


Article

# Perceived Value and Customer Adoption of Electric and Hybrid Vehicles

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**Abstract:** Internal combustion engine vehicles are a key source contributing to urban air pollution. In order to reduce noxious emissions and reliance on fossil fuels, governments and the automobile industry have started promoting the adoption of electro mobility (EM) options over the last few years, albeit with limited success in terms of market penetration. This study aimed to improve the current understanding of factors influencing customers' intentions to adopt EM options. Building on the theories of perceived value and reasoned action, this study posits a behavioural model based on four dimensions of perceived value and two technical performance characteristics of EM vehicles with regards to their influence on customer attitudes towards EM options, as a precursor to purchase. The model was tested empirically using structural equation modelling analysis using data gathered through an online survey of 404 consumers in Spain. The results of this study showed that emotional issues, product price, vehicle acceleration and low engine noise levels have a considerable impact on consumer attitudes, which, in turn, have a positive impact on purchase intentions of EM vehicles. However, quality and social value were not found to have a positive influence on consumer attitudes. On the basis of this research it is recommended that, in order to promote the use of EM vehicles, governments and manufacturers alike should make better use of emotional issues in their social and product marketing strategies, as well as focusing on specific product attributes such as performance (e.g., vehicle acceleration and low engine noise levels) and value for money in terms of energy consumption.

**Keywords:** electric vehicles; hybrid vehicles; customer attitudes; perceived value; sustainable mobility; Spain; electromobility

## 1. Introduction

Transport is one of the main sectors of the economy contributing to air pollution [1]. It is partly a result of this that sustainable mobility has developed as a concept in order to reduce the environmental and social impacts caused by the use of private internal combustion engine vehicles as a means of transport, particularly in urban settings. In line with this, new sustainable energy paradigms have evolved focusing on the use of electricity as an alternative energy source for vehicles. Among the propulsion systems for electric vehicles, there are different modalities in terms of the technology used. For instance, hybrid vehicles have electric motors that support an internal combustion engine, while electric vehicles rely solely on electricity. This study focused on these two typologies

of vehicles—electric and hybrid—often referred to jointly as electro mobility (EM), which are largely recognised as the most viable transport option to reduce carbon dioxide emissions [2,3].

Replacing internal combustion vehicles with EM alternatives is not a straightforward process. Firstly, internal combustion engine vehicles enjoy proven technologies as well as widespread public acceptance for their use, in addition to reliable infrastructures, global supply chains, and established government policies and standards. Moreover, existing drivers of change include growing concerns about energy security and air pollution, as well as increasingly new government policies influenced by climate change evidence, new technologies, rising government support for competitiveness among industry's key players and growing levels of interest in electro mobility in key consumer markets such as China, Germany, Japan and the USA. Additionally, EM vehicle adoption is generally supported by governments through legislation that penalises vehicle emissions and favours clean energy solutions [4]. However, the development and adoption of new technologies remains a complex process from their inception to their implementation on a global scale [5]. Not surprisingly, sales of EM vehicles continue to be rather underwhelming compared to internal combustion engine alternatives. One of the reasons behind this may be that their acceptance by consumers depends largely on issues related to perception [6]. A number of consumer behaviour studies have analysed factors affecting the adoption of EM vehicles. For instance, Shafiei et al. [7] concluded that the most favourable scenario leading to a rise in EM vehicle market share would involve a combination of high fossil fuel prices, tax-free and/or lower prices for EM vehicles as well as plentiful and convenient charging point locations. Other research studies have shown that consumers with some level of environmental awareness tend to be more predisposed to purchase sustainable vehicles [8–10]. Likewise, Noppers [11] found that instrumental, environmental and symbolic attributes influence the adoption of EM options. Furthermore, Moons and De Pelsmacker [12] expanded the range of factors affecting behaviour related to EM vehicles to existing evidence of environmentally friendly behaviour, environmental concerns, innovativeness, personal values, attitudes, media, perceived complexity, compatibility, relative advantage and emotions. As regards market share of EM vehicles, a study by Kim [13] found that it tends to be closely correlated to the relative price of these vehicles compared to internal combustion engine vehicles, their expected driving range and the breadth of vehicle model choices available. Nosi [14] posited that the buying intention of EM vehicles was heavily influenced by consumer attitudes and subjective norms, while pre- and post-sale service perception generally had a negative impact. Similarly, a study by Rodríguez-Brito [15] found that purchase intentions related to EM vehicles were influenced by customers' predisposition to the use of new technologies, their environmental awareness, other personal characteristics (e.g., age and education) and access to information. Vehicle leasing was found to be the preferred business model for EM in a study by Liao [16], whereas Rietmann and Lieven [17] found that "the higher the level and amount of political incentives in a country, the higher the country's proportion of EM" (p. 125).

