PT instead. In addition, there are more bike users in the countryside and smaller cities, for two reasons. Firstly, they opt to choose a car or bike since PT within one city is usually unavailable. Residents in small cities typically have lower personal incomes and pay more attention to fuel savings. Secondly, in small cities, nearly everything is within walking distance (up to 20 minutes on foot), this leads to a higher share of walking and bike usage. In that sense, they can be considered as: 20-minute cities. The significant differences across the different types of residential living were also confirmed by carrying out the chi-square test (test value: 403,66, df=22, p=0.000). Therefore, it was justified to later analyze only the subgroup of large city residents, who face higher traffic externalities and have more opportunities to change their mobility choices.

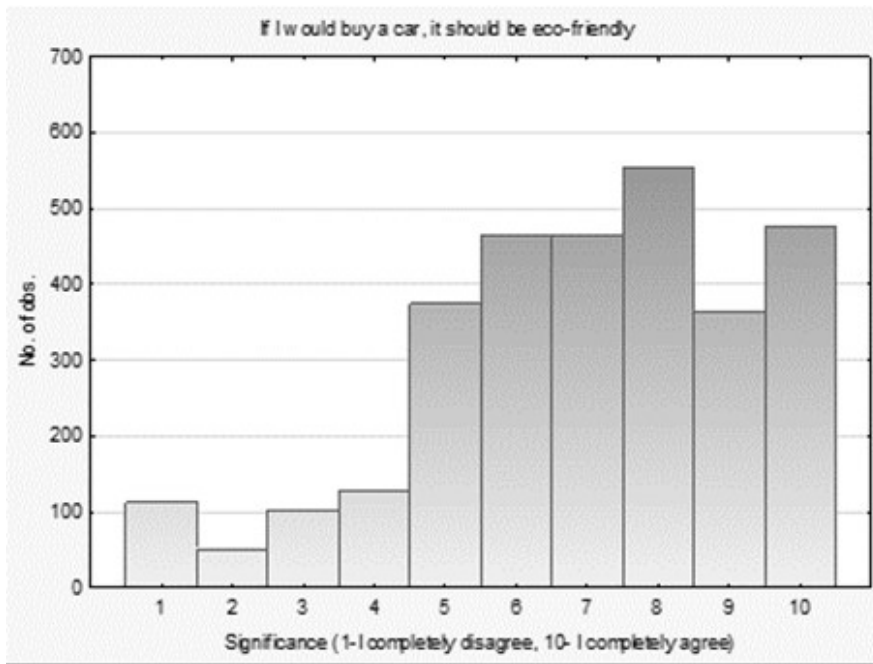
Table 3. The differences between residents of countryside, small and medium cities and big cities in their first mode choice

Place of living	Bike	Car	On foot	Fast rail/metro	Carsharing	Regional rail	Motor bike	Bus	Tram/trolley	Taxi	E-scooter	Shared e-scooter	Sum
Small or medium sized city	82	552	215	8	5	17	2	104	11	11	4	2	1011
Share in %	8,11%	54,60%	21,27%	0,79%	0,49%	1,68%	0,20%	10,29%	1,09%	1,09%	0,20%	0,20%	100%
Countryside	114	796	94	4	4	27	10	107	10	6	0	0	1172
Share in %	9,73%	67,92%	8,02%	0,34%	0,34%	2,30%	0,85%	9,13%	0,85%	0,51%	0,00%	0,00%	100%
Big city	54	386	130	23	4	8	2	190	97	12	5	2	911
Share in %	5,93%	42,37%	14,27%	2,52%	0,44%	0,88%	0,22%	20,86%	10,65%	1,32%	0,55%	0,22%	100%

Source: survey (n=3094)

Next, the respondents' opinions were analyzed, with regards to their preferences for purchasing a car or their general perception of cars. As presented in Figure 2, respondents affirmed that when considering the purchase of a new car, they would pay attention to its ecofriendliness.

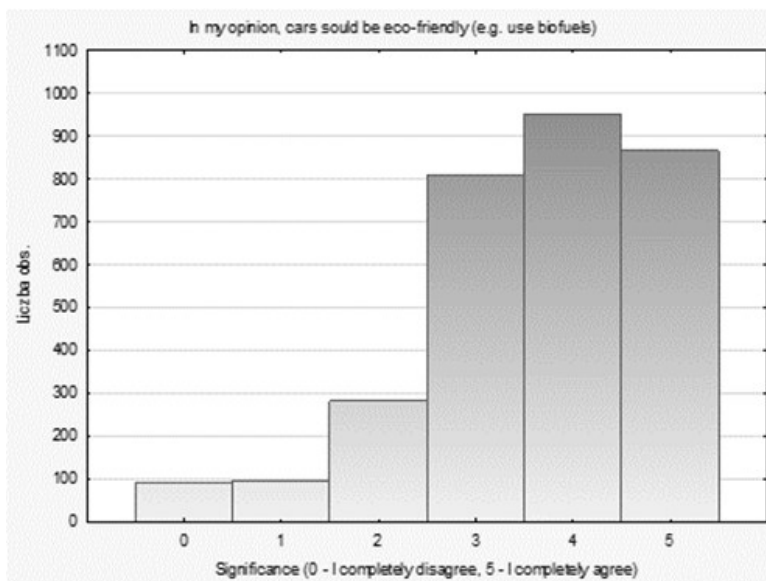
Figure 2. Answers for the question, if the respondent would pay attention to car's ecofriendliness while buying a car



Source: own preparation (n=3094).

