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The Expectations towards Cars to Be Used in Car-Sharing Services—The Perspective of the Current Polish Non-Users

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Abstract: In the era of upcoming European Union regulations limiting the registration of combustion cars from 2035, the development of various types of alternatives to balancing transport is on the agenda of modern cities. One of these types of services includes automated short-term car rental systems, i.e., car-sharing systems. In recent years, car-sharing services have been gaining more and more interest among operators and municipal authorities. Despite their intense activities, there are still people in society who have not used car-sharing services so far. A lot of research has been devoted to an attempt to answer their needs in the field of car-sharing, but there is a research gap in the field of detailed analyses of the fleet of cars that they would like to use. Noticing this niche, this article is dedicated to the topic of selecting vehicles for car-sharing systems from the point of view of current non-users and indicating the features that, in their opinion, are the most important parameters characterizing the given vehicles. The research was conducted for the Polish car-sharing market. The obtained results indicate that current non-users would be most interested in small, city B-class cars equipped with internal combustion or electric engines, equipped with a large luggage compartment, and meeting the highest safety standards. Interestingly, the issue of the charging time for electric vehicles was not considered crucial. The results showed that the expectations of non-user vehicles are in contradiction to the expectations of current system users. The article supports car-sharing operators who want to properly manage and modernize their fleet of vehicles to encourage the use of car-sharing among those who are currently unconvinced.

Keywords: car-sharing; e-car-sharing; electric car-sharing; shared mobility; sustainable transport systems; transportation engineering; fleet management

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1. Introduction

The use of various types of solutions aimed at reducing the negative impact of transport on the environment is a standard that has become part of cities' and countries' behavior around the world. One of the solutions that both constitutes an environmentally-friendly form of travel and at the same time replaces the classic form of motorization with the use of cars is car-sharing systems. Car-sharing systems are mobility services that focus on the possibility of renting a car for a short time. The services operate as a form of car rentals that are available to users via a smartphone application or website. Car-sharing systems, however, have more facilities than classic car rental companies. Unlike rental companies, car-sharing systems offer [1]:

- round-the-clock availability and freedom of rental time;
- an automatic vehicle rental process without the need to contact the customer service office;
- often freedom of the place of return (depending on the type of system);
- additional benefits in cities, e.g., dedicated parking spaces or the possibility of driving the vehicle in certain lanes i.e., bus lines.

Car-sharing systems among other forms of shared mobility, e.g., bike-sharing or scooter-sharing, are considered the most popular and convenient alternative for users [2].

Numerous benefits related to car-sharing services, pointing for example to the "release" of urban space which is currently occupied by private cars [3], which ensures greater transport accessibility for the general public by eliminating the stigma that cars are only for the rich [4], help to contribute to the implementation of sustainable development assumptions through the use of electric vehicles in car-sharing [5–7] and they are translated into a growing interest in systems among city authorities and, as a result, the emergence of an increasing number of car-sharing service providers [8,9]. Statistics show that currently car-sharing services are offered by 236 operators, who provide users with 380,000 cars, in 59 countries and 3128 cities around the world [10]. It is estimated that in 2025 the fleet of vehicles offered in car-sharing will grow to 7.5 million units, and the car-sharing market will be worth more than 11 billion USD [11]. However, to be able to achieve improvements in the functioning car-sharing system, in addition to improving the networking among service providers or municipal authorities, there must be a desire among the public to use these vehicles. Referring to the literature from around the world, one can find many studies devoted to society's approach to and impact on car-sharing, their perception of the services offered, business models, and analyses of the desire to replace travel with their own vehicle with car-sharing services, optimization and consideration of the issue of car-sharing from the point of view of broadly understood sustainable development. For example, Hahn et al. showed that societies like the idea of car-sharing but are not fully interested in using it due to the lack of adaptation of services to their needs and lifestyle [12]. Caulfield and Kehoe pointed out that the main factor driving car-sharing is the cost of travel relative to their own car [13]. Nguyen pointed out that the lack of willingness to use the systems is associated with the fact that potential customers have incomplete knowledge about the functioning of the systems, especially the ideas of operation, insurance policy, and liability [14]. In turn, Jochem et al. pointed out that the main factor influencing the acceptance of car-sharing is the frequency of its use, specifying that the number of kilometers traveled by car through car-sharing increases [15]. So, how may it be possible to make the public more interested in using car-sharing systems? A lot of research work around the world has been devoted to this topic. They were connected, among others, with the search for appropriate social behavior [16], detailed analyses of the socio-economic factors that determine the choice of electromobility for future smart cities [17], indications of the influence of various exogenous socio-economic and demographic variables on the frequency of use of car-sharing services [18], developing various types of scenarios for using the systems [19], indicating the need for changes in business models of system operation [20], and searching for new business models to improve the functioning of services, including models based on the concept of open innovation [21]. In addition to this, they were connected with indicating policies for the proper functioning of services in urban conditions [22], developing various types of conceptual models for integrating a sustainable supply chain, electric vehicles and renewable energy sources also for car-sharing vehicles [23], determining the proper location of car-sharing vehicle charging stations from the point of view of operational issues [24] as well as from the point of view of the end user-oriented approach [25]. The studies try to indicate a broad approach to economic, social, or environmental issues, but there is a research gap in them regarding the car fleets used in car-sharing. This aspect is particularly important because the car used in car-sharing is the main factor for making a trip, but also an element on which the decision to make a trip and assess its quality or level of comfort while moving may depend. When comparing the importance of the car-sharing fleet to other forms of transport, it is worth pointing out, for example, the increased interest of passengers in the use of rail journeys equipped with specific types of trains [26–28] or improving the attractiveness of public transport thanks to the modernization of bus fleets [29].

Which fleet of cars should be used in car-sharing systems to meet the expectations of society? This subject was devoted to the author's research cycle, which has so far focused on more or less active users of car-sharing from people using the services rarely or often to regular users of the systems. Previous research, however, has looked at people who already

use car-sharing systems. Considering the year of 2035, which based on a European Union project, i.e., a "deal confirms zero-emissions target for new cars and vans in 2035" [30], is to carry with it a ban on the sale of cars with internal combustion engines, it is important to look for various types of solutions that will be able to become an alternative to mobility and complement the transport offer of cities. Based on this assumption, the work was devoted to the selection of fleets for car-sharing systems from the point of view of people who have not used the systems so far. The study aimed to check what factors defining the vehicles are considered the most important if they were to make a car-sharing trip. The article is intended to support car-sharing service operators in properly managing or modernizing the current fleet of vehicles.