All in all, the research evidence outlined above appears to suggest that the adoption of EM vehicles depends to a large extent on a wide array of factors that range from government incentives and policies to the characteristics of EM vehicles available, including also social and personal issues. In this sense, published research related to the adoption of EM vehicles has so far tended to focus primarily on the role of consumer attitudes, values, beliefs and norms pertaining to the environment with regards to their purchase intentions [6]. However, few studies have considered the effect of consumers' perceived value (PERVAL) with regards to their attitude towards EM vehicles and its impact on their intention to adopt this technology, even if PERVAL has been used to gauge consumer attitudes towards various modes of transport [18,19]. Therefore, a better understanding of the role of PERVAL and consumer attitudes with regards to adopting EM vehicles would contribute to current knowledge related to consumer behaviour in this sphere, including specific research on EM vehicles and initiatives to increase their current share of the market.

In spite of the myriad of government policies implemented by different countries to promote the adoption of EM vehicles, their share of the market remains almost embryonic in most of the world's

leading economies, including Spain. Today, Spain is the European Union's fifth largest country in terms of population and one of the world's main car manufacturers with >1.5 million vehicles registered nationally on an annual basis [20]. Spain's National Strategy for Energy and Climate (2021–2030) posits that the generation of energy, transport and mobility remain the sources of more than half of the country's emissions responsible for air pollution. More specifically, the mobility sector was responsible for 26.1% of the country's emissions in 2017, which led the Spanish government to set a national target of 5 million electric vehicles on the country's roads by 2030 [21]. Yet, this target is likely to be missed in spite of the fact that registered EM vehicles are growing at an annual rate of >75% with <1000 EM vehicles registered on an average monthly basis against a 91% annual share of the market for internal combustion vehicles [22].

The aim of this research is to improve current knowledge related to the factors affecting customers' intention to purchase an EM vehicle in Spain. Building on the theories of perceived value [23] and reasoned action [24], a behavioural model was proposed with four key dimensions of perceived value and two attributes of EM vehicles influencing customer attitudes, which are key antecedents to adoption. Specifically, this study focuses on a PERVAL analysis of the quality, price, emotional factors and social value, along with two technological differentiating characteristics of EM vehicles as compared to internal combustion engine vehicles, namely, speed of acceleration and low engine noise levels. This model was tested empirically using structural equation modelling (SEM) analysis on data gathered through an online survey of 404 consumers in Spain. The results of this research offer unique insights into the adoption of EM vehicles by Spanish consumers and informs existing initiatives for their commercialisation.

The findings of this analysis show that emotional issues, product price, vehicle acceleration and low engine noise levels have a considerable impact on consumer attitudes, which, in turn, have a positive impact on purchase intentions of EM vehicles. It is also found that product quality and social factors do not have a significant impact on customer purchase intention. On the basis of this research, it is recommended that in order to promote a wider use of EM vehicles, governments and manufacturers alike should make better use of emotional issues in their social and product marketing strategies, as well as focusing on specific product attributes such as performance (e.g., vehicle acceleration and low engine noise levels) and value for money in terms of energy consumption.

The remaining part of this article is organized as follows: Section 2 provides the theoretical background and the process of development of the hypotheses tested as part of the research model; in Section 3, the data collection process, sample characteristics and data analysis process are explained; Section 4 presents the results of the analysis. Finally, Sections 5 and 6 provide a discussion of the findings with associated conclusions and recommendations for further research and policy making.

## 2. Theoretical Background and Hypotheses

Electro mobility technology needs to overcome a number of challenges in order to achieve commercial success. In this sense, consumer acceptance is a decisive factor affecting the viability of sustainable transport options [25]. For companies involved in the marketing of these products, it is essential to identify and overcome these challenges, particularly those affecting customer perceptions and attitudes. Attitude within the framework of behaviour has been defined as a person's evaluation or appraisal of the anticipated outcomes associated with a given behaviour [26]. According to the theory of reasoned action, attitude is generally influenced positively by the evaluation of behavioural outcomes (e.g., value attached to a behavioural outcome or attribute) [24].

Furthermore, a number of studies within the framework of perceived value theory [23] have shown that perceived value has a direct impact on people's intention to use public transport [27], air transport [28], bicycle sharing schemes [19] and EM vehicles [18]. Perceived value (PERVAL) can be defined as a consumer's overall assessment of the usefulness of a product based on his or her perceptions [23]. In this sense, PERVAL is normally interpreted using a range of dimensions [29]. On this front, previous studies have shown that a four-dimension conceptual approach can be used to

interpret consumers' perceived value [30–32]. This includes quality, emotional factors, price/value for money and social values. Firstly, quality is related to the practical or technical benefits that consumers obtain when using a product. Secondly, emotional factors generally involve the mental or psychological needs of consumers related to their feelings associated with a product. Thirdly, price is generally related to consumers' satisfaction with a purchase based either on monetary cost, time or effort invested in obtaining that product. Finally, the social dimension of a customer's evaluation process is more closely related to aspects of prestige associated with a product's purchase [32]. A number of consumer behaviour studies related to the adoption of new technologies have confirmed the role of attitude as a key mediator variable between perceived value and intention of use [33–37]. On that basis, the following hypotheses were formulated for this study:

**Hypothesis 1 (H1).** *Perceived quality value will have a significant positive impact on consumers' attitude towards EM.*

**Hypothesis 2 (H2).** *Perceived emotional value will have a significant positive impact on consumers' attitude towards EM.*

**Hypothesis 3 (H3).** *Perceived price value will have a significant positive impact on consumers' attitude towards EM.*

**Hypothesis 4 (H4).** *Perceived social value will have a significant positive impact on consumers' attitude towards EM.*

Furthermore, it is posited that EM vehicles' differentiating technical characteristics (e.g., driving range, acceleration, recharging, engine noise) may also have an impact on consumer attitudes [38,39]. If these characteristics fulfil consumers' needs, it is likely they will have a positive impact on consumers' intention to adopt the product [40]. More specifically, this study seeks to establish the effect of two of the EM vehicles' most valued performance characteristics: speed of acceleration and low engine noise [41]. On this front, earlier research has shown that low engine noise levels and vehicle acceleration are factors with a positive impact on consumers' satisfaction as well as their intention to purchase EM vehicles [42,43]. In line with this, the following hypotheses were proposed:

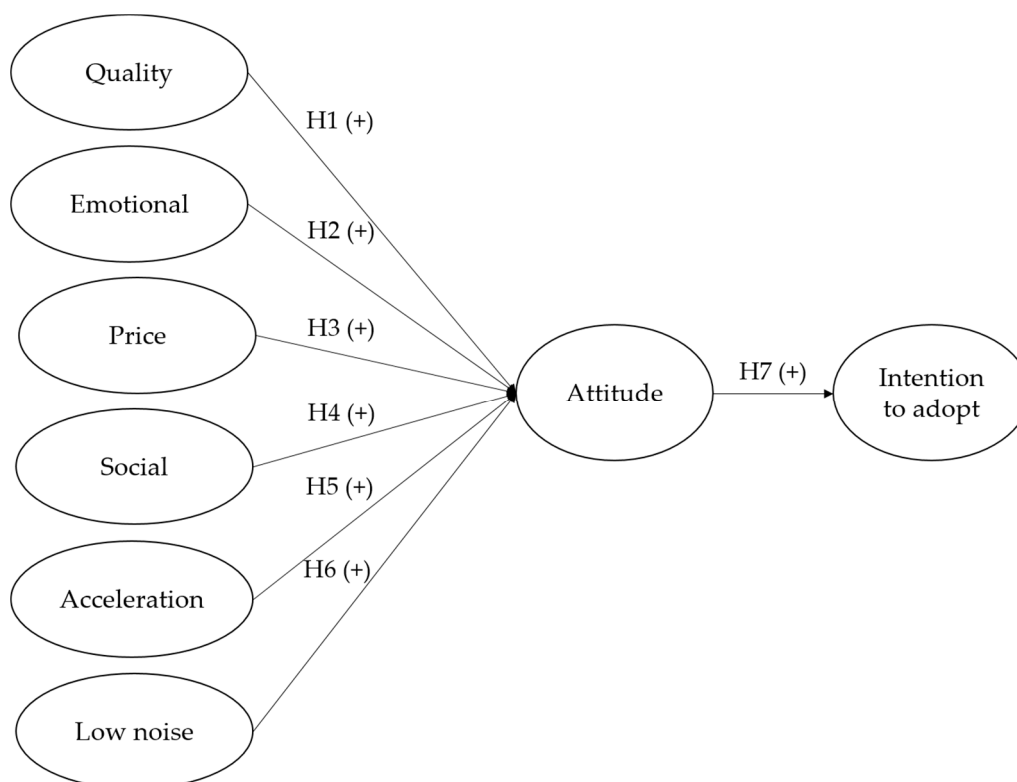
**Hypothesis 5 (H5).** *Strong acceleration will have a significant positive impact on consumers' attitude towards EM.*

**Hypothesis 6 (H6).** *Low engine noise emission will have a significant positive impact on consumers' attitude towards EM.*

In addition to the above, the theory of reasoned action suggests that attitude positively affects consumers' behavioural intentions [24]. A significant number of studies have shown a positive relationship between consumers' attitudes and their intentions to adopt new technologies, especially EM vehicles [14,44–48]. As a result of this, the following hypothesis was proposed:

**Hypothesis 7 (H7).** *The more favourable consumers' attitudes are towards EM, the greater their intention to adopt EM.*

An outline of this study's theoretical model is shown below (Figure 1).



**Figure 1.** Theoretical model of consumers' intentions to adopt electro mobility (EM).

### 3. Research Method

#### 3.1. Measures

All the variable measures included in the theoretical model were adopted from earlier studies. The PERVAL dimensions (e.g., quality, emotional, price and social values) were assessed using a scale adopted from Walsh [32]. Enjoyable acceleration and enjoyable low engine noise emissions were measured using a scale adopted from Schmalfuß [43]. Attitude was assessed using three items adopted from Mohamed [44]. Intention to adopt was measured using three items adopted from Moons and Pelsmacker [49] and Barbarossa [50]. All these items were operationalised using a seven-point Likert scale ranging from 1 (completely disagree) to 7 (completely agree). Table 1 outlines the items used to measure the model's variables. Additional information was collected through relevant socio-demographic variables.

**Table 1.** Variables and items used as part of the measurement instrument.

Variables	Items	Source
Quality	EM offers reliable levels of quality. EM vehicles are well made.	[32]
Emotional value	EM is something I would enjoy. EM would make me feel good.	
Price	EM offers value for money. EM is a good product for the price.	
Social value	EM would improve the way I am perceived by others. EM would make a good impression on other people.	

Table 1. Cont.

Variables	Items	Source
Acceleration	I would perceive the fast acceleration of EM as pleasant. The immediate acceleration increases the driving comfort of EM. I would like the fast acceleration of the EM.	
Low engine noise emission	The lack of engine noise of EM increases the pleasure of driving. I would like the low soundscape of EM. I would not need to change my driving style due to the lack of engine noise of the EM. I believe that the lack of noise from the EM is not dangerous for road traffic. The lack of engine noise would not make driving more difficult.	[43]
Attitude	In the long term, I think buying an EM vehicle is more cost effective than owning a conventional (internal combustion engine) vehicle. Buying an EM vehicle will help to mitigate the effects of climate change. I think buying an EM vehicle is a good decision.	[44]
Intention to adopt	Next time I buy a car, I will consider buying an EM vehicle. I expect to drive an EM car in the near future. I intend on driving an EM vehicle in the near future.	[49,50]

### 3.2. Data Collection and Sample

The data used for the empirical evaluation of this model were gathered through an online survey of customers older than 18 years of age and in possession of a driving license. For this purpose, a consultancy company specialising in online surveys—Toluna Spain—was used with a sample that reflects Spain’s population structure. A questionnaire was developed, pre-coded and administered through the Toluna Quick Surveys platform. Responses to this questionnaire were obtained on a voluntary basis between April and July 2018, with full anonymity guaranteed to all respondents. Overall, 404 valid responses were obtained of which 51% were female respondents and 60% were below the age of 46. Among them, 58.7% of respondents were in full- or part-time employment and 77% had five or more years of driving experience. Table 2 outlines the main characteristics of the sample.