In general, they confirm that cars should be eco-friendly (see Figure 3)

Figure 3. Answers for the question, if generally cars should be eco-friendly



Source: own preparation (n=3094).

On the other hand, we are aware of the prevailing characteristics of the car fleet in Poland, which usually comprises of old, diesel vehicles that are not eco-friendly, generating high emissions that often fail to meet EURO standards. With this in mind, is the ecofriendliness of Polish people presented in our study a myth? Do we still face the growing car culture and are not able to transition towards more sustainable mobility? To answer this, we estimated the correlation between the characteristics of people's mode choices and their opinions regarding the ecofriendliness of cars. The correlation analysis (see Table 4) showed that:

- The younger the generation, the less eco-friendly they tend to be are less likely are to look for an eco-friendly car. However, the most eco-friendly opinions were presented by the oldest cohort (Baby Boomers, aged 59 or more) and generation Z (aged 22 or less). The lower ecofriendliness was displayed by generation Y (aged 23-42)
- Larger households are generally less eco-friendly regarding car-related opinions. This is highly correlated with having children with bigger households usually including children, or elderly with limited mobility possibilities who depend on younger family members.
- When there are children at home, the ecofriendliness of a car is less important. Usually, parents present less eco-friendly mobility choices because of their travel needs, higher levels of exhaustion and the need to take more things while traveling with children.
- The higher levels of income, are linked with an increased focus on ecofriendliness while purchasing a car and in the general opinions about cars. Academic literature supports this, suggesting that financial stability encourages a more eco-friendly lifestyle and ideas.
- The more flexibility and freedom are in the respondent's life (typically BB and Z), the more eco-friendly the respondent tends to be. Often the youngest cohorts (generation Z), present the most flexible approach to mobility. They usually have no children, are just embarking on their professional career, have no loans, live with their parents, or rent a room or flat with friends. As such, so their lifestyle and life stage allow for flexible use of time and resources.
- Having a driver's license is inversely correlated with seeking for an eco-friendly car. Drivers do not usually consider this as an essential factor. This confirms their limited orientation towards ecofriendliness, with them focusing on using the car. The same mentality we observed among motorbikes users.
- However, car users indicated they would pay attention to the car's ecofriendliness when purchasing a new model. However a deeper screening, is needed to determine whether their motivation is based on their want to be eco-friendly or their desire to generate savings while driving the car,
- People using PT and bikes or those who often walk, indicated that if they looked for a car, they would pay attention to its ecofriendliness. This also confirms their

approach to mobility, where their focus is on mobility itself rather than the need to use a car.

- Surprisingly, bus users indicated that they would ignore ecofriendliness in purchasing process while buying a car, but strongly believe that cars should be eco-friendly.

In addition, to clarify and support the obtained results, we estimate that (see Table 5):

- Larger households have a longer the travel time per day often due to commuting to children’s school or driving with the partner or spouse to work with one car.
- Having children is correlated with longer daily travel time as previously mentioned
- Bigger residential areas have greater quantities of people using PT due to its availability.
- Larger households, tend to use PT less because of shared commuting every day to school and work, in addition to having children.
- Higher income levels, correlate with increased frequency of PT usage. While this is contrary to exciting knowledge. It is important to keep in mind, that typically, higher income per person was linked with living in larger cities being single or in a relationship but without children, reaffirming previous results.

Table 4. Correlation coefficients – respondents’ characteristics vs. opinions about car ecofriendliness (bolded are significant)

	If I would buy a car, it should be eco-friendly	In my opinion, car should be eco-friendly (e.g. use biofuels)
Generation	-0,0590	-0,1678
No. of persons in household	-0,0350	-0,0423
Children 0-15 in a household	-0,0637	-0,0231
Income level (per person)	0,0551	0,0852
Mindset – I prefer freedom and flexibility than stable but boring work.	0,0621	0,0648
Having driving license	-0,0497	0,0050
Main_mode_tram/trolley	0,0892	0,0144
Main_mode_fast_rail/metro	0,0594	0,0198
Main_mode_regional_rail	0,0831	-0,0033
Main_mode_motorbike	0,0053	-0,0362
Main_mode_bike	0,1028	0,0161
Main_mode_on foot	0,0703	0,0393
Main_mode_bus	-0,0421	0,0508
Main_mode_car	0,1241	0,0138

Source: own preparation (n=3094)