The article Is divided into five chapters. The first one presents an introduction and a general outline of the concept of car-sharing, and the second chapter is devoted to the presentation of the research methodology. The third chapter presents the results of the research, which are discussed in the fourth chapter. The last chapter presents the summary, recommendations, research limitations, and further research plans.

2. Materials and Methods

2.1. Research Method Selection

Choosing cars for car-sharing services that will meet the expectations of people who have not yet been convinced to use the systems is a complex decision-making problem that requires consideration of many, often contradictory, factors. Due to the complexity of the issues, tools belonging to the multiple-criteria decision analysis (MCDA) group are commonly used to solve such problems, which allows analysis of the factors determining a given phenomenon, assessment of the decision options, and creation of a final classification of variants [31–33].

There are many methods of MCDA that are used to address transportation problems. Since different factors are considered when selecting vehicles, the factors characterizing individual vehicles are often contradictory to compare and evaluate them in pairs, and as a result, to obtain a ranked ranking of variants at work, a tool–ELECTRE III–was used. The ELECTRE III method owes its popularity to the fact that with its help it is possible to perform analyses along with the indication of the final classification of the analyzed variants [34].

The ELECTRE III method is commonly used when it is possible and desirable to quantify the relative importance of the factors. ELECTRE III is a type of method that uses a structured procedure to isolate the relationship between alternatives. The main advantage of this method is the direct participation of the decision-maker in the decision-making process. ELECTRE III allows the decision maker to analyze both qualitative and quantitative criteria at different levels of ambiguity. Therefore, the method finds its application in solving real social problems, with it being referred to as the "method of integration" [35].

2.2. Characteristics of the Case Study Research Area—The Polish Car-Sharing Market

The research was carried out for a case study of the Polish car-sharing services market. The Polish market of car-sharing services is considered one of the most dynamically developing European markets from the point of view of shared mobility [36,37]. Even though unlike the Western market, car-sharing services only began to appear in in Poland 2016, they gained a lot of approval among operators. Interest was aroused to such an extent that at a key moment of development, 17 operators were available on the market, who provided their services in over 250 Polish cities [37]. This development is also visible from the point of view of economic statistics; in 2019, car-sharing services reached annual revenues of 50 million PLN, and in 2021, this figure was 100 million PLN [37]. Unfortunately, the good market streak of services did not last long because many systems were closed or suspended. In the literature, it can be found that this was related to the mismatch of services to the needs and expectations of customers [4,38,39]. Currently, in 2022, out of 17 operators,

there are 5 systems on the market offering services based on passenger cars [40]. Therefore, the implementation of all kinds of research aimed at improving the current car-sharing situation in Poland is advisable.

2.3. Research Process and Calculation Procedure

To obtain an answer as to what types of vehicles should be used in car-sharing vehicle fleets from the point of view of people currently not using the systems, a four-stage algorithm based on the next steps in the ELECTRE III method was proposed, which is presented in Figure 1.

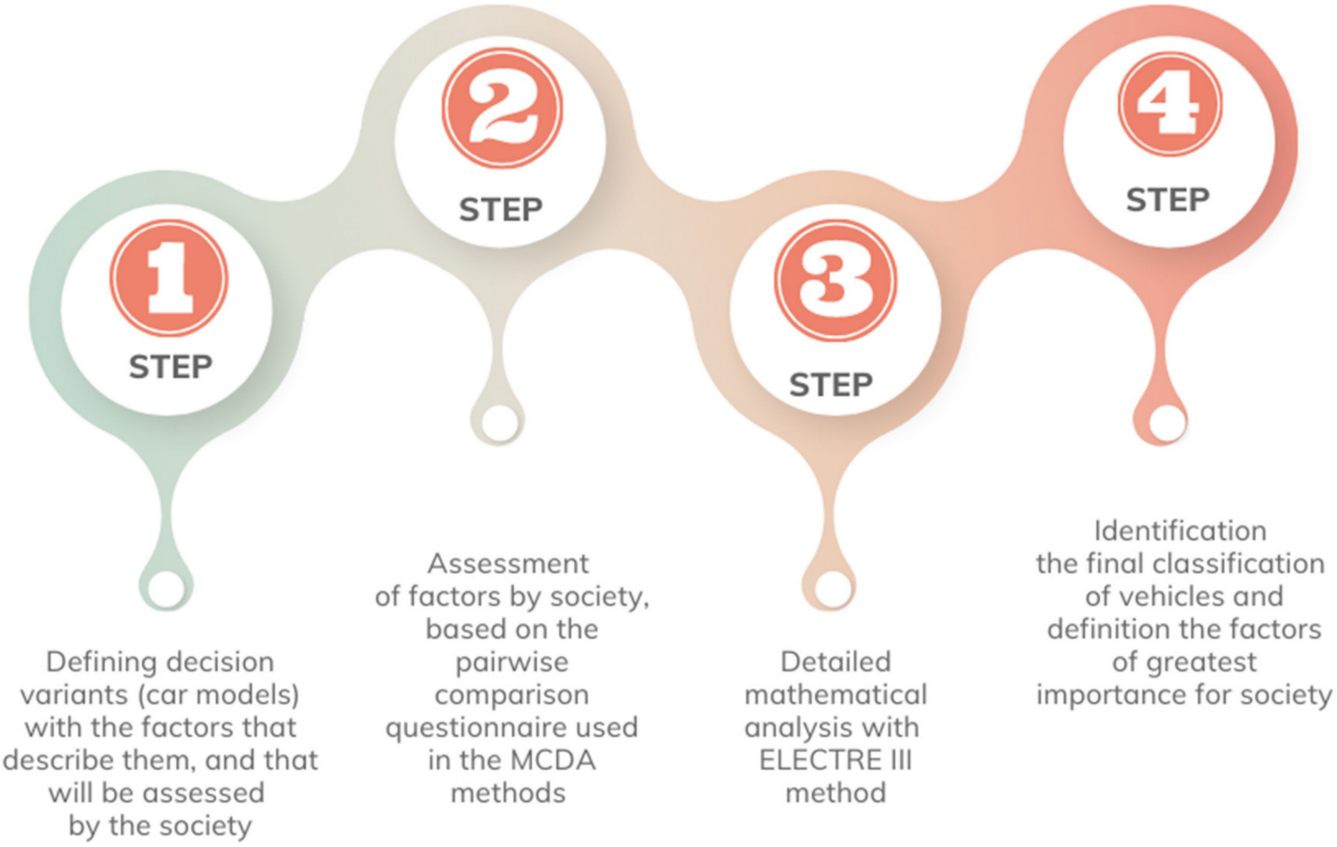

Figure 1. Research process.