Table 2. Demographic characteristics of survey respondents ( $n = 404$ ).

Variable	Description	Frequency	% in Sample
Gender	Female	206	51.0
	Male	198	49.0
Age	18–25	55	13.6
	26–35	111	27.5
	36–45	77	19.1
	46–55	74	18.3
	56–65	56	13.9
	More than 65	31	7.7
Education	Basic schooling or less	21	5.2
	Vocational training	114	28.2
	Bachelor’s degree	178	44.1
	Postgraduate degrees	91	22.5
Employment status	Unemployed	37	9.2
	Student	43	10.6
	Employed	237	58.7
	Self-employed	39	9.7
	Retired	48	11.9

Table 2. Cont.

Variable	Description	Frequency	% in Sample
Monthly income (Euros)	No income	37	9.2
	Less than €1100	73	18.1
	From €1100 to €1800	135	33.4
	From €1800 to €2700	95	23.5
	More than €2700	40	9.9
	Do not know/No answer	24	5.9
Experience as a driver (years)	0–1	27	6.7
	1–3	34	8.4
	3–5	32	7.9
	5–8	207	51.2
	More than 8	104	25.7
Annual distance driven (km)	Up to 2500	78	19.3
	Up to 7500	77	19.1
	Up to 12,500	75	18.6
	Up to 15,000	57	14.1
	Up to 20,000	64	15.8
	Up to 32,500	31	7.7
	More than 32,000	21	5.2

### 3.3. Data Analysis

A structural equation modelling (SEM) approach was used to assess the measurement and structural models. Data analysis was carried out following a two-stage approach. First, the validity and reliability of the measures were assessed using SPSS v20 software. Then, the structural model was assessed to test the research hypotheses using AMOS v18 software.

## 4. Results

### 4.1. Assessment of the Measurement Model

The adequacy of the measures was evaluated by analysing their reliability and validity. The reliability analysis carried out involved two internal consistency indicators: Cronbach's alpha (CA) and composite reliability (CR). The values of both tests were higher than the minimum recommended value—0.6 and 0.7, respectively. Convergent validity was assessed using the average variance extracted (AVE). All AVE values were above the minimum recommended value of 0.50. The AVE estimates for every combination of two factors were also greater than the correlation between the two factors, evidencing discriminant validity [51]. Therefore, according to Hair's [52] recommendations, the measures adopted had appropriate reliability, convergent validity and discriminant validity (Tables 3 and 4).

Table 3. Reliability and convergent validity of the measures.

Variables	Items	Factor Loading	CA	CR	AVE
Quality	Q1	0.80	N/A	0.836	0.719
	Q2	0.89			
Emotional value	E1	0.91	N/A	0.910	0.834
	E2	0.92			
Price	P1	0.90	N/A	0.916	0.845
	P2	0.93			
Social value	S1	0.86	N/A	0.878	0.782
	S2	0.90			

Table 3. Cont.

Variables	Items	Factor Loading	CA	CR	AVE
Acceleration	Acc1	0.79	0.860	0.863	0.679
	Acc2	0.88			
	Acc3	0.80			
Low noise	LN1	0.71	0.873	0.876	0.586
	LN2	0.75			
	LN3	0.77			
	LN4	0.70			
	LN5	0.88			
Attitude	ATT1	0.82	0.868	0.863	0.679
	ATT2	0.76			
	ATT3	0.88			
Intention to adopt	IA1	0.76	0.944	0.910	0.772
	IA2	0.86			
	IA3	0.70			

CA: Cronbach's alpha; CR: composite reliability; AVE: average variance extracted; N/A: not applicable.

Table 4. Discriminant validity of the measures.

	Quality	Emotional	Price	Social	Acceleration	Low Noise	Attitude	Intention
Quality	<i>0.848</i>	-						
Emotional	0.642	<i>0.913</i>	-					
Price	0.487	0.382	<i>0.919</i>	-				
Social	0.437	0.445	0.406	<i>0.884</i>	-			
Acceleration	0.171	0.145	0.158	0.134	<i>0.824</i>	-		
Low noise	0.008	0.048	0.000	0.011	0.000	<i>0.766</i>	-	
Attitude	0.352	0.451	0.597	0.504	0.326	0.279	<i>0.824</i>	-
Intention	0.357	0.514	0.638	0.512	0.330	0.263	0.253	<i>0.879</i>

Values in italics are the square root of the AVE.

The variance inflation factor (VIF) was analysed to test for multicollinearity among the variables. The mean VIF value was 1.8295 and far below the maximum recommended value of 10 [52].

#### 4.2. Goodness of Fit Tests

The results displayed in Table 5 show the values of the goodness of fit of the proposed model. The normed Chi-square value (CMIN) was between 1 and 5 (2.298). The goodness of fit index (GFI) was higher than the recommended value (>0.90) at 0.911. The comparative fit index (CFI) was greater than 0.9 (0.962). The Tucker–Lewis index (TLI) was greater than 0.9 (0.953). The Bollen's incremental fit index (IFI) was also greater than 0.9 (0.962). The root mean square error of approximation (RMSEA) was suitable for the recommended value, <0.08 (0.057). Therefore, all the indices reached the recommended values, indicating that the theoretical model fit well with the collected sample data.

Table 5. Fit indices.

Fit Indices	CMIN	GFI	CFI	TLI	IFI	RMSEA
Recommended value <sup>1</sup>	1–5	>0.90	>0.90	>0.90	>0.90	<0.08
Value of the model	2.298	0.911	0.962	0.953	0.962	0.057

<sup>1</sup> Hair [52]. CMIN: normed Chi-square value; GFI: goodness of fit index; CFI: comparative fit index; TLI: Tucker–Lewis index; IFI: Bollen's incremental fit index; RMSEA: root mean square error of approximation.



### 4.3. Assessment of the Structural Model

In order to evaluate the structural model proposed here, the multiple correlation coefficient squared ( $R^2$ ) was first used. This coefficient indicates the amount of variance of the construct explained by the model. Falk and Miller [53] reported that an appropriate value should be greater than or equal to 0.1. The value of  $R^2$  for attitude was 0.757, with a value of 0.652 obtained for intention to adopt, so that the recommended minimum value was exceeded and the factors explain a high proportion of the model variance. Table 6 shows the causal relationships established in the research hypotheses focusing on the value of the standardized coefficients. Five of the seven hypotheses were supported by the data analysis.

**Table 6.** Research hypotheses tests.

Research Hypotheses	$\beta$	$p$ -Value	Results	$R^2$
Quality → Attitude	−0.020	0.822	Not supported	-
Emotional → Attitude	0.619	0.000	Supported	-
Price → Attitude	0.181	0.000	Supported	-
Social → Attitude	0.046	0.383	Not supported	-
Acceleration → Attitude	0.121	0.004	Supported	-
Low noise → Attitude	0.071	0.049	Supported	-
Attitude → Intention	0.945	0.000	Supported	-
Attitude	-	-	-	0.757
Intention	-	-	-	0.652

$R^2$ : multiple correlation coefficient squared.  $\beta$ : path coefficient.

## 5. Discussion

### 5.1. Theoretical Implications

This study contributes to current knowledge related to consumer attitudes towards EM vehicles and its findings have important theoretical implications for a number of reasons, which are outlined below:

1. The majority of research carried out to date on consumer attitudes towards EM vehicles has focused on people's attitudes towards the environment and barriers to the purchase of EM vehicles [6]. All in all, the findings of this study suggest that the adoption of EM vehicles depends on a wide array of factors (e.g., government incentives and policies, vehicle characteristics, infrastructure availability, price, social and personal issues, environmental concerns) [8–17,54,55]. Building on studies related to the adoption of new technologies [33–37], this study is one of a few to investigate consumers' perceived value and its effect on their attitude towards EM vehicles. As opposed to earlier research on this topic, where different measures of consumer perceived value have prevailed as antecedents to purchase intention of EM vehicles [18], this study instead evaluated the influence of four PERVAL dimensions on consumer attitudes within a theoretical framework based on the theory of perceived value [23] and incorporating the theory of reasoned action [24] to take into account the effect of perceived outcome on customers' intentions to purchase EