



## Identifying Consumer Preferences for New Generation Vehicles Using Multidimensional Preference Analysis

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**Abstract:** In recent years, developments in the automotive sector have impacted consumer preferences in transportation, creating more options for consumer needs in this area. Changing consumer needs raises a number of complex issues, such as how automotive companies should develop their products and what actions should be taken to ensure that their brands are popular with consumers and increase their loyalty. It is necessary to investigate the preferences of consumers regarding electric cars, which are expected to be among the types of vehicles that will become increasingly popular in the near future in terms of efficiency and utility. The aim of this study is to investigate consumers' purchasing processes, to determine the preferred brands and car features in this process and to determine consumers' expectations of new car models. At the same time, this study aimed to assess car users' perspectives on electric vehicles and examine participants' preferences for traditional fuel types such as gasoline, diesel and LPG, as well as electric and hybrid vehicles. The study used a questionnaire to collect data from customers of an automotive company to identify the factors that influence consumer preferences in the automotive sector. As part of the study, a 16-question questionnaire was randomly distributed to 405 respondents. In analysing the data, descriptive statistics were used to determine the demographic characteristics of the participants, chi-square tests were used to examine the relationships between demographic characteristics and factors influencing consumers' purchasing decisions, and multidimensional preference analysis methods were used to determine the most important and most preferred characteristics of customers when purchasing. The multidimensional preference analysis method, a multivariate statistical method, provides valuable information about the factors that determine consumers' preferences and decisions. Multidimensional preference analysis provides companies with an important perspective on both competition and the identification of gaps in the market. According to the results of the data analysis, participants indicated that a new generation car should have low fuel consumption and a good safety system. While the environmental friendliness of electric vehicles and the increase in diesel and gasoline prices were the main reasons for their preference, the reasons for nonpreference were problems with recharging.

**Keywords:** consumer choice; electric automobile; fuel system preference; multidimensional preference analysis; new generation car.

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**1. Introduction.** When customers make a purchasing decision, they evaluate the positive or negative benefits of a product or service and choose the product or service with the features that they believe will bring them the greatest benefit. Taking these evaluations into account, manufacturers try to produce the best product for the customer to satisfy them and thus increase both their market share and their profitability. Manufacturers have conducted market research to determine how much interest customers have in their products. These studies are known as marketing research. With the help of these studies, it is possible to determine which criteria the customer attaches the greatest importance to when purchasing a product or service (Kotler et al, 2018).

Companies need to know customer behavior in detail to ensure that their products or services are preferred by customers, and they should plan every step they take for the future based on this information. After determining customers' wants and needs, companies should also determine the group of customers they can satisfy with their existing resources (Armstrong et al., 2014). As customer satisfaction becomes increasingly important in the field of marketing, companies focus their attention on this point, and companies that can better satisfy their customers gain superiority in the market (Anderson et al., 1994).

The automotive sector collaborates with many other sectors and contributes significantly to the economy both in terms of employment and the volume of production it generates. Moreover, its importance will increase in the future if it is supported by technological development. Developments in the transportation and automotive sectors are changing consumer preferences in terms of transportation, and consumers are being offered more options than ever before to meet their needs in this area (Amadeo, 2021). Changing consumer needs are leading to a number of complex issues that affect how automotive companies develop their products and how they maintain consumer loyalty to their brands.

With increasing concern for the environment and technological development in recent years, interest in electric vehicles has also increased. Companies in the global automotive industry are working hard to transform both technologically and organizationally to meet some of the trends that are emerging to meet the demands of the new generation of users and that the industry foresees for the near future. The shift to electric vehicles that are emerging to support the reforms that developed countries, particularly the US and the European Union, are looking to implement in areas such as the environment and climate across the industry and the development of autonomous driving and connected vehicle technologies in the areas of human safety, supported by data science. It is observed that there are new global trends such as the development of advanced material technologies to both reduce the environmental impact of the new generation of vehicles and meet safety expectations. Many brands in the automotive industry are planning to stop producing gasoline and diesel vehicles and switch to all-electric cars. The increasing popularity of electric cars is expected to surpass that of conventional cars in the 2040s. The market for electric vehicles is growing, and the demand for environmentally friendly vehicles is increasing. Therefore, it is important to understand consumer preferences for electric vehicles and identify the factors that influence these preferences. Opting for electric vehicles can help promote green transportation and reduce carbon emissions. Therefore, it is important to encourage consumers to choose electric vehicles to maintain a clean environment (Bibra et al., 2021; Deloitte, 2014).

Car manufacturers attach great importance to market research to better understand consumer preferences and meet their expectations. However, it is not always easy to understand the complex preferences of consumers and develop the right strategies (Mothersbaugh & Hawkins, 2016). For this reason, analysing consumer behaviour is necessary to maintain demand in the automotive sector. Multidimensional preference analysis is a valuable tool for understanding consumer preferences, optimizing product development processes and defining marketing strategies. This method is based on combining multiple variables to understand how consumers think about different attributes and priorities. Multidimensional preference analysis provides a graphical representation in which products are represented by dots and customers by vectors (Malhotra, 2020).

In this study, the plan was to use multidimensional preference analysis to determine consumer preferences for new generation vehicles. The aim of this study is to investigate consumers' purchasing processes, to determine which brands and vehicle features they prefer and to determine consumers' expectations of new vehicle models. Another objective was to assess car users' perspectives on electric vehicles and to examine participants' preferences for electric and hybrid cars as well as traditional fuel types such as gasoline, diesel and LPG. In addition, the relationships between demographic characteristics such as age, gender, income and preferred fuel type, reason for car purchase and vehicle class characteristics should be investigated. In this respect, the results of our research can help manufacturers in the automotive industry better understand consumer preferences and design their products accordingly.

In addition, the multidimensional preference analysis method, which should be widely used in marketing research, is not used enough, and its use should be increased. This study, which includes the introduction of this statistical method and its application in the automotive industry, which contributes greatly to the economy, will also make an important contribution to the literature. This study begins with an introduction that explains the purpose and importance of the research and provides an overview of the study. In the second part of the study, a literature review is given, including a summary of studies related to the subject of the study. In the third section, the methodology and research methods, hypotheses and research questions are given in detail. In the fourth section, the empirical findings are presented. The fifth part of the study contains a discussion, and the sixth part contains the conclusion.

**2. Literature Review.** The most important factors influencing consumer product preferences can be summarized in two dimensions: internal and external factors. The internal factors are gender, education level, age and other important consumer characteristics. External factors include external information such as advertising, word of mouth, product prices and promotions that influence consumers' purchasing decisions. Therefore, different consumers affected by different conditions will have different product preferences (Yang, 2002). Consumer preference is the way consumers express their desires and tendencies when choosing products or services based on various characteristics (Osborne & Rubinstein, 2020). Research has shown that analysing consumer preferences is crucial for product managers to effectively adapt market strategies. Consumer preferences can be influenced by factors such as product attributes such as taste, size, color, durability, and price (Liao et al., 2023). Maolidan (2022) emphasized the importance of understanding the cognitive mechanisms behind consumer preferences, including the use of nonlinear functions. Sun (2013) explored choice scenarios in which consumer choice is a nonlinear function of decisive product attributes, developed a conceptual framework and created a propositional inventory.

Personality plays an important role in consumers' product preferences, as individuals tend to choose products that suit their characteristics and emotional needs (Pambudi et al., 2022). Ethical issues such as no child labor and no use of animal skin and features such as fit and comfort have been found to influence consumer decisions in different countries (Rahman et al., 2021). Sociopersonal factors and situational determinants are crucial in shaping consumer buying decisions for electronic products, emphasizing the importance of understanding buyer preferences for market success (Kushwaha et al., 2015). Czellar & Palazzo (2004) concluded that consumers have different product preferences depending on their own characteristics, the physical characteristics of the products and the perception of product value. To summarize, consumers' preferences in product selection vary according to the effects of different factors. Numerous studies have been conducted to identify the factors that influence consumer preferences and to develop new marketing strategies. Mittal (2018) explored an analytical perspective on socioeconomic factors that influence consumers' liking and disliking of electronic products. This shows that consumer likes and dislikes for electronic products are significantly influenced by socioeconomic factors. In particular, socioeconomic factors such as income level, education level, occupation and age were found to be determinants of consumers' preferences for electronic products. Nadanyiova et al. (2020) conducted research to understand the impact of the influencer marketing method on consumers' purchasing behavior, preferences and lifestyle. This shows that influencer marketing influences consumers' purchasing decisions and shapes their lifestyle. In particular, influencers' product recommendations and promotions were found to influence the purchasing behavior of young consumers. Wibowo et al. (2020) investigated the impact of social media marketing on customer behaviour. This research was conducted to understand the role of social media marketing activities and customer experiences on customer behavior. This shows that social media marketing activities influence customer behaviour and that customer experience plays an important role in this impact. In particular, social media marketing activities were found to increase customer satisfaction. Sukant (2021) studied the factors influencing consumer brand choice in Indian mobile communication services. This shows that there are various factors that influence consumer brand choice in the Indian mobile communication industry. In particular, it was found that price, service quality, customer service, brand image and advertising play important roles in determining consumers' brand preferences. Kita et al. (2023) discussed the design of an instrument to measure the behavioral aspects of conscious and sustainable consumer attitudes and developed a valid and reliable scale. Four dimensions were identified in the scale:

- 1) the "civic participation" dimension,
- 2) the "consumer awareness" dimension
- 3) the "circular thinking" dimension,
- 4) the "social responsibility" dimension.

These dimensions are seen as key to consumers' attitudes toward conscious and responsible behavior. Gajanova et al. (2023) look at digital marketing in the information and communication technology (ICT) industry in the context of consumer behavior and include a case study in the Slovak Republic. This shows that digital marketing influences consumer behavior in the ICT industry and that marketing strategies play an important role in consumer preferences. In particular, it focuses on how digital marketing tools (websites, social media, mobile applications, etc.) influence consumer purchasing decisions and increase consumer loyalty.

Customer preference in the automotive sector is influenced by various factors, such as technological innovation, fuel economy, and safety features. Studies show that understanding consumer preferences is crucial for designing vehicles that meet market demands (Yoo et al., 2021; Chopra, 2018; Gao et al., 2024; Barreto & Arruda, 2019). Research comparing consumer preferences for different car brands highlights varying priorities, such as resale value and price (Lustgarten & Le Vine, 2018). The availability of real-time sales data allows for more accurate and timely identification of customer preferences, aiding in vehicle design improvements. Additionally, consumer attitudes toward features such as multimedia systems and fuel efficiency play a significant role in shaping their purchasing decisions. Ultimately, aligning design specifications with consumer preferences is essential for enhancing market competitiveness and meeting evolving consumer demands (Chopra, 2018; Lustgarten & Le Vine, 2018).

Apart from these studies, although the subject of electric vehicles is new, many more studies have been conducted to determine the factors affecting consumer preferences in the automobile industry, consumers' perceptions of electric vehicles and their expectations of next-generation vehicles. Coffman et al. (2017) analyse the factors affecting electric vehicle adoption, addressing the role of government policies as well as factors such as consumer perceptions, costs, range concerns, and charging infrastructure. Liao et al. (2017) reviewed the literature and aimed to examine consumers' preferences for electric vehicles. Ramya (2016) investigated the factors that influence consumers' choice of car brands. This shows that there are various factors that influence consumer preference for the Maruti-Suzuki brand in the city of Coimbatore. In particular, price, brand image, vehicle performance, reliability and after-sales service were found to play important roles in determining consumer preferences for automobile brands. Hardman et al. (2018), including a literature review on the factors affecting the adoption of electric vehicles, address research conducted to understand consumers' attitudes, perceptions and preferences toward electric vehicles. Oliveira et al. (2020) used the multicriteria decision analysis (MCDA) approach in their study to investigate the impact of consumer preferences for alternative fuel vehicles. The study was conducted in Brazil. As part of the study, a survey was administered to 150 participants. The participants were informed about alternative fuel vehicles (e.g., electric vehicles, hybrid vehicles, and biofuel vehicles) and various characteristics of these vehicles. Multicriteria decision analysis (MCDA) was then used to determine the participants' preferences. Participants determined their preferences by considering factors such as environmental impact, fuel consumption, cost and range. In their study, Kowalska-Pyzalska et al. (2022) wanted to understand consumer preferences for alternative fuel vehicles and how different vehicle characteristics influence consumer preferences. Participants were informed about different alternative fuel vehicles and the different characteristics of these vehicles. A conjoint analysis was then conducted to determine participants' preferences. The study shows that consumer interest in alternative fuel vehicles has increased and that environmental factors (e.g., low emissions), fuel consumption, cost and range play important roles in the reasons for choosing alternative fuel vehicles. Consumers believe that electric vehicles are preferable to other alternative fuel vehicles due to their environmental advantages and low operating costs. Papantoniou et al. (2022) investigated user preferences for electric passenger vehicles. A survey was conducted to understand the factors affecting electric vehicle usage. It examined the role of factors such as price, range, charging infrastructure and environmental impacts on consumer preferences. In this study, Visaria et al. (2022) investigated electric vehicle (EV) owners' charging, pricing schemes and charging infrastructure preferences. Using survey data, this study analyses the preferences of EV users and the impact of these preferences on EV charging infrastructure and pricing policies. The study by Wang et al. (2023) focused on the question of how the requirements of vehicle customers differ based on online reviews. In particular, the study focused on differentiating consumer preferences between fuel-powered vehicles and new energy vehicles. Researchers have examined online reviews to determine consumer preferences and opinions on these two types of vehicles. The aim of the study is to establish that factors such as performance, price and comfort are just as important as environmental factors in regard to consumer preferences for a vehicle. In this way, information for the creation of strategies and the development of marketing plans in the automotive industry should be provided. The authors collected

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evaluation data from online automotive forums and created a corpus after preprocessing. The study by Buhmann & Criado (2023) aimed to understand consumer preferences for electric vehicles and determine the factors that influence these preferences. This study examined factors such as "status" and "reputation" to determine the factors that influence consumer preferences for electric vehicles. The analyses show that consumer preferences for electric vehicles are significantly influenced by factors such as vehicle status and brand reputation. Dou & Chen (2023) conducted their study to investigate the factors influencing sustainable consumption behavior based on the perception of health risks and to determine the degree of preference for electric vehicles in Kunming, Yunnan Province, China. The research was conducted in Kunming city in 2020. As part of the study, face-to-face surveys were conducted with 391 participants. Participants were asked questions about their perception of health risks associated with the use of electric vehicles, environmental sensitivity, demographic factors and their opinions on vehicle characteristics. The data obtained were analysed using multivariate regression analysis. The important factors influencing the participants' sustainable consumption behaviour included the perception of health risks, environmental awareness, income level, education level and vehicle price. Jia & Chen (2023) examined the role of factors such as price, range, charging infrastructure, and environmental impacts on electric vehicle preferences. Analysis reveals that different consumer segments show different preferences and that these preferences are important in shaping government policies. Ramachandaramurthy et al. (2023) examined the social acceptance and preferences of electric vehicle (EV) users. This paper reviews studies in the literature to understand how electric vehicles are perceived by society and the factors affecting users' preferences. In their study, Bhat et al. (2024) examined the public's preferences for electric vehicle charging infrastructure locations. Geographic, demographic and environmental factors play important roles in determining the public's preferences for electric vehicle charging infrastructure locations. With this study, Gao et al. (2024) aim to analyse customer preferences for electric vehicles using big sales data. Using data mining techniques, it aims to identify customer preferences to support the design decisions of electric vehicles. This study provides a comprehensive analysis to understand which features are important to customers in the design of electric vehicles and how this information affects design decisions.

**3. Methodology and research methods.** The core of multidimensional preference analysis is principal component analysis based on classification. The main purpose of PCA is to obtain several principal variables from several original variables through a series of transformations. Multidimensional preference analysis based on principal component analysis is suitable not only for continuous variables but also for ordinal variables (He & Li, 2021). The purpose of multidimensional preference analysis is to obtain a graphical representation in which products are represented by points and customers are represented by vectors. In this graphical representation, products that are close to customer vectors are more preferred by customers, while products that are far from customer vectors are less preferred (Kuhfeld, 1992).

$X$  is a data matrix showing  $n$ -product preference by  $p$ -customers with  $n \times p$ -size. The graphical result of the analysis is based on a principal component model. The columns of the data matrix  $X$  are standardized so that the mean is 0 and the variance is 1. By applying singular value decomposition (SVD) to the standardized  $Z$  data matrix, the representation given in (1) is obtained (Cox & Cox, 2001).

$$Z = ((n - 1)^{1/2}U)((n - 1)^{-1/2} \Lambda)(V) \quad (1)$$

The standardized principal component score matrix  $F = (n - 1)^{1/2}U$  and component structure matrix  $G$  are obtained. The rows of  $F$  and columns of  $G$  give the coordinates of  $n$  points for rows and  $p$  points for columns, respectively (Greenacre, 1984). Each product point can have orthogonal projections on each customer vector.

The projection of product  $i$  on customer vector  $j$  is  $g_j((f_i'g_j)/(g_j'g_j))$ , and the length of this projection is  $\|f_i\| \cdot \cos\theta$ . The cosine of the angle between the two vectors is equal to the correlation between the variables. The projections of products that go furthest in the same direction as the vectors of customers have the highest predicted preference. In multidimensional preference analysis, the absolute length of the customer vector is unimportant because the goal is to study the projections of the points onto the vectors. Sometimes one multiplies the coordinates at the endpoints of the vectors by some fixed values to make the graphical representation qualitatively better and more understandable without changing anything in the interpretation of the graph.

In this study, the data to determine the factors affecting consumer preferences in the automotive industry were collected through a face-to-face survey of consumers who wanted to buy a car in an automotive industry

company in Antalya between November 2022 and January 2023 using the scanning method, which is a quantitative research method. The questionnaire, consisting of 16 questions, was randomly distributed to 450 people. The questionnaires that were found to be incomplete and sloppy were removed, and 405 questionnaires were analysed. With a sample size of 405, the power of the test was 95%, the reliability was 95%, and the effect size was 0.22. The G-Power program was used for these sample size calculations. The SPSS 22 and R programs were used to analyse the data collected with the questionnaire.

This study first examined descriptive statistics to describe the data set and determine the characteristics of the participants. Then, the following hypotheses were formulated to determine the relationships between demographic characteristics and the factors that influence car purchases. The hypotheses were tested using chi-square analysis. *Hypotheses:*

H<sub>1</sub>: There is a relationship between new- or second-hand vehicle preference and gender.

H<sub>2</sub>: There is a relationship between the reason for purchasing a car and gender.

H<sub>3</sub>: There is a relationship between preferred vehicle class and gender.

H<sub>4</sub>: There is a relationship between preferred fuel type and gender.

H<sub>5</sub>: There is a relationship between income and preferred fuel type.

H<sub>6</sub>: There is a relationship between age and preferred fuel type.

In addition, a multidimensional preference analysis was conducted to identify customers' most important and most preferred features when making purchasing decisions, their preferred brands and consumers' expectations of new vehicle models. For each of the research questions listed below, the multidimensional preference analysis was evaluated, and answers to these questions were sought.

*Research questions:*

*RQ1: Which car brands are preferred by consumers and which car brands are similar in terms of consumer preference?*

*RQ2: Which criteria are most important to consumers when buying a new car?*

*RQ3: What features do consumers prefer most in new generation vehicles?*

*RQ4: What criteria are important to consumers when buying a used car?*

*RQ5: Which features are most important when choosing electric vehicles?*

*RQ6: Why do consumers not prefer electric vehicles?*

**4. Results.** Descriptive statistics on the demographic characteristics of the participants are shown in Table 1. Table 1 shows that 27.2% of the 405 respondents were women and 72.8% were men. The average age of the respondents was 36 years, indicating that this was a young sample. It was beneficial for this study that young people closely follow technology and developments in the automotive sector.

**Table 1.** Descriptive statistics on the demographic characteristics of the participants

Demographic Variable	Characteristics	Number of Respondents	Percentage
Gender	Female	110	27.2
	Male	295	72.8
Age distribution	18-25	73	18.0
	26-33	93	22.9
	34-41	123	30.4
	42-49	80	19.8
	50-57	30	7.4
	58-65	5	1.2
	65 upper	1	0.3
Income distribution	Less than 5.000	49	12.1
	5.001-10.000	136	33.6
	10.001-15.000	134	33.1
	15.001-20.000	38	9.4
	20.001-25.000	27	6.7
	More than 25.000	21	5.2

Sources: developed by the authors.

In addition to demographic characteristics, participants in the study were asked about their reason for buying a car, preferred vehicle class and preferred vehicle category. The distribution of these variables by sex was examined, and the chi-square test was used to determine whether these variables were independent of sex; the results are shown in Table 2.

**Table 2.** Chi-square results of vehicle preference, reasons for buying a car, and car class preference by gender

Particulars	Gender				Chi square value	p-value	
	Female		Male				
	Number	%	Number	%			
Vehicle Preference	New car	37	33.6	115	39.0	3.213	0.201
	Second-hand car	24	21.8	43	14.6		
Reasons for buying a car	Indecisive	49	44.5	137	46.4	12.768	0.012
	For more luxury and higher performance	17	15.5	52	17.6		
	To make changes	10	9.1	55	18.6		
	Obsolescence of existing car	24	21.8	79	26.8		
	To own a car	53	48.2	90	30.5		
Car class preference	Visual appeal of new models	6	5.5	19	6.4	41.324	0.000
	Sedan	28	25.5	128	43.4		
	Hatchback	19	17.3	38	12.9		
	Jeep	26	23.6	15	5.1		
	SUV	26	23.6	100	33.9		
	Other	10	9.1	14	4.8		

Sources: developed by the authors.

According to the results of the chi-square test in Table 2 for hypothesis H1, there is a correlation between gender and preference for a new or second-hand vehicle. The chi-square test statistic equals 3.213, and the corresponding p value equals  $0.201 > 0.05$ ; thus, the relationship between vehicle preference and gender is not statistically significant. When testing hypothesis H2: There is a relationship between the reason for buying a car and gender, the result of the chi-square test showed a statistical value of 12.768 and a p-value of  $0.012 < 0.05$ , so the relationship between gender and the reason for buying a car was considered statistically significant. This means that 48.2% of women chose the possibility of owning a car as a reason for buying a car. For men, on the other hand, this percentage was 30.5%. Second, the reason for wanting to buy a car was the obsolescence of the existing vehicle. While this percentage is 21.8% for women, it is 26.8% for men. Due to the visual appeal of new models, the purchase of a vehicle is in last place for both men and women. These rates were calculated at 5.5% and 6.4% for women and men, respectively.

When testing hypothesis H3: There is a relationship between the preferred vehicle class and gender, the chi-square test statistic was calculated as 41.324, and the p value was calculated as  $0.000 < 0.05$ . In other words, the preferred vehicle class differs according to gender. Accordingly, it was found that sedans and SUVs are mainly preferred by men, while jeeps and hatchbacks are more preferred by women than men. This result could be an important factor for car manufacturers when determining marketing strategies. For example, they could develop advertising campaigns for sedans and SUVs that are geared more towards men. They could also take these gender preferences into account when determining vehicle designs and features. For example, they could offer a sportier design for SUVs or more powerful engines for sedans.

In recent years, most car brands have started to produce electric cars for environmental reasons. To support this development, many countries have made new decisions about the use of electric cars. To assess car users' perspectives on this change, participants in this study were asked about their preferences for electric and hybrid cars, as well as traditional fuel types such as gasoline, diesel and LPG. The relationships between the participants' demographic characteristics and their preferred fuel types were analysed using the chi-square test. The results are shown in Table 3.

According to the results of the chi-square test in Table 3, as a result of the chi-square test of hypothesis H4, there is a relationship between the preferred fuel type and gender, the test statistic is 16.746, and the p value is  $0.002 < 0.05$ . Therefore, the preferred fuel type for cars differs according to gender. Diesel was the preferred fuel type for both men and women. Forty percent of women and 32.9% of men chose diesel as their preferred fuel. In addition, 32.9% of male participants preferred gasoline to the same extent as diesel, while this percentage was 14.5% for females. The fuel types preferred by male participants were diesel, gasoline, electricity, hybrid, and LPG. This order changes for female participants, with hybrid and electric vehicles coming to the fore. That is, female participants preferred diesel, hybrid, electric, gasoline, and LPG. Diesel vehicles are preferable for long-distance journeys because they generally consume less fuel. For this reason, it has become the preferred fuel type for both women and men. Women generally pay more attention to environmental impacts. Hybrid and electric vehicles are perceived to be more environmentally friendly than

conventional combustion engines. It has therefore been found that women are more likely to prefer such devices. Based on this information, the automotive industry can emphasize environmentally friendly and economical vehicles for women, while more powerful and performance-oriented vehicles can be emphasized for men.

**Table 3.** Chi-square results of fuel system choice by demographic characteristics

		Fuel System Preference										Chi-test statistic	p-value
		Gasoline		Diesel		Electric		Hybrid		LPG			
		n	%	n	%	n	%	n	%	n	%		
<b>Gender</b>	Female	16	14.5	44	40	17	15.5	18	16.4	15	13.6	16.746	0.002
	Male	97	32.9	97	32.9	49	16.6	29	9.8	23	7.8		
<b>Income</b>	Less than 10 000	52	28.2	55	29.7	32	17.3	20	10.8	26	14.1	16.955	0.031
	10 000-20 000	52	30.2	61	35.5	28	16.3	20	11.6	11	6.4		
	More than 20 000	9	18.8	25	52	6	12.5	7	14.6	1	2.1		
	18-25	21	28.8	15	20.5	16	21.9	11	15.1	10	13.7		
26-33	27	29	32	34.4	15	16.1	7	7.5	12	12.9			
34-41	31	25.2	49	39.8	16	13.0	15	12.2	12	9.8			
<b>Age</b>	42-49	21	26.3	36	45	10	12.5	9	11.3	4	5		
	More than 49	13	36.1	9	25	9	25	5	13.9	0	0		

Sources: developed by the authors.

According to the results of the chi-square analysis conducted to test hypothesis H<sub>5</sub>, there is a relationship between income and preferred fuel type, and the test statistic was calculated as 16.955 (p value of 0.031 < 0.05). Thus, there is a significant relationship between income and preferred fuel type. The preferred fuel types differ by income level. Diesel vehicles were most preferred at all income levels. In the group that can be defined as high-income, electric and hybrid vehicles rank second after diesel vehicles. Diesel vehicles generally consume less fuel than do gasoline vehicles. As the purchase cost of electric and hybrid vehicles is generally higher than that of other vehicles, electric vehicles may not be accessible to people in lower income brackets. Electric vehicles can be disadvantageous in regions where charging infrastructure is inadequate. Diesel vehicles, on the other hand, may be preferred by consumers because they have a greater range and therefore offer greater travel flexibility.

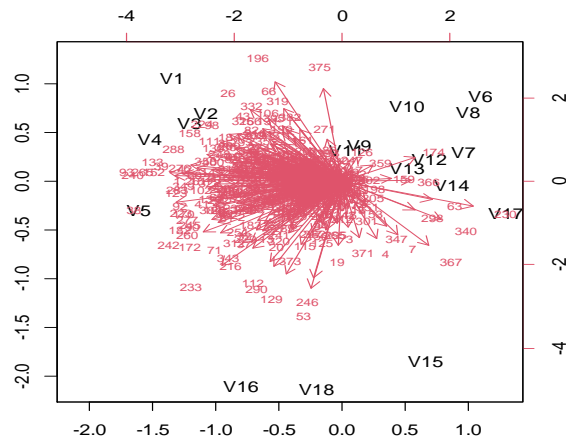
According to the chi-square test for hypothesis H<sub>6</sub>, there is a relationship between age and preferred fuel type, the test statistic was 24.495, and the p value was 0.076 > 0.05. Accordingly, the relationship between age and the preferred fuel system was not statistically significant.

#### 4.1. Multidimensional Preference Analysis Results

In the second part of the study, participants were asked to rate their preferences for car brands, important criteria when choosing a car, features that a new-generation car should have, their preference for an electric car and reasons for not choosing an electric car on a Likert scale from 0 to 9. 0 represents the least important preference, while 9 represents the most important preference. Multidimensional preference analysis was applied to determine the car brands preferred by the participants and to determine which car brands were similar in the eyes of the consumers. The resulting diagrams and comments are shown below. The vectors in the diagrams indicate the participants. A diagram of the multidimensional preference analysis was constructed to answer the following question: RQ1: Which car brands are preferred by consumers, and which car brands are similar in terms of consumer preference? is given in Figure 1.

Figure 1 shows that the participants most frequently preferred vehicles from the Audi (V1), Volkswagen (V2), BMW (V3), Mercedes (V4) and Volvo (V5) brands on the left-hand side of the graph. Ford, TOGG and Fiat vehicles show similar characteristics in terms of consumer preferences. This result can be used by brands when defining their marketing strategies and targeting consumers. For example, luxury and premium brands such as Audi, Volkswagen, BMW, Mercedes and Volvo can try to impress consumers by emphasizing their brand image and prestige. On the other hand, brands such as Ford, TOGG and Fiat can develop marketing strategies for more affordable vehicles and a broader customer base.

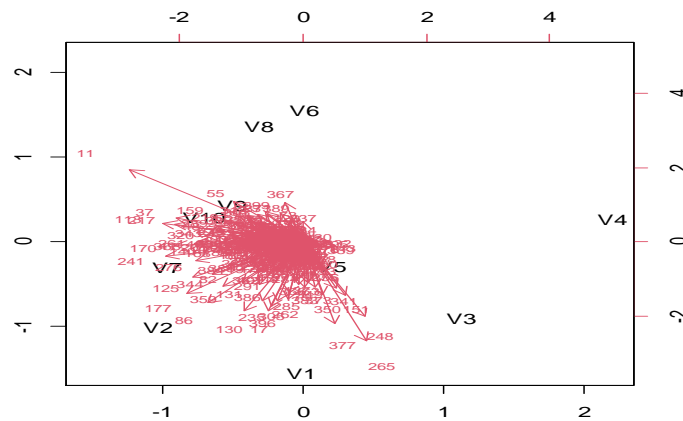




- |                    |                    |                   |                     |                   |                     |
|--------------------|--------------------|-------------------|---------------------|-------------------|---------------------|
| <b>V1:</b> Audi    | <b>V2:</b> VW      | <b>V3:</b> BMW    | <b>V4:</b> Mercedes | <b>V5:</b> Volvo  | <b>V6:</b> Citroen  |
| <b>V7:</b> Renault | <b>V8:</b> Peugeot | <b>V9:</b> Toyota | <b>V10:</b> Nissan  | <b>V11:</b> Honda | <b>V12:</b> Hyundai |
| <b>V13:</b> Opel   | <b>V14:</b> Kia    | <b>V15:</b> Fiat  | <b>V16:</b> Ford    | <b>V17:</b> Dacia | <b>V18:</b> TOGG    |

**Figure 1.** Multidimensional preference analysis graph for preferred automobile brands  
Sources: developed by the authors.

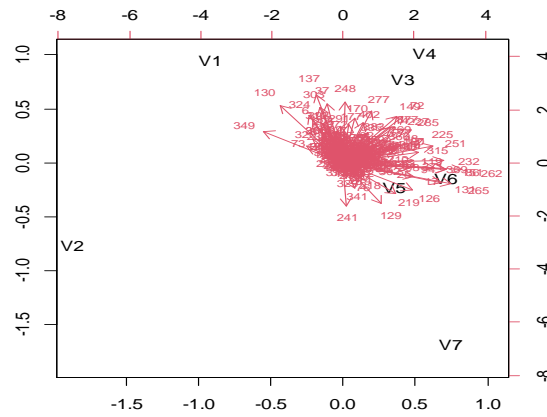
A diagram of the multidimensional preference analysis conducted to answer RQ2: Which criteria are most important to consumers when buying a new car? is given in Figure 2.



- |                    |                  |                  |                              |                               |
|--------------------|------------------|------------------|------------------------------|-------------------------------|
| <b>V1:</b> Design  | <b>V2:</b> Price | <b>V3:</b> Speed | <b>V4:</b> Color             | <b>V5:</b> Second hand Market |
| <b>V6:</b> Luggage | <b>V7:</b> Fuel  | <b>V8:</b>       | <b>V9:</b> Interior Capacity | <b>V10:</b> Service network   |
| Capacity           | Consumption      | Environmentally  |                              | prevalence                    |
|                    |                  | Friendly         |                              |                               |

**Figure 2.** Multidimensional preference analysis graph for important automobile preference criteria  
Sources: developed by the authors.

Figure 2 shows that the most important criteria for participants when buying a new car are design (V1), price (V2) and fuel consumption (V7). On the other hand, criteria such as the color of the car (V4), luggage capacity (V6) and environmental friendliness (V8) are features to which the participants do not attach any importance. The speed of the car (V3), the characteristics of the second-hand market (V5), the interior capacity (V9) and the existence of a service network (V10) were also grouped in the same order of importance. This result is an important guide for the automotive industry. Companies can use this information to understand the factors that influence consumers' purchasing decisions. Design, price and fuel economy are the factors that consumers value most when buying a new car. Therefore, car manufacturers can gain competitive advantage by focusing on these areas. A diagram of the multidimensional preference analysis conducted to answer RQ3: What features do consumers prefer most in new generation vehicles? is shown in Figure 3.

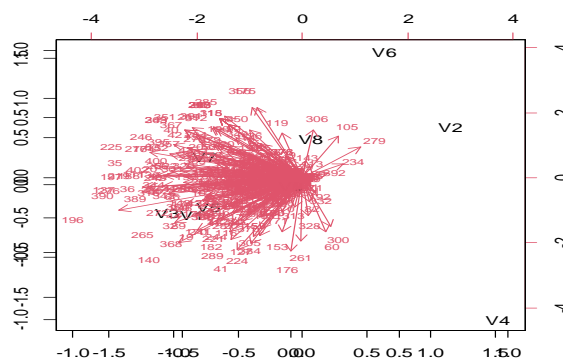


**V1:**Low exhaust emissions    **V2:** Recycling materials    **V3:** Safety systems    **V4:**Low fuel consumption  
**V5:**Other vehicle    **V6:**Ease of driving    **V7:** internet and social networking

**Figure 3.** Multidimensional preference graph for new generation car features  
 Sources: developed by the authors.

In Figure 3, participants ranked in order of importance the features that a new generation car should have: safety systems (V3), low fuel consumption (V4), technology that differentiates it from other vehicles (V5), and driving comfort (V6). In contrast, the extraction of materials used in the vehicle from recycling (V2) and the ability to connect to the internet and social networks in the vehicle (V7) were not prioritized as features that should be present in a new generation car. While technologies for recognizing other vehicles (V5) and driving comfort (V6) are similar in order of importance, safety systems (V3) and low fuel consumption (V4) appear to be similar in order of importance. These results can play an important role in determining product development and marketing strategies in the automotive industry. Manufacturers can design their products according to these priorities to better respond to consumer needs and preferences. One of the most important features for participants is safety systems. This underlines how important it is for car manufacturers to invest in safety technologies and integrate more advanced safety systems into their vehicles. In addition to safety, fuel consumption was also considered important. This shows that car manufacturers should focus on developing more fuel-efficient engines and alternative drive systems such as electric and hybrid vehicles. The fact that the variable of having differentiating technologies is ranked as important indicates that car manufacturers should focus on developing features that stand out from other vehicles. In terms of ride comfort, car manufacturers should focus on interior design, suspension and sound insulation. In contrast, the fact that the materials used in the vehicle are recycled and the ability to connect to the internet and social networks in the vehicle were not considered important features by the participants. This suggests that car manufacturers may place less emphasis on the use of recyclable materials and connectivity features.

A diagram of the multidimensional preference analysis conducted to answer RQ4: What criteria are important to consumers when buying a used car? is given in Figure 4.

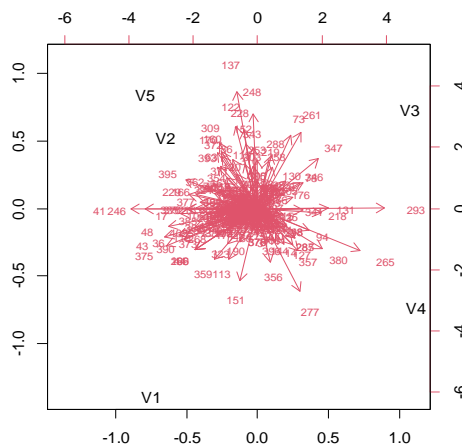


**V1:**Mileage    **V2:** Previous owner    **V3:**Accident and repair    **V4:**Close to residence  
**V5:** Age of car    **V6:**Color    **V7:**Brand and model    **V8:** Person or organization selling

**Figure 4.** Multidimensional preference graph for important criteria in used car purchases  
 Sources: developed by the authors.

In Figure 4, the most important characteristics when buying a used car are the mileage (V1), the number of accident repairs (V3) and the age of the car (V5). Figure 4 also shows that the make of the car (V7) and the person selling the car (V8) are also important when buying a used car. The fact that the car is close to the buyer's home (V4), its color (V6) and the previous owner (V2) are the least important characteristics for buying a used car. It is important to understand consumer preferences and purchasing decisions in the used car market. Vehicles with fewer kilometres, younger vehicles, well-known brands and reliable dealers are more likely to be preferred by consumers. Because vehicles with fewer miles experience less wear and tear and tend to last longer, younger vehicles tend to have fewer problems and may have more modern features. Consumers tend to favour brands that are reliable and that know more about durability. At the same time, consumers value being informed about previous accidents in which the vehicle has been involved and the repairs that have been carried out. There is generally less demand for vehicles with an accident history. This is because consumers are concerned that vehicles with an accident history could cause more problems in the future. The residence of the seller of the vehicle, the color of the vehicle and the previous owners of the vehicle, on the other hand, are less important to consumers.

A diagram of the multidimensional preference analysis conducted to answer RQ5: Which features are most important when choosing electric vehicles? is shown in Figure 5.



**V1:** Diesel gasoline prices

**V2:** Low noise pollution

**V3:** Design and prestige

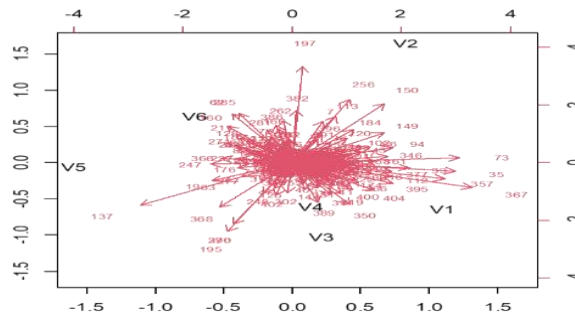
**V4:** Campaigns

**V5:** Environmentally friendly

**Figure 5.** Multidimensional preference graph for the preferred features of electric cars

Sources: developed by the authors.

Figure 5 shows that the fact that electric cars are environmentally friendly (V5), cause little noise pollution (V2) and increase diesel and gasoline prices (V1) are the most important characteristics for choosing these cars. On the other hand, design prestige (V3) and campaigns (V4) were rated as less important than the other features. The rise in diesel and petrol prices has made the operating costs of electric vehicles more attractive. The charging costs of electric vehicles are generally lower than the fuel costs of gasoline and diesel vehicles. This situation encourages consumers to switch to electric vehicles. The fact that electric cars are environmentally friendly, reduce carbon emissions and offer a more sustainable transportation option is an important factor for consumers. As environmental awareness increases, this feature is becoming increasingly important to consumers. The quiet operation of electric cars and the fact that they cause less noise pollution are important advantages, especially in city traffic. The fact that they offer a quieter driving experience is attractive to consumers. Design, prestige and campaigns are less important than other features when choosing electric cars. Nevertheless, design, prestige and campaigns can influence consumers' purchasing decisions and increase the competitiveness of electric car brands. A diagram of the multidimensional preference analysis conducted to answer RQ6: Why do consumers not prefer electric vehicles? is given in Figure 6.



**V1:** Charging station availability      **V2:** Price      **V3:** Time required for charging  
**V4:** Long journey charging      **V5:** Used car market      **V6:** Battery replacement cost

**Figure 6.** undesirable features of electric cars

Sources: developed by the authors.

Figure 6 shows that the number of available charging stations (V1), the price (V2), the time needed to recharge the battery (V3) and the problem of recharging on long journeys (V4) are the most important factors that affect the performance of an electric car. The situation in the used car market (V5), on the other hand, was not considered as important as other characteristics by the participants. One of the greatest concerns of electric car owners is the lack or availability of charging stations for long-distance journeys. Inadequate charging station infrastructure can deter consumers from switching to electric vehicles or make them reluctant to do so. Electric cars generally have a higher purchase cost than combustion engine vehicles. These high purchase costs can reduce consumer interest in electric vehicles. The long time it takes to recharge the batteries of electric vehicles also influences the choice. In addition, concerns about the need for recharging on long-distance journeys and the availability of charging stations can increase consumer hesitation toward electric vehicles.

**5. Discussion.** In this study, the multidimensional preference analysis method was used to understand consumers' preferences for the automotive industry and to determine their interest in electric vehicles. The results of the study provide important insights that can help car manufacturers better understand consumer preferences and design their products according to these preferences. The results of our study will help manufacturers in the automotive industry better understand consumer preferences and design their products according to these preferences. In particular, understanding the relationships between consumers' demographic characteristics, such as age, gender, income and preferred fuel type, and the reason for buying a car and vehicle class can help car manufacturers better determine their marketing strategies. It is also believed that this study will make an important contribution to the introduction of the multidimensional preference analysis method and its increased application in the automotive industry.

Previous studies have provided evidence that women are more environmentally conscious and therefore more likely to purchase electric vehicles than men (Knez et al., 2014; Jansson et al., 2017). As a result of this study, it was found that, in line with the literature, the proportion of women using electric and hybrid vehicles is greater than the proportion of men (31.9% for women, 26.4% for men). The finding that the preferred fuel type does not differ according to age is also consistent with the literature. In the literature, different results have been obtained from sample to sample. While young participants were observed to prefer electric vehicles in some studies (Hackbarth & Madlener, 2016; Mukherjee & Ryan, 2020), older participants were observed to prefer electric vehicles in other studies (Zhang et al., 2011). Other studies have shown that preferred fuel types vary by income level. Lower-income individuals prefer options with lower usage costs, and higher-income consumers are more likely to adopt electric vehicles (Plotz et al. 2017; Junquera et al., 2016). In this study, it was found that there is a relationship between the income variable and the preferred fuel type.

Studies show that consumers prefer reliable quality and economical products in new energy vehicles, with potential for fashion technology and luxury comfort models in the future (He & Li, 2021). As a result of this study, it was consistently concluded that a new generation car should have security systems, low fuel consumption, technology that differentiates it from other vehicles, and good driving comfort. Rezvani et al. (2015) and Hamzah & Tanwir (2021) concluded that individuals who are more aware of environmental problems tend to prefer electric vehicles. In this study, the environmental friendliness of electric cars and their low noise pollution are the most important features in choosing these vehicles, and results consistent with

those of previous studies are obtained. Other studies indicate that the reasons why electric vehicles are not preferred are price, charging time, driving range and charging infrastructure (Barth et al., 2016, Li et al., 2017, Liao et al., 2017). Similar results were obtained in this study, and in addition, it was determined that the number of available charging stations negatively affected the choice of electric vehicles.

Previous studies have shown that classical multivariate statistical methods such as multiple regression analysis, cluster analysis, factor analysis and conjoint analysis are frequently used to determine consumer preferences. The use of the multidimensional preference analysis method, which graphs the results of the analysis, is not widespread. However, graphs show consumer preferences and the relationships between products more clearly. They visually show which features are more important to consumers and which products are preferred by consumers. Graphs also allow decision makers to quickly identify key trends and relationships.

**6. Conclusions.** In recent years, developments in the automotive sector have had an impact on consumer preferences in transportation, creating more options for consumer needs in this area. The change in consumer needs raises a number of complex issues, such as how automotive companies should develop their products and what actions should be taken to ensure that their brands are popular with consumers and increase customer loyalty.

The aim of this study is to examine consumer purchasing processes, identify preferred brands and vehicle features and determine consumer expectations of new vehicle models. At the same time, the study investigated the reasons for consumer preferences for electric vehicles. An analysis of the data revealed that the relationships between gender and preferred fuel system and between gender and preferred vehicle class were related to gender. It was found that women prefer electric and hybrid vehicles more than men. In terms of preferred vehicle classes, men preferred sedans and SUV models, while women preferred jeeps and hatchbacks. Given the interest of female consumers in electric and hybrid vehicles, automotive companies could rethink their marketing and sales strategies. They can increase their market share in this segment by organizing special campaigns for female consumers and better aligning their brands with women's preferences. In addition, electric and hybrid car manufacturers can use these insights to increase their sales by reaching agreements on design, color and accessories for the production of Jeep and hatchback class electric vehicles.

Among the participants defined as having high incomes, electric and hybrid vehicles ranked second after diesel vehicles. Diesel vehicles tend to have lower fuel consumption than gasoline vehicles, making them a more economical option for consumers. The purchase cost of electric vehicles is generally higher than that of other vehicles. However, for higher income consumers, this purchase cost is less of a barrier, and in the long term, the potential savings in fuel and maintenance costs can offset the lower purchase cost. The interest of high-income consumers in electric and hybrid vehicles opens up opportunities for car manufacturers to offer more products and services in this segment. In addition, factors such as improving charging infrastructure and eliminating range issues may result in electric vehicles being favoured by a larger number of consumers. It is therefore important for car manufacturers to follow this trend closely and design their product portfolios accordingly. The features that a new generation car should have been, in order of importance, the following: safety systems, low fuel consumption, technology that sets it apart from other vehicles, and driving comfort. On the other hand, obtaining the materials used in the vehicle from recycling and the ability to connect to the internet and social networks in the vehicle were not prioritized as features that a new generation car should have. Accordingly, it was found that consumers do not attach enough importance to environmental factors such as the use of recycled materials and vehicle exhaust emissions. Identifying consumer preferences and expectations plays an important role in determining the marketing strategies of automotive companies. Based on this information, companies can shape their marketing campaigns and communication strategies by focusing on the features that are important to consumers. The development of products that meet consumer expectations can increase the competitiveness of automotive companies. By offering vehicles with the most important features to consumers, companies can differentiate themselves from their competitors and be more successful in the marketplace.

Although the use of environmentally friendly fuels is attractive to consumers, they are hesitant to buy for many reasons, such as price and range. It should be noted that consumer behavior may change over time. It is recommended that the study be repeated to determine consumer preferences as electric vehicles become more convenient for all consumers. At the same time, to generalize the results, the study can be extended to examine the differences between countries. By comparing the results in developed and developing countries, the



influence of economic factors on consumer preferences can be determined. It is assumed that these limitations and proposed solutions will point the way for future studies.

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**Conflicts of interest:** The authors declare no conflicts of interest.

**Data Availability Statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

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### **Визначення споживчих переваг автомобілів нового покоління багатовимірним підходом**

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Останніми роками розвиток автомобільного сектору істотно вплинув на споживчі переваги в сфері транспорту, створюючи більше можливостей для задоволення потреб у цій галузі. Зміна потреб споживачів піднімає низку складних питань, зокрема, як автомобільні компанії повинні адаптувати свої продукти та які заходи слід вживати для забезпечення популярності їхніх брендів серед споживачів та підвищення їхньої лояльності. Електромобілі, які, як прогнозується, стануть одними з найпопулярніших видів транспорту в найближчому майбутньому з огляду на їхню ефективність та практичність. Метою цієї роботи є дослідження процесів прийняття рішень споживачами при купівлі автомобілів, їх ключових характеристик, а також очікувань споживачів щодо нових моделей автомобілів. Крім того, дана робота спрямована на оцінку ставлення користувачів до електромобілів та аналіз споживчих переваг щодо традиційних видів палива, таких як бензин, дизельне паливо та зріджений нафтовий газ (LPG), а також електричних та гібридних автомобілів. Для збору даних використовувалися анкети клієнтів автомобільної компанії з метою визначення факторів, що впливають на споживчі переваги в автомобільному секторі. В рамках дослідження було випадковим чином роздано анкету з 16 питаннями 405 респондентам. Для аналізу даних використовувалися описова статистика для визначення демографічних характеристик учасників,  $\chi^2$ -квадрат тест для вивчення взаємозв'язків між демографічними характеристиками та факторами, що впливають на споживчі рішення, а також методи багатовимірного аналізу переваг для визначення найважливіших і найбільш переважних характеристик клієнтів при купівлі. Метод багатовимірного аналізу переваг, який є багатоваріантним статистичним методом, надає цінну інформацію про фактори, що визначають споживчі переваги та рішення. Багатовимірний аналіз переваг надає компаніям важливу перспективу як щодо конкуренції, так і щодо визначення прогалів на ринку. Згідно з результатами аналізу даних, учасники зазначили, що автомобіль нового покоління повинен мати низьке споживання палива та добру систему безпеки. Основними причинами вибору електромобілів були їх екологічність та підвищення цін на дизельне паливо і бензин, тоді як основною причиною негативного ставлення були проблеми з підзарядкою.

**Ключові слова:** вибір споживача; електромобіль; переваги системи палива; багатовимірний аналіз переваг; автомобіль нового покоління.