In the first step, decision variants were defined, i.e., car models which were analyzed in terms of the possibility of using them in fleets of car-sharing systems by people who have not yet used the systems. For the analysis of vehicles that can be included in the implementation of car-sharing systems, 10 different car models representing different car brands, vehicle sizes, price ranges, and engine types were selected. The models that were the most popular and at the same time the most ecological solutions were considered. Both internal combustion engine vehicles as well as electric and hybrid cars are included. When selecting vehicles, the latest automotive reports indicating the "best-selling cars in Europe in 2022" [41] and the "best low-emission green cars 2022" [42] were used to choose the newest, most popular, and most ecological cars. The models considered together with the indicated engine type are presented in Table 1.

Table 1. Considered decision variants.

Variant No.	Vehicle Classification by Propulsion System
Var_1	ICEV
Var_2	ICEV
Var_3	HEV
Var_4	EV
Var_5	HEV
Var_6	ICEV
Var_7	ICEV
Var_8	EV
Var_9	EV
Var_10	EV

ICEV–internal combustion engine vehicle; EV–electric vehicle; EV–electric vehicle; HEV–hybrid electric vehicle.

Subsequently, the factors were indicated from the point of view of respondents, of which it is worth noting that in order not to suggest specific vehicle models to respondents, indicating their names or performance, the respondents made comparisons in pairs of only individual factors since each vehicle is characterized by individual technical data referring, for example, to its dimensions, performance, etc. Therefore, the factors that were used in the analysis to assess the importance of each of them for society were subsequently identified. Twelve factors presented and characterized in Table 2 are indicated. The factors were partly selected based on the literature [43–45], supplemented by arbitrary indications of the author. The values of individual factors are presented in the results section.

Table 2. Factors characterizing decision variants.

Factor No.	Factors Describing Vehicle Models	Characteristics of Factors
Fact_1	Vehicle length [mm]	Distance from the front to the rear of the vehicle in millimeters.
Fact_2	Width with side mirrors [mm]	Distance from the front to the right to the left side mirror in millimeters.
Fact_3	Number of doors in the vehicle [-]	Number of doors the car has.
Fact_4	Luggage compartment capacity (seats up) [L]	The size of the luggage space expressed in the number of liters it can accommodate, considering the folded-up seats.
Fact_5	Engine power [kW]	Engine power is the amount of work an engine can carry out in a given time.
Fact_6	Time of battery charging/time of refueling [min]	The amount of time required to fully charge an electric car battery or to refuel an internal combustion engine car's fuel tank.
Fact_7	Rental fee [€]	The cost of 1 min of travel and 1 km of travel, including a minute stop-over fee.
Fact_8	Euro NCAP rating [-]	Five-star safety rating system to help consumers identify the safest choice for their needs. The safety rating is determined from a series of vehicle tests, and it is designed and carried out by the Euro NCAP organization.
Fact_9	Adult occupant protection rate [%]	The Adult occupant protection score is determined from frontal impact, lateral impact, and whiplash tests, which are completed to evaluate the protection offered by the vehicle to the adult driver and passengers, and from an assessment of the measures provided for prompt and safe rescue and extrication.
Fact_10	Child occupant protection rate [%]	The assessment of child occupant protection covers three aspects: the protection offered by the child restraint systems in the frontal and side-impact tests; the vehicle's ability to accommodate child restraints of various sizes and designs; and the availability of provisions for the safe transport of the children in the car.
Fact_11	Vulnerable road user (VRU) protection rate [%]	The assessment of the vulnerable road user protection rate covers the protection of pedestrians and riders. It contains vehicle tests related to the potential risks of injuries to a pedestrian's head, pelvis, and upper and lower leg.
Fact_12	Safety assist rate [%]	The safety assist score is determined from tests to the most important driver assist technologies that support safe driving to avoid and mitigate accidents. Euro NCAP tests system functionality and/or performance during normal driving and in typical accidents.

The second step was related to determining the importance of the individual factors describing vehicles (decision variants) for people who have not yet used car-sharing services. For this purpose, a research survey was carried out. It is worth mentioning that this was not a typical social survey, however, but rather a questionnaire of comparisons in pairs, where the public assessed each of the pairs of factors characterizing the vehicles. For each pair of factors, respondents were assigned a rating accordingly. Ratings were valued from 1 to 9 according to the scale used in the multi-criteria decision support methods, i.e., Saaty's scale [46]. The characteristics of the ratings according to Saaty's scale were as follows:

- "1"–In the analyzed pair, both factors considered are of equal importance to the respondent;
- "2"–In the analyzed pair there is a very weak advantage of one factor over another;
- "3"–In the analyzed pair there is a weak advantage of one factor over another;
- "4"–In the analyzed pair there is a more than weak advantage of one factor over another, but it not strong enough to be referred to as a strong advantage;
- "5"–In the analyzed pair there is a strong advantage of one factor over another;
- "6"–In the analyzed pair there is more than a strong advantage of one factor over another, but a very strong advantage nonetheless;
- "7"–In the analyzed pair, there is a very strong advantage of one factor over another;
- "8"–In the analyzed pair, there is a very strong advantage of one factor over another, but it is not strong enough to be referred to as an extremely large advantage;
- "9"–In the analyzed pair there is a total, extreme advantage of one factor over another.

The third stage of the procedure is related to the performance of detailed analyses using the ELECTRE III method, and it is based on the next steps of the procedure when using the method. In the first step, based on the obtained assessments, the difference between the maximum and minimum value of a given factor was determined, which is determined by the Formula (1):

$$\Delta = v_{max} - v_{min} \quad (1)$$

where:

Δ–difference between factor values,
v_{max}–maximum value of given factor,
v_{min}–minimum value of given factor.

This value was determined for each of the factors. In turn, for each of the factors, three main parameters were defined to indicate the relationship between the analyzed variants, i.e., equivalence threshold, preference threshold, and veto threshold, which are directly related to the difference in the assessment of two variants concerning a given factor. Thresholds were determined from the Formulae (2)–(4), respectively:

$$Q = 0.25 \times \Delta \quad (2)$$

where:

Q–equivalence threshold. If the difference in ratings does not exceed this threshold, the options shall be considered equivalent.

$$p = 0.5 \times \Delta \quad (3)$$

where:

p–preference threshold. This means the minimum difference in the assessment of the two options. The preference threshold is not less than the value of the equivalence threshold, its value indicates the boundary between strong and weak preference. If the difference in ratings is between p and Q, then there is talk of a weak preference. On the other hand, if the difference is greater than p, it is said that there is a strong preference for one variant over another.

$$V = \Delta \quad (4)$$

where:

V–veto threshold. It specifies the maximum difference in the evaluations of the variants. It allows determination of the amount by which the values of the criteria may differ between the compared variants.

Sequentially an altitude difference matrix is created. To obtain a complete ranking of alternatives, the normal ELECTRE III ranking method uses a structured algorithm using two intermediate ranking procedures: one is descending, where the alternatives are classified from best to worst (descend distillation), while the other is in ascending order from the worst to best alternative (ascend distillation). Ascend distillation is a planning process that begins with selecting the best variant and placing it at the top of the ranking. The best variant is selected one by one from the remaining variants and placed in the next position in the classification. This procedure is repeated until all possible variants have been analyzed. Descend distillation is a planning process that starts with selecting the worst variant and placing it at the end of the ranking. Subsequently, similarly to ascending distillation, further analyses should be performed, bearing in mind that in the subsequent iterations of the variants to be considered, the worst variant is always selected and placed in the next positions from the end of the ranking [47,48].

In the fourth stage, the final ranking of variants from best to worst was determined. The results are presented in the next chapter.

3. Results

In accordance with the developed methodology, for each of the ten variants considered, a list of the values of individual factors was prepared, which is presented in Table 3.

Table 3. A detailed set of criteria characterizing individual variants of car models.

Var No.	Fact_1	Fact_2	Fact_3	Fact_4	Fact_5	Fact_6	Fact_7	Fact_8	Fact_9	Fact_10	Fact_11	Fact_12
	[mm]	[m]	[-]	[l]	[kW]	[min]	[€]	[-]	[%]	[%]	[%]	[%]
Var_1	4236	2012	5	445	110	2	0.44	5	96	87	79	71
Var_2	4088	1848	5	328	90	2	0.44	2	70	72	41	42
Var_3	3945	1745	3	286	106	2	0.44	5	86	81	78	85
Var_4	3632	1900	3	185	95	240	0.41	4	75	80	67	67
Var_5	4074	1832	3	245	110	2	0.44	5	94	80	70	70
Var_6	3670	1680	5	252	100	2	0.41	3	69	75	52	59
Var_7	4048	1941	5	292	125	2	0.44	5	87	84	64	60
Var_8	4084	1787	5	338	109	555	0.44	5	89	80	66	85
Var_9	3845	1727	5	211	183.6	350	0.44	5	79	73	66	56
Var_10	4261	1809	5	370	150	450	0.44	5	87	89	71	88

The data come from information on the technical parameters of individual vehicle models published by car concerns and the NCAP ranking.

The next step was to determine the validity of the individual factors during the selection of vehicles. For this purpose, research was carried out with the participation of respondents. The research was carried out anonymously, via the Internet, for the Polish market in June 2022. The study included people who had not yet used car-sharing systems. The study involved 2345 people, of whom 53% were men and 47% were women. The respondents represented a population of 38,179,800 Polish residents. For the study sample, the confidence level was 95% ($\alpha = 0.95$). The fraction size was 0.5 and the maximum error was estimated at 2%. The respondents compared each work of factors characterizing the vehicles, giving them a value of 1–9 according to the Saaty's scale. The comparison questionnaire in pairs is shown in Figure 2.