Table 5. Correlation coefficients – travel times and using PT vs. respondents characteristics

Category/variable	Characteristic of respondent			
	Size of the place of living	No. of persons in the household	Children 0-15	Income level
Travel time	0,0339	0,0385	0,0408	0,0092
Frequency of using public transport	0,3240	-0,0945	-0,0914	0,0635

Source: own preparation (n=3094)

As well, as shown in Table 6, further research results revealed that:

- The benefits of using a car are recognized mainly by respondents having children or living in bigger households. For them, the car is not also a means of transport but something more – it serves as a tool that helps to achieve goals, save time and complete all planned activities,
- Residents in large cities perceive the car not as the only way to achieve their mobility goals, such as meeting friends and family or going to a pub. They do not perceive owning a car as a means to demonstrate their freedom, express themselves or be happy. Instead, they more frequently expressed that they could live without a car. A stark contrast to the opinions presented by the group of members from larger households and parents,
- Respondents with higher personal income levels did not perceive cars as giving unlimited mobility possibilities. Instead, they regard it as a facilitator for meetings with friends and family and an object offering freedom and independence. They also pay attention to comfort, unlike parents and those living in larger households, who place a greater emphasis savings but are not willing to resign from their car.

Additionally, partial correlations were estimated to assess opinions and attitudes of Polish people. As shown in Appendix (see Table A1), the willingness to resign from using the car was limited. The results are as follows:

- Using PT is associated with a longer travel time compared to other means of transport. Using PT denies the usually indicated benefits of car like independence and freedom. PT users also do not want cars to be more durable and express more favourable feelings towards using the sharing economy solutions.
- Respondents who argue that cars should be more environmentally friendly indicated that, all of the above mentioned benefits of driving a car are true, but primarily view cars as a tool to achieve other goals. They are also willing to replace the car with sharing economy solutions. Similar opinions were observed among individuals who want cars to be more durable and efficient in the long-term.
- Car enthusiasts generally were optimistic towards all of the mentioned benefits, recognizing the significant benefits they gain from using a car

- Positive attitudes towards shared mobility were not influenced by the respondents travel time, nor their preferences of a car as the best mode of transport. However, within the entire surveyed group, it was visible that they are optimistic about the shared economy of carsharing. This implies that they are not willing to abandon car usage but can resign from owning a car.

In the case of big city residents who are car enthusiasts (see Table 7), they expressed approval for the concept of carsharing. The idea of carsharing services provided by PT operators was also positively favoured among them. These individuals indicated they would use such a solution. They also expressed that their willingness to give up driving their own cars in favour of shared cars provided by the PT operator. In addition, when discussing bike-sharing services, surprisingly, car enthusiasts living in big cities viewed them as a good idea to implemented in their city.

Table 6. Correlation coefficients – opinions about cars in the whole surveyed sample (bolded are significant)

Category/variable	Characteristic of respondent			
	Size of the place of living	No. of persons in the household	Children 0-15	Income level
The car gives unlimited travel possibilities	-0,0173	0,0551	0,0616	-0,0455
The car makes it easier to get together with family and friends than any other means of transport	-0,1410	0,0885	0,0588	0,0455
The car is just a means of transport for me, nothing more	-0,0094	-0,0611	-0,0620	0,0147
I prefer to travel by car than any other means of transport	-0,1321	0,1210	0,1002	0,0171
Thanks to the car, you can get to the desired place much faster than by other means of transport	-0,0993	0,0463	0,0247	0,0130
The car supports self-realization, the achievement of one's own goals	-0,1032	0,0883	0,0762	0,0153
The car facilitates the use of entertainment (cinema, theatre, pub)	-0,1523	0,1046	0,1028	0,0159
The car is associated with freedom and independence	-0,0688	0,0625	0,0430	0,0590
I would like to travel cheaply by car, even at the expense of comfort and quality	-0,1070	0,0976	0,0549	-0,0624
Owning a car contributes to a higher level of happiness	-0,1119	0,1452	0,1274	-0,0245
Your car reflects your standard of living and material status	-0,0138	0,1135	0,1234	-0,0276
I like the concept of carsharing or car rental	0,0177	0,0115	0,0401	0,0302
You can live without a car	0,1421	-0,0949	-0,0976	0,0248

Source: own preparation (n=3094)

Table 7. Correlations coefficients – willingness to use the car, car enthusiasm, willingness to use sharing economy among the big cities residents

Variable/opinion	Generation	Income	Household size	Children 0-15
The car gives unlimited travel possibilities	0,0021	-0,0071	0,0108	0,0186
The car makes it easier to get together with family and friends than any other means of transport	-0,0327	0,0641	0,0344	0,0206
The car is just a means of transport for me, nothing more	-0,1555	0,0564	-0,0743	-0,0881
I prefer to travel by car than any other means of transport	0,0443	-0,0048	0,1355	0,0849
Thanks to the car, you can get to the desired place much faster than by other means of transport	-0,0576	-0,0190	-0,0187	-0,0218
The car supports self-realization, the achievement of one's own goals	0,0373	0,0151	0,0430	0,0668
The car facilitates the use of entertainment (cinema, theatre, pub)	0,0193	0,0350	0,0522	0,0945
The car is associated with freedom and independence	0,0215	0,0388	0,0211	0,0366
I would like to travel cheaply by car, even at the expense of comfort and quality	0,0200	-0,0210	0,0679	0,0391
Owning a car contributes to a higher level of happiness	0,0952	-0,0329	0,1072	0,1246
Your car reflects your standard of living and material status	0,0576	-0,0486	0,1024	0,1506
I like the concept of carsharing or car rental	0,0443	0,0720	0,0212	0,0791
You can live without a car	-0,0867	-0,0243	-0,0775	-0,0701
If a public carrier offered a car by the hour as one of the means of transport, I would use such a solution	0,0762	-0,0253	0,0932	0,1384
I believe that the introduction of bicycles rented by the minute is a good idea	-0,0766	0,0744	-0,0631	-0,0416
If the public transport offer included a car rented for minutes, I would give up driving my own car	0,0182	-0,0200	0,0679	0,0955

Source: own preparation (n=911)

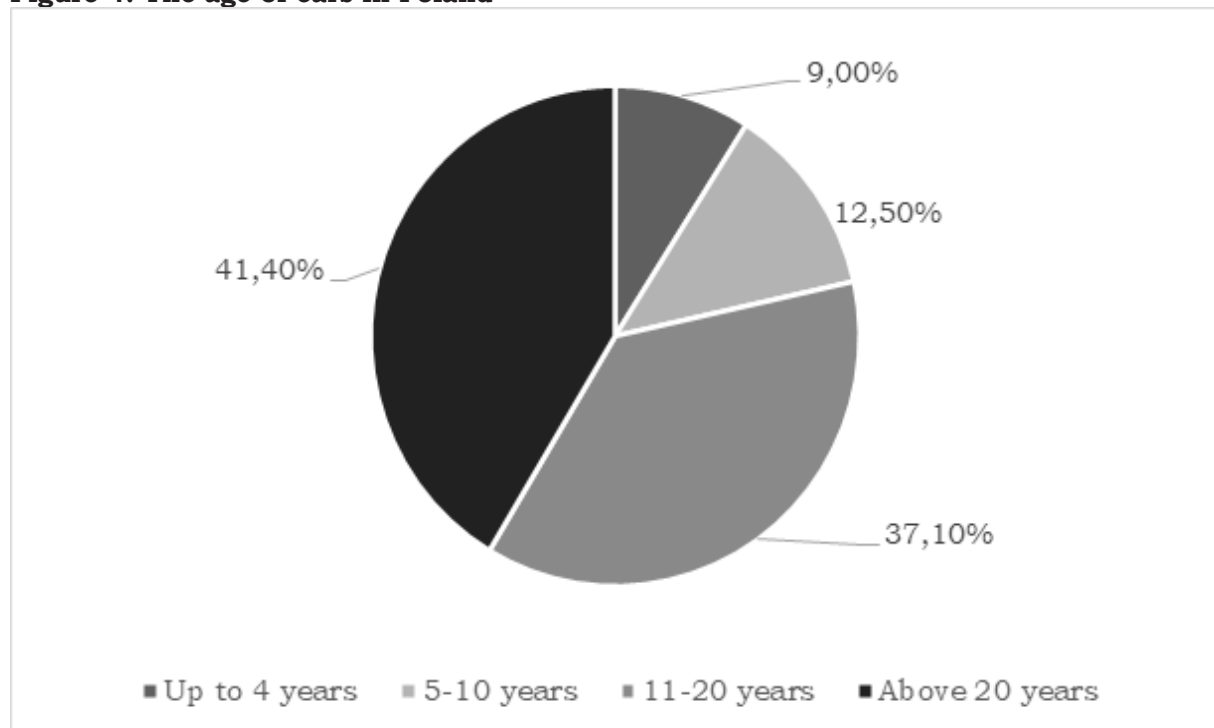
5. DISCUSSION AND CONCLUSION

The results we elaborated allowed to answer the research questions as presented below.

RQ1: Is there currently a peak car phenomenon observed in Poland, or will it occur in future?

In our assessment, taking into consideration the survey data, we are currently experiencing the peak of car usage. Residents of big cities are open to use alternative solutions but are not willing to resign from using cars as main mode of transport. Moreover, the statistical data confirms the level of car enthusiasm in Poland. The results of the statistics show how Poland is more car-oriented every year. In the CEE region, it has the highest number of cars per 1000 residents, a number that is growing yearly. Moreover almost half of the city's emissions are generated by traffic. Although, the mean age of cars in Poland decreases every year, it is over 20 years old. Even if we assume that at least 10% of those cars included are not used in practice, the car age in Poland is still relatively high, exceeding 10 years (see also Figure 4). With this in mind, the motorization ratios are still the highest in CEE region (see Figure 5). Considering the history of motorization in developed countries, this ratio will not grow as much in the future; instead, we are witnessing the highest focus on car mobility. However, we might expect changes in the car fleet's in the future, namely the average age of car size is expected to decline.

Figure 4. The age of cars in Poland



Source: Yearbook of Automotive Industry 2022/2023, page 28, Polish Automotive Industry Association, Warsaw 2023

Figure 5. CEE region – cars per 1000 inhabitants

Source: Eurostat.

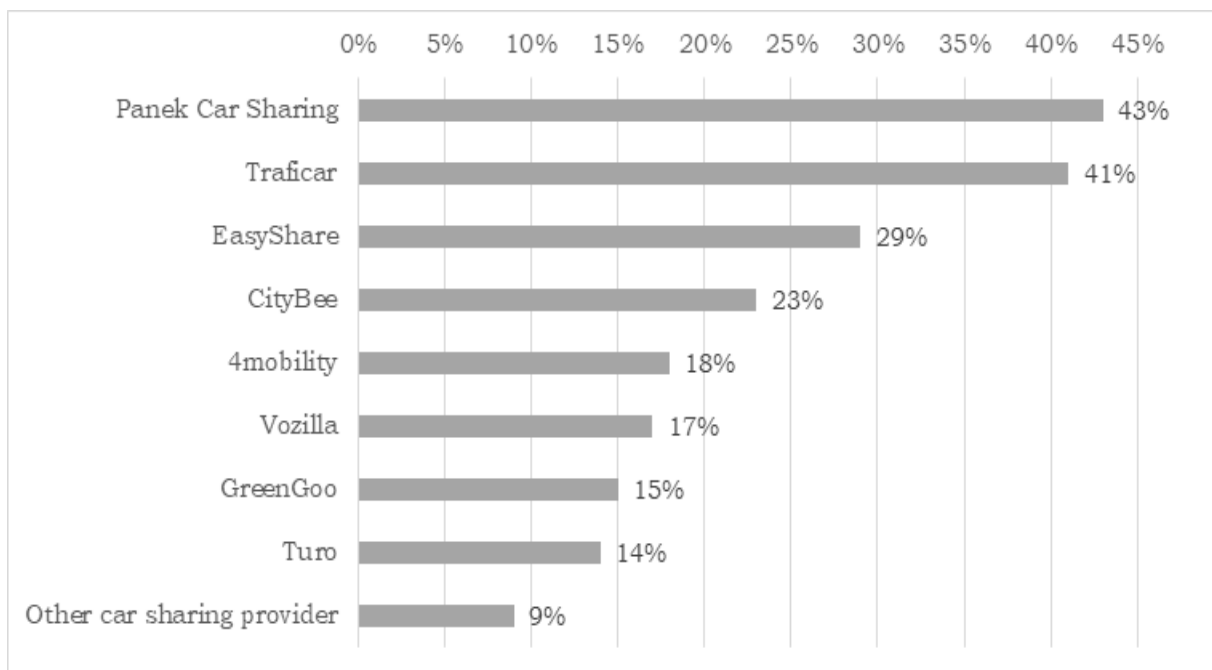
RQ2: Are Polish people ready to change their mobility choices from owned cars to sharing, especially in large cities?

Certainly, there is a strong car orientation among the Polish people. They recognize the benefits of using a car and are willing to change in favour of more sustainable usage of cars, in the form of carsharing. However, they are not willing to abandon the ownership of cars. For now, using the bike and other micromobility solutions, including the shared one, is strongly related to living in a big city where those solutions are available. However, car enthusiasm and orientation will still support the car culture in the following years, and the development of shared mobility will be slow.

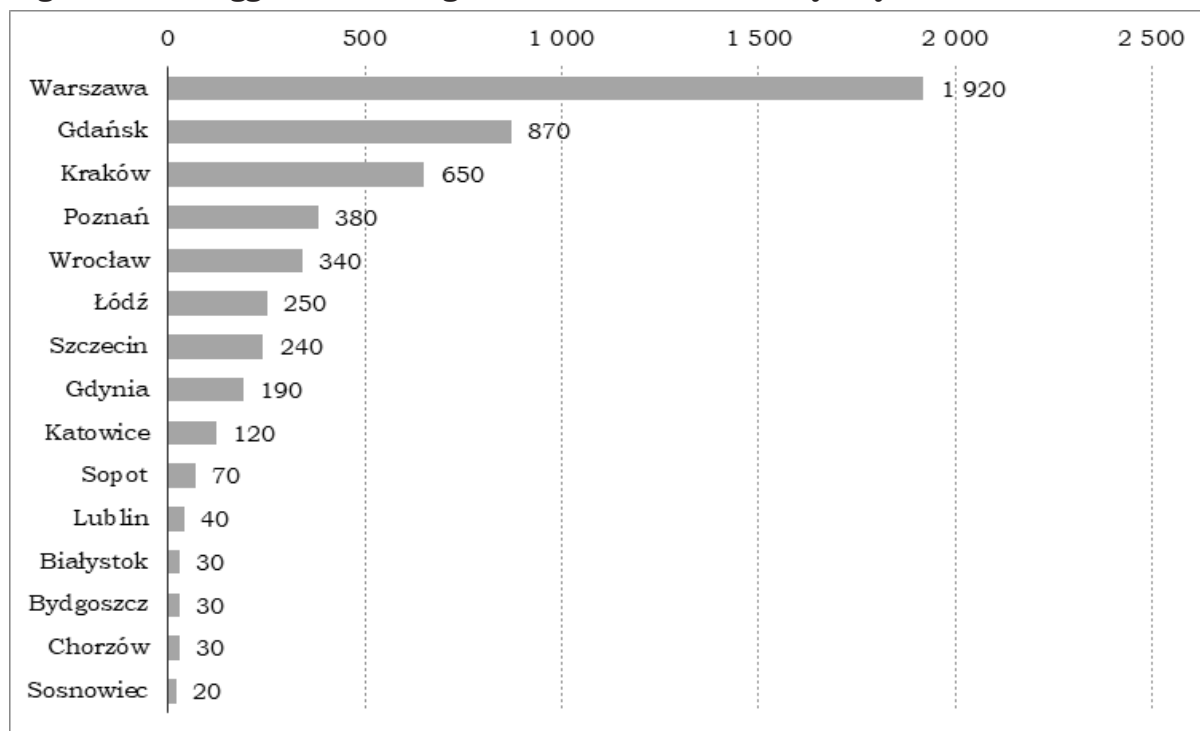
Poland's carsharing market is estimated at 1 million users and is still growing. Data presented in Figure 6 and Figure 7 illustrates the most prominent market players and cities with the highest number of shared cars. To further discuss the results and draw recommendations, we also compared the carsharing fleet size with the congestion levels (see Table 8). The results show that there is no correlation between the car fleet size, congestion level and population density (checked by the tau Kendall and rho Spearman test, the p-value was higher than 0,05). Consequently, the congestion level is not correlated with the city's population size, and the fleet size does not impact congestion levels, due to low mobility choices for the residents. Therefore, future research is needed to simulate these changes if e.g. 10% or 20% of car users will move to carsharing. Despite this pessimistic data regarding car usage and the car-centric approach in Polish society, in our opinion, the results of this study

how shared economy solutions and micromobility, provide hope for the changes in mobility choices and modal splits (see Figure 8). Although there is still a large interest in carsharing services, both non-commercial and commercial, the use of micromobility is still high, considering that not all mobility service providers operate in large cities. Nearly 10% of the surveyed group living in large cities declared they use shared micromobility (bearing in mind that bikes are the most popular transport mode among micromobility users in general, with most users owning a bicycle). Within this group, Lime services (kick-scooter sharing) which are available in the vast majority of Polish cities had the highest usage in the group of shared micromobility service providers.

Figure 6. The biggest carsharing providers in Poland in 2022



Source: Statista

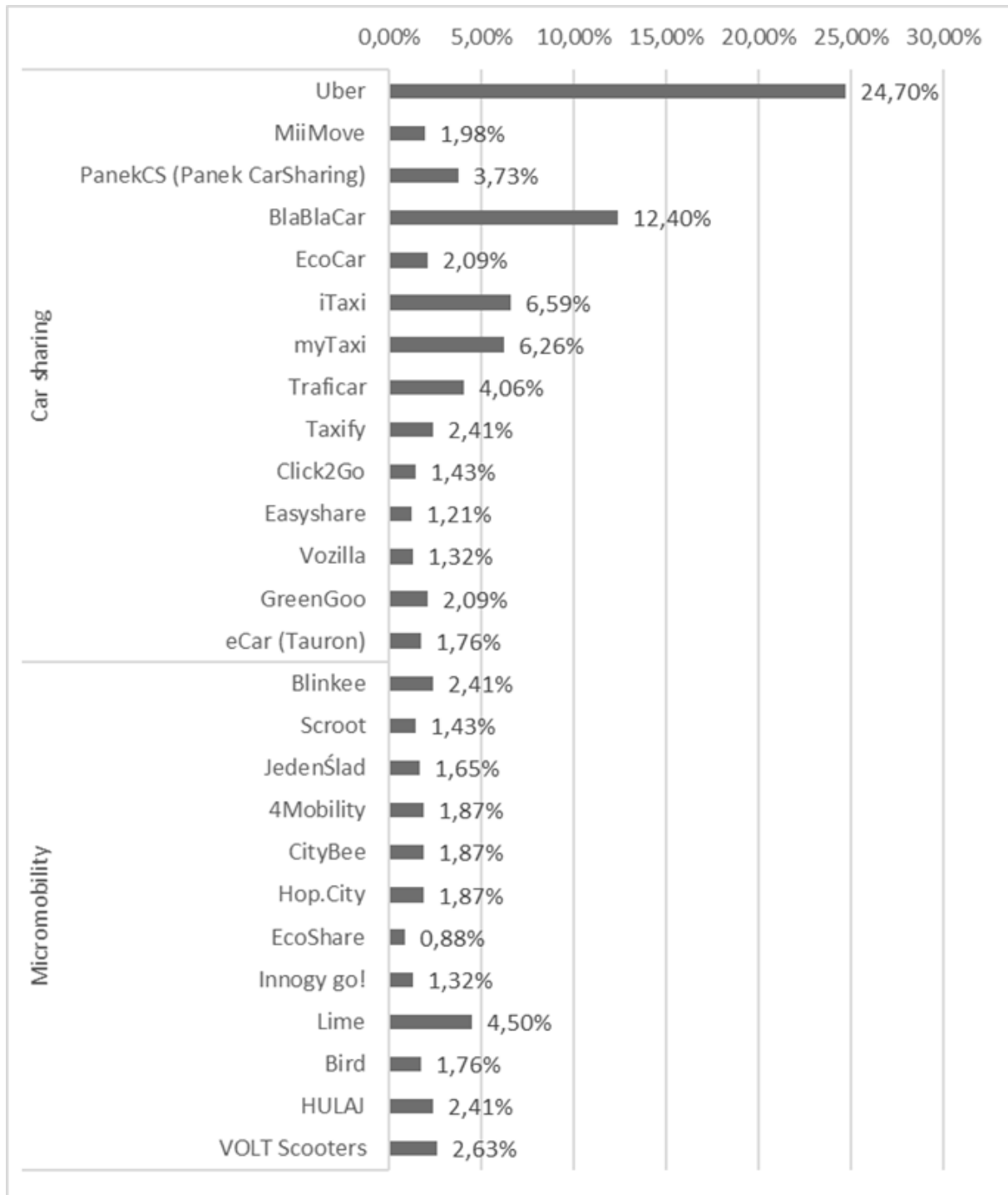
Figure 7. The biggest carsharing fleet in Poland in 2022 by city

Source: Statista

Table 8. Ranks of carsharing fleet size and the congestion level

City	Rank – car-sharing fleet size	Rank – congestion level	Rank-population density	Population density per 1 sq km
Warszawa	1	5	1	3597
Gdańsk, Gdynia, Sopot	2	9	9	1855 (Gdańsk)
Kraków	3	3	3	2450
Poznań	4	7	7	2088
Wrocław	5	1	4	2298
Łódź	6	2	5	2287
Szczecin	7	4	11	1318
Katowice	8	11	10	1717
Lublin	9	8	6	2270
Bydgoszcz	10	6	8	1919
Białystok	10	10	2	2881

Source: own elaboration based on TomTom Traffic Index and Statista.

Figure 8. Use of carsharing and micromobility in the group of respondents living in big cities in Poland

Source: own elaboration (n=911).

To conclude, our research has revealed that Polish people are car enthusiasts unwilling to abandon their vehicles, in large cities, small and medium-sized and in the countryside. In large cities, residents are more willing to use carsharing services, both among car users and PT users. However, their enthusiasm towards cars re-

mains high, and car culture remains prevalent among Polish society. The oldest and youngest residents present more eco-friendly mobility choices and attitudes. Nevertheless, their choices are dependent on the life stages, with parents being more car-oriented than people without children. The cohort of people aged 23-42 years old (generation Y) are the most enthusiastic about cars, many of whom are also parents. In general, the peak car phenomenon will be observed in Poland will likely persist for a few more years. However the Polish population is willing to transition their mobility choices towards more sustainable mobility options while still keeping ramming enthusiastic about cars.

Despite the valuable insights gained through this study, there are still some limitations. Firstly, the primary focus was on on carsharing services, not bike sharing. As such the study does not investigate people's willingness to use bike sharing and micromobility to transition away from car ownership. This should be the focus of future research investigations. Secondly, we did not examine the reasons for using cars other than those set forth by the limitations and obstacles put forth by PT operators. Lastly, we did not analyze the data with correlation to transport exclusion. Despite the limitations, we hope this study provides insightful information about Polish people, their mobility choices and preferences and start the discussion about providing viable alternatives to private car ownership in urban areas. Addressing the problem of high car enthusiasm is a high priority, not only in terms of choosing the preferred mode of transport but also in terms of convenience, that allows people to complete their daily activities. People need attractive alternative choices to cars in cities (e.g. micro cars or carsharing), in order to help them be more eco-friendly while still meeting mobility needs and preferences. Local authorities need to tackle congestion problems not only by restricting access to the city center but by also proposing alternatives away from private car usage.

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APPENDIX

Table. A1. Partial correlations between the respondents with particular opinions (opinions 3-17), travel time (1) and frequency of using PT (2)

No.	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Travel time	1,00	0,09	-0,01	-0,03	-0,01	-0,07	-0,02	-0,07	-0,03	-0,04	-0,02	-0,05	-0,02	0,00	0,01	-0,02	-0,02
2	Frequency of using public transport		1,00	-0,02	-0,13	-0,03	-0,19	-0,04	-0,36	-0,20	-0,15	-0,15	-0,17	-0,12	-0,15	-0,01	0,08	0,19
3	In my opinion, cars should be environmentally friendly (e.g. powered by fuels from renewable raw materials)			1,00	0,28	0,18	0,22	0,22	0,11	0,24	0,23	0,19	0,21	0,19	0,11	0,09	0,23	0,12
4	Cars should be more durable than they are now				1,00	0,24	0,47	0,22	0,38	0,47	0,43	0,32	0,46	0,33	0,33	0,13	0,12	0,03
5	The car gives unlimited travel possibilities					1,00	0,29	0,18	0,23	0,25	0,30	0,29	0,27	0,28	0,31	0,23	0,13	0,02
6	The car makes it easier to get together with family and friends than any other means of transport						1,00	0,13	0,54	0,56	0,57	0,54	0,60	0,35	0,48	0,25	0,08	-0,07
7	The car is just a means of transport for me, nothing more							1,00	0,07	0,15	0,06	0,08	0,09	0,21	-0,02	-0,03	0,11	0,14
8	I prefer to travel by car than any other means of transport								1,00	0,54	0,50	0,45	0,53	0,36	0,48	0,23	0,02	-0,19
9	Thanks to the car, you can get to the desired place much faster than by other means of transport									1,00	0,49	0,44	0,56	0,32	0,42	0,17	0,03	-0,07
10	The car supports self-realization, the achievement of one's own goals										1,00	0,50	0,65	0,37	0,58	0,32	0,14	-0,10
11	The car facilitates the use of entertainment (cinema, theater, pub)											1,00	0,49	0,33	0,47	0,26	0,13	-0,10
12	The car is associated with freedom and independence												1,00	0,37	0,56	0,28	0,11	-0,10
13	I would like to travel cheaply by car, even at the expense of comfort and quality													1,00	0,37	0,25	0,16	-0,05
14	Owning a car contributes to a higher level of happiness														1,00	0,44	0,13	-0,14
15	The car reflects the standard of living and material status															1,00	0,22	-0,02
16	I like the concept of carsharing or car rental by the minute/hour																1,00	0,16
17	I can live without a car																	1,00

Source: own elaboration (n=3094)

Table A2. Partial correlations between the attitudes and opinions of urban residents about the car and shared mobility

No.	Attitude/opinion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	The car gives unlimited travel possibilities	1,000	0,300	0,137	0,221	0,237	0,295	0,313	0,244	0,302	0,306	0,213	0,165	0,044	0,121	0,121	0,148
2	The car makes it easier to get together with family and friends than any other means of transport	1,000	1,000	0,101	0,541	0,556	0,553	0,550	0,614	0,368	0,518	0,302	0,073	-0,114	0,120	0,074	0,023
3	The car is just a means of transport for me, nothing more			1,000	0,027	0,126	0,007	0,058	0,051	0,162	-0,026	-0,038	0,131	0,169	0,024	0,133	0,069
4	I prefer to travel by car than any other means of transport				1,000	0,525	0,509	0,462	0,546	0,391	0,540	0,274	0,031	-0,232	0,158	-0,007	0,037
5	Thanks to the car, you can get to the destination much faster than by other means of transport					1,000	0,461	0,423	0,547	0,325	0,444	0,219	0,002	-0,076	0,026	0,077	-0,069
6	The car supports self-realization, the achievement of one's own goals						1,000	0,468	0,649	0,443	0,608	0,394	0,119	-0,202	0,164	0,080	0,086
7	The car facilitates the use of entertainment (cinema, theatre, pub)							1,000	0,459	0,359	0,496	0,357	0,087	-0,121	0,143	0,038	0,132
8	The car is associated with freedom and independence								1,000	0,401	0,581	0,380	0,092	-0,149	0,133	0,113	0,044
9	I would like to travel cheaply by car, even at the expense of comfort and quality									1,000	0,434	0,267	0,180	-0,100	0,220	0,075	0,189
10	Owning a car contributes to a higher level of happiness										1,000	0,476	0,157	-0,208	0,210	0,068	0,152
11	Your car reflects your standard of living and material status											1,000	0,212	-0,103	0,323	0,115	0,250
12	I like the concept of carsharing or car rental												1,000	0,119	0,587	0,404	0,531
13	You can live without a car													1,000	0,005	0,161	0,064
14	If a public carrier offered a shared car as one of the means of transport, I would use such a solution														1,000	0,245	0,702
15	I believe that the introduction of shared bicycles is a good idea															1,000	0,212
16	If the public transport offer included a shared car, I would give up driving my own car																1,000

Source: own elaboration (n=911)