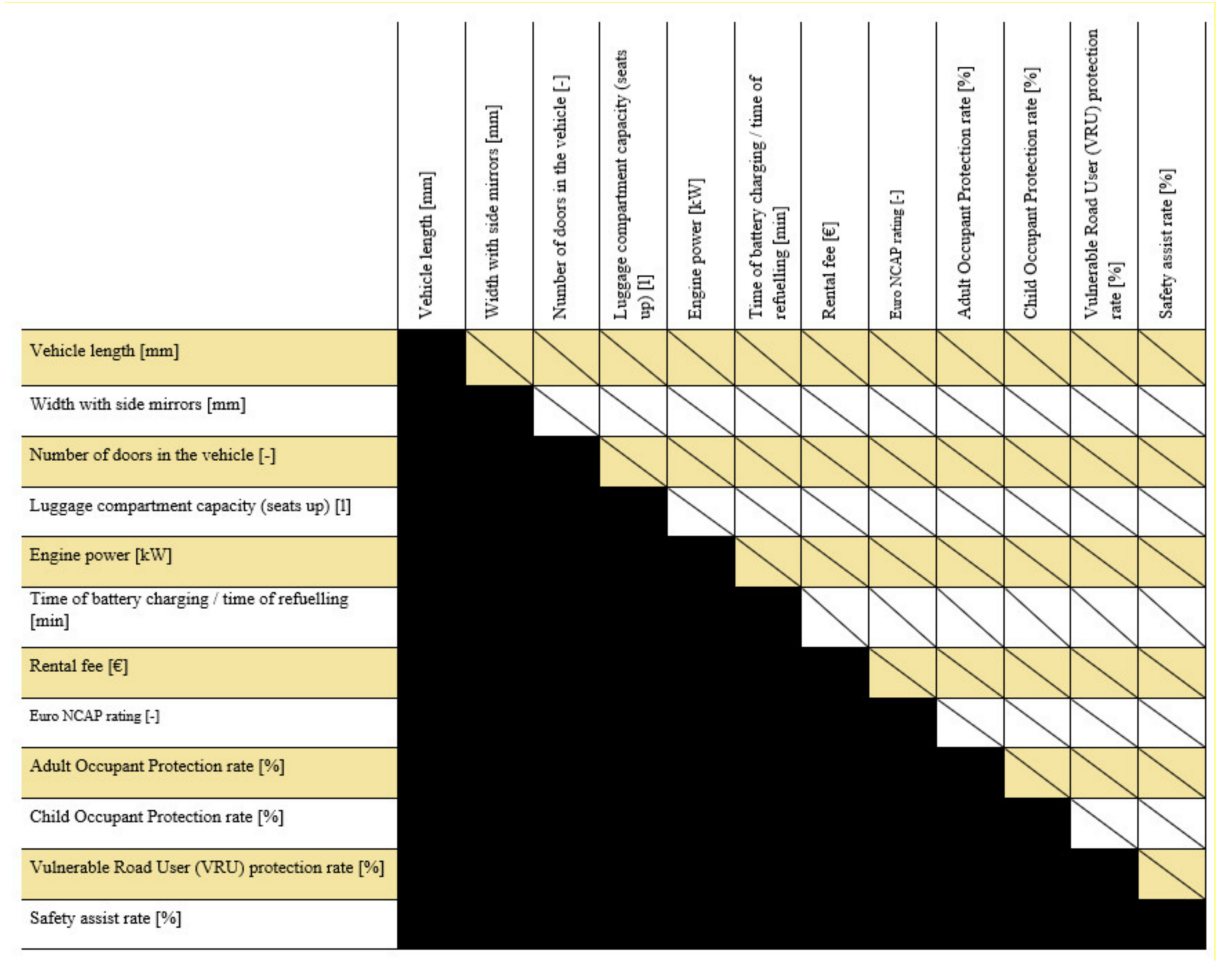

Figure 2. Pairwise factor comparison questionnaire.

It is important to emphasize that the respondents assessed the individual criteria without knowing the actual technical characteristics of the vehicles. This type of procedure allowed reliable answers to be obtained without suggesting the specific make or model of the vehicle. Due to the differences in the importance of the individual criteria in the eyes of the surveyed women and men, further detailed results are presented in the following Sections 3.1 and 3.2.

3.1. Results—Analyses from the Point of View of the Surveyed Men

The averaged weights of the individual criteria obtained from the men studied are presented in Table 4.

Table 4. Average factors values from the point of view of the surveyed men.

	Fact_1	**Fact_2**	**Fact_3**	**Fact_4**	**Fact_5**	**Fact_6**	**Fact_7**	**Fact_8**	**Fact_9**	**Fact_10**	**Fact_11**	**Fact_12**
Average factors values	0.04	0.03	0.03	0.14	0.18	0.10	0.15	0.06	0.07	0.07	0.05	0.08

The next step following the ELECTRE III methodology was to determine the parameters characterizing the relationships between the studied factors, i.e., the maximum difference of criteria values, equivalence threshold, preference threshold, and veto threshold. Detailed data are presented in Table 5.

Table 5. The set of equivalence, preference, and veto thresholds from the point of view of the surveyed men.

	Fact_1	Fact_2	Fact_3	Fact_4	Fact_5	Fact_6	Fact_7	Fact_8	Fact_9	Fact_10	Fact_11	Fact_12
Maximum Difference of Factors Values	629.00	332.00	2.00	260.00	93.60	553.00	0.03	3.00	27.00	17.00	38.00	46.00
Equivalence Threshold	157.25	83.00	0.50	65.00	23.40	138.50	0.01	0.75	6.75	4.25	9.50	11.50
Preference Threshold	314.50	166.00	1.00	130.00	46.80	276.50	0.02	1.50	13.50	8.50	19.00	23.00
Veto Threshold	629.00	332.00	2.00	260.00	93.60	553.00	0.03	3.00	27.00	17.00	38.00	46.00

The next step according to the ELECTRE III methodology was to create the concordance matrix. The matrix is presented in the form of Table 6.

Table 6. Concordance matrix values from the point of view of the surveyed men.

Variants	Var_1	Var_2	Var_3	Var_4	Var_5	Var_6	Var_7	Var_8	Var_9	Var_10
Var_1	0.00	1.00	0.98	0.93	1.00	1.00	1.00	0.88	0.72	0.73
Var_2	0.53	0.00	0.67	0.68	0.68	0.93	0.61	0.58	0.57	0.39
Var_3	0.70	0.96	0.00	0.90	0.99	0.97	0.94	0.87	0.69	0.57
Var_4	0.48	0.64	0.62	0.00	0.72	0.97	0.56	0.40	0.61	0.20
Var_5	0.75	0.93	0.98	0.93	0.00	0.97	0.96	0.79	0.69	0.49
Var_6	0.39	0.76	0.53	0.84	0.60	0.00	0.55	0.41	0.45	0.07
Var_7	0.80	1.00	0.90	0.93	1.00	1.00	0.00	0.82	0.72	0.75
Var_8	0.81	1.00	0.99	0.99	1.00	1.00	0.97	0.00	0.82	0.79
Var_9	0.61	0.85	0.82	0.92	0.84	1.00	0.84	0.64	0.00	0.66
Var_10	0.93	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.92	0.00

The next stage in the ELECTRE III method was to perform the ascend and descend distillation against each of the variants and to create a dominance matrix in the final step. The dominance matrix is presented in Table 7.

Table 7. Dominance matrix values from the point of view of the surveyed men.

Variants	Var_1	Var_2	Var_3	Var_4	Var_5	Var_6	Var_7	Var_8	Var_9	Var_10
Var_1	0	P+	P+	P+	P+	P+	P+	P−	P+	P−
Var_2	P−	0	P−	P+	P−	P+	P−	P−	P−	P−
Var_3	P−	P+	0	P+	I	P+	P−	P−	P−	P−
Var_4	P−	P−	P−	0	P−	P−	P−	P−	P−	P−
Var_5	P−	P+	I	P+	0	P+	P−	P−	P−	P−
Var_6	P−	P−	P−	P+	P−	0	P−	P−	P−	P−
Var_7	P−	P+	P+	P+	P+	P+	0	P−	R	P−
Var_8	P+	P+	P+	P+	P+	P+	P+	0	P+	P−
Var_9	P−	P+	P+	P+	P+	P+	R	P−	0	P−
Var_10	P+	P+	P+	P+	P+	P+	P+	P+	P+	0

where: (I)—a pair of variants is equivalent; (P+)—the first variant is better than the second variant; (P−)—the first variant is worse than the second variant; R—variants are incomparable.

The last step was to prepare the final ranking by presenting the ranking of variants in terms of the preferences of experts and the adopted factors. The final ranking is presented in Table 8.

Table 8. Final ranking from the point of view of the surveyed men.

Dominance Matrix	Ascend Distillation	Descend Distillation	Average
Var_1	3.0	3.0	3.0
Var_2	7.0	6.0	6.5
Var_3	6.0	6.0	6.0
Var_4	9.0	8.0	8.5
Var_5	6.0	6.0	6.0
Var_6	8.0	7.0	7.5
Var_7	5.0	4.0	4.5
Var_8	2.0	2.0	2.0
Var_9	4.0	5.0	4.5
Var_10	1.0	1.0	1.0

The graphical arrangement of the variants is shown in Figure 3.

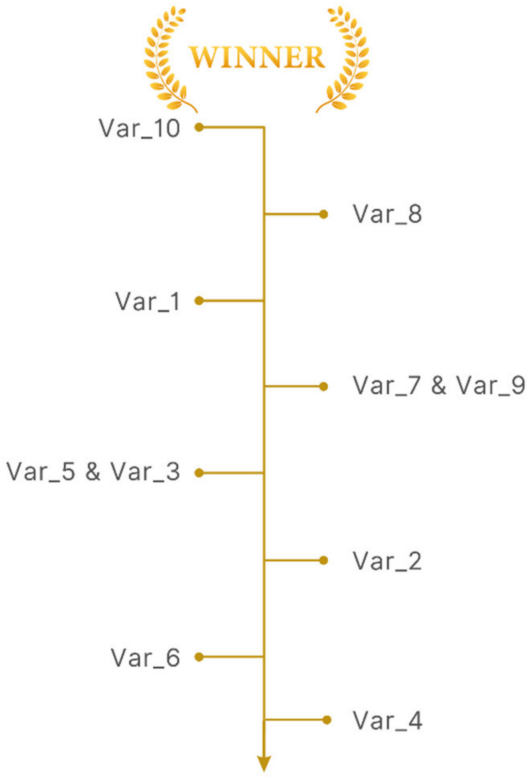

Figure 3. The final ranking of vehicle models from the point of view of the surveyed men.

3.2. Results—Analyses from the Point of View of the Surveyed Women

Analogous to the presented results of the analysis performed from the point of view of men, the results obtained from the point of view of women were presented. The average weights of the individual criteria obtained from the women studied are presented in Table 9.

Table 9. Average factors values from the point of view of the surveyed women.

	Fact_1	Fact_2	Fact_3	Fact_4	Fact_5	Fact_6	Fact_7	Fact_8	Fact_9	Fact_10	Fact_11	Fact_12
Average factors values	0.04	0.03	0.03	0.11	0.04	0.05	0.04	0.16	0.14	0.14	0.14	0.08

The values of the individual thresholds were determined in turn, and they are presented in Table 10.

Table 10. The set of equivalence, preference, and veto thresholds from the point of view of the surveyed women.

	Fact_1	Fact_2	Fact_3	Fact_4	Fact_5	Fact_6	Fact_7	Fact_8	Fact_9	Fact_10	Fact_11	Fact_12
Maximum Difference of Criteria Values	629.00	332.00	2.00	260.00	93.6	553.00	0.03	3.00	27.00	17.00	38.00	46.00
Equivalence Threshold	157.25	83.00	0.50	65.00	23.40	138.25	0.08	0.75	27,546.00	45,748.00	44,690.00	44,692.00
Preference Threshold	314.5	166.00	1.00	130.00	46.80	276.5	0.02	44,682.00	44,694.00	44,689.00	19.00	23.00
Veto Threshold	629.00	332.00	2.00	260.00	93.60	553.00	0.03	3.00	27.00	17.00	38.00	46.00

Then, the concordance matrix was created. The matrix is presented in the form of Table 11.

Table 11. Concordance matrix values from the point of view of the surveyed women.

Variants	Var_1	Var_2	Var_3	Var_4	Var_5	Var_6	Var_7	Var_8	Var_9	Var_10
Var_1	0.00	1.0	0.98	0.96	1.00	1.00	1.00	0.93	0.91	0.92
Var_2	0.23	0.00	0.34	0.46	0.36	0.89	0.35	0.31	0.55	0.33
Var_3	0.68	0.96	0.00	0.94	0.97	0.97	0.94	0.92	0.88	0.69
Var_4	0.45	0.78	0.65	0.00	0.73	0.96	0.65	0.49	0.82	0.41
Var_5	0.74	0.94	0.98	0.96	0.00	0.97	0.96	0.85	0.88	0.64
Var_6	0.20	0.87	0.35	0.77	0.45	0.00	0.41	0.35	0.57	0.28
Var_7	0.75	1.0	0.85	0.96	0.99	1.00	0.00	0.87	0.91	0.89
Var_8	0.75	1.0	0.96	0.99	1.00	1.00	0.97	0.00	0.96	0.82
Var_9	0.46	0.88	0.74	0.88	0.73	1.00	0.77	0.61	0.00	0.68
Var_10	0.70	1.0	0.81	0.92	0.91	0.98	0.96	0.92	0.98	0.00

The next step of the dominance matrix was created and it is presented in the Table 12.

Table 12. Dominance matrix values from the point of view of the surveyed women.

Variants	Var_1	Var_2	Var_3	Var_4	Var_5	Var_6	Var_7	Var_8	Var_9	Var_10
Var_1	0	P+	P+	P+	P+	P+	P+	R	P+	P+
Var_2	P−	0	P−	P+	P−	P+	P−	P−	P−	P−
Var_3	P−	P+	0	P+	P+	P+	P−	P−	P−	P−
Var_4	P−	P−	P−	0	P−	P−	P−	P−	P−	P−
Var_5	P−	P+	P−	P+	0	P+	P−	P−	P−	P−
Var_6	P−	P−	P−	P+	P−	0	P−	P−	P−	P−
Var_7	P−	P+	P+	P+	P+	P+	0	P−	P+	P−
Var_8	R	P+	P+	P+	P+	P+	P+	0	P+	P+
Var_9	P−	P+	P+	P+	P+	P+	P−	P−	0	P−
Var_10	P−	P+	P+	P+	P+	P+	P+	P−	P+	0

where: (I)—a pair of variants is equivalent; (P+)—the first variant is better than the second variant; (P−)—the first variant is worse than the second variant; R—variants are incomparable.

The last step was to prepare the final ranking of the analyzed variants. The final ranking is presented in Table 13.

Table 13. Final ranking from the point of view of the surveyed women.

Dominance Matrix	Ascend Distillation	Descend Distillation	Average
Var_1	2.0	1.0	1.5
Var_2	8.0	5.0	6.5
Var_3	6.0	5.0	5.5
Var_4	10.0	7.0	8.5
Var_5	7.0	5.0	6.0
Var_6	9.0	6.0	7.5
Var_7	4.0	3.0	3.5
Var_8	1.0	2.0	1.5
Var_9	5.0	4.0	4.5
Var_10	3.0	3.0	3.0

The graphical arrangement of the variants is shown in Figure 4.

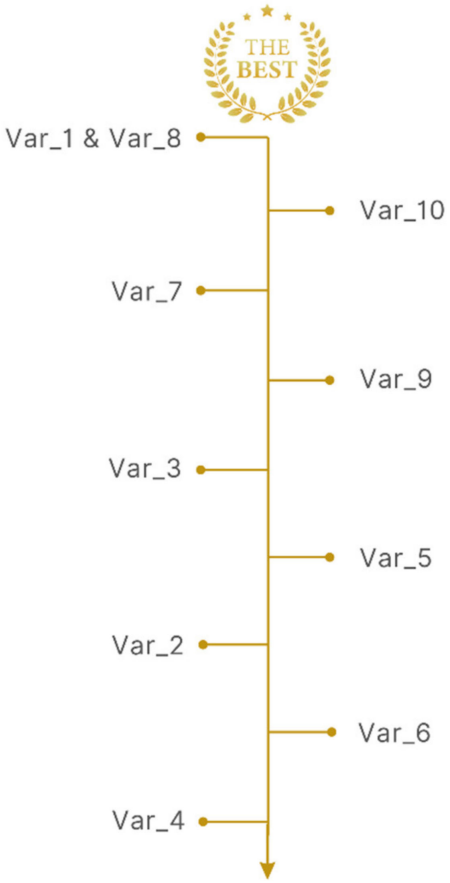

Figure 4. The final ranking of vehicle models from the point of view of the surveyed women.

4. Discussion

Based on the conducted research, it can be concluded that by using the multi-criteria decision support method, ELECTRE III is suitable for solving the problem of selecting vehicles for car-sharing systems.

In the analyzed case study, the use of the ELECTRE III method allowed for indication of which car models and car attributes best meet the expectations of Polish people who have not used the systems so far.

According to the obtained results, the best variant for men turned out to be the Var_10 model, while for women, the best variants were ex aequo Var_1 and Var_8. It is worth noting that the indicated models are vehicles representing the B vehicle class, i.e., city cars

with relatively small dimensions. These are usually cars chosen for short journeys because during long routes, these cars might not be very comfortable. It is worth noting that in the case of men, Var_8 and Var_1, i.e., cars placed in the leading position in the eyes of women, were in the second and third positions in the ranking. In turn, the Var_10 model, which is the leading model in the ranking by men, ranked second in the women's ranking. Such results represent a very interesting conclusion for car-sharing service operators. Currently, in car-sharing services, there is a large disproportion between the people who are using them, with the disproportion mainly focused on men [49]. The results indicate, however, that the choice of models for the car fleet in car-sharing is similar in the case of both women and men, which may indicate that the low interest on the part of women is associated with a fleet improperly selected to the client's needs. It is worth noting that currently none of the models indicated in the leading positions in Poland are cars commonly used in car-sharing systems.

When analyzing the top-rated models in the ranking, an important conclusion is that they are small city vehicles. Earlier studies of the proprietary fleet of vehicles dedicated to people who rarely, often, and constantly use car-sharing services indicated that such customers were not interested in this type of vehicle at all [46–48] but were eager to choose large and family cars. This proposal is important because it indicates that the use of small city cars in the fleet may increase the interest of people who have not used car-sharing systems yet. Translating the results into Polish market realities is a valuable tip for operators who already have such cars in their fleet. Firstly, they do not have to invest additionally in the modernization of the car fleet, but focus on marketing and promotional activities instead, with particular emphasis in their campaigns on the factors that were indicated in the study as leading factors. Secondly, it is also an important tip to properly rotate the fleet of vehicles and locate the fleet in strategic transport locations associated with high passenger flow, which may attract the attention of people not yet interested in car-sharing. Such places include, e.g., railway stations, bus stops, and transfer centers. Thirdly, another important tip is to properly regulate the tariffs of their services for this group of small vehicles to properly encourage the public to use car-sharing services. What is important, however, and what should be remembered is that the operators should appropriately diversify their fleet so that it is directed towards groups of users bringing economic benefits, i.e., current users. According to the current users, the leading vehicles are large and family vehicles, which is in contradiction to the vehicles that current non-users considered as the leading ones. Therefore, the cars identified as the leading ones for current non-users should be included in, but not the main part of, the fleet.

On the other hand, in the case of operators who do not have this type of vehicle on offer, it is an important indication of what sort of car fleet to equip their services with. However, it should be remembered that it should not be most of the fleet, but only a part of it.

From the point of view of vehicle propulsion, in the case of men, a fully electric vehicle was classified as the highest in the ranking. In addition, the second place was occupied by a car with this type of drive. In turn, the third and fourth place is represented by cars with a conventional drive. In the case of women, the first place ex aequo was taken by cars with a conventional and electric drive and the second and third places were taken by cars with an electric drive. Fourth in the ranking was a car with a conventional drive. Interestingly, the last places in both rankings were taken by cars with an electric and conventional drive. The results, therefore, indicate that, for respondents, the type of vehicle power supply was not a key aspect of the selection of the car, but rather the possession of specific technical parameters by the vehicles.

Analyzing the obtained results from the point of view of the importance of the individual criteria for users, it should be mentioned that for men, the most important issues were engine power, rental fee, and luggage compartment capacity. This may indicate that the vehicle is to become an additional opportunity to test a car characterized by high engine performance. In turn, the least important factor was the time of battery charging/time of

refueling. If these issues are irrelevant, it may indicate the fact that men plan to use vehicles for such a short time that the aspects of vehicle operation are not important to them. For comparison, in the case of women, the most important issues were security issues, i.e., Euro NCAP rating, adult occupant protection rate, child occupant protection rate, and vulnerable road user (VRU) protection rate. The number of doors on the vehicle was the most important factor.

5. Conclusions

In summary, the conducted research provided achievement of the goal of indicating the types of vehicles that meet the expectations of Polish customers who do not use car-sharing systems. The research showed that the best solution for this group of people will be equipping the car-sharing fleets with small, city cars, which will be characterized by high engine performance, large luggage space, the highest levels of safety both from the point of view of driver and passenger protection and the protection of children and vulnerable road users, and affordable rental prices. In the eyes of the respondents, the fleet of this type of vehicle can be equipped with both electric and conventional motors. The use of this type of vehicle while applying the appropriate promotion of services and emphasizing the factors expected of the vehicles will have a chance to increase the level of interest in car-sharing services shown by both women and men, and the indicated criteria will support operators looking for answers on how to modernize their current car fleet. Moreover, noting the similar places in the ranking of car models among women and men, it is worth emphasizing that meeting the requirements for their criteria will allow the use of the same vehicle models that will meet the expectations of both social groups. This type of procedure will avoid the additional costs of fleet diversification related to gender.

Based on the research results, the following recommendations for car-sharing operators have been developed:

(1) It should be remembered that the operators should properly diversify their fleet. This is important because to bring economic profit, service providers must focus on regular and frequent groups of users. According to the current users, the leading vehicles are large and family vehicles, which is in contradiction to the vehicles that current non-users considered as the leading ones. Therefore, the cars identified as leading for non-users should be found in the system of the fleets but not as the main part of the fleet.

(2) In the case of operators who have a fleet rated as the best rated in their systems, it is important that they properly improve the promotion of their services by focusing on emphasizing the fleet's parameters that were rated as being the best parameters by the respondents.

(3) In the case of new operators and current service providers who want to modernize their fleets and want to encourage people who are not car-sharing users to use the services, it is important to have small city B-class cars with a high engine performance, large luggage space, and high safety parameters in their fleet. More importantly, however, they should not be the main part of the vehicle fleet.

The article, like any other research work, has its limitations. The main limitation is that the research was conducted in terms of the area of the Polish market. The second limitation is the methodological limitation resulting from the use of the Saaty's scale, which limits the possibility of expressing the respondents' opinions in the form of numerical standardization. Thanks to this, it was possible to obtain quantitative results, but without the possibility of making detailed qualitative analyses as in the case of typical social research. The third limitation is the lack of similar studies for other geographic areas, which makes it impossible to refer to other studies in the discussion. The fourth limitation is conducting the study on a group of car-sharing non-users. Due to this, in future works, the author plans to expand the group of analyzed users to obtain the full range of the fleet tailored to the needs of each of them. What is more, the author also plans to carry out this type of research for other

countries to show differences in the approaches to the vehicle fleet, especially in countries with a highly developed approach to ecology.

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Institutional Review Board Statement: According to our university ethical statement, as follows, the following shall be regarded as research factors requiring a favorable opinion from the Ethics Commission in the case of human research (based on document in Polish: https://prawo.polsl.pl/Lists/Monitor/Attachments/7291/M.2021.501.Z.107.pdf (accessed on 20 November 2022): research in which there are persons with a limited capacity to give informed consent or research on persons whose capacity to give informed or free consent to participate in the research is diminished and persons who have a limited ability to refuse research participation before or during its implementation, in particular: children and adolescents under 12 years of age, persons with intellectual disabilities, persons whose consent to participate in the research may not be fully voluntary, prisoners, soldiers, police officers, employees of companies (when the survey is conducted at their workplace), persons who agree to participate in the research on the basis of false information about the purpose and the course of the research (masking instructions, i.e., deception) or persons who do not know at all that they are subjects (in so-called natural experiments); research in which persons particularly susceptible to psychological trauma and mental health disorders are present, in particular: mentally ill persons, victims of disasters, war trauma, etc., patients receiving treatment for psychotic disorders, family members of terminally or chronically ill patients; research involving active interference with human behavior aimed at changing it, research involving active intervention in human behavior aimed at changing that behavior without direct intervention in the functioning of the brain, e.g., cognitive training, psychotherapy, psychocorrection, etc. (this also applies if the intervention is intended to provide benefits and this also applies when the intended intervention is of benefit to the subject (e.g., to improve his/her memory); research concerning controversial issues (e.g., abortion, in vitro fertilization, the death penalty) or requiring particular delicacy and caution (e.g., research concerning religious beliefs or attitudes towards minority groups); research that is prolonged, tiring, physically or mentally exhausting. Our research was not carried out on people meeting the abovementioned conditions. Of the people researched: none of them had a limited capacity to be informed and none of them had been susceptible to psychological trauma and mental health disorders. The research did not concern the abovementioned controversial issues, and the research was not prolonged, tiring, or physically or mentally exhausting.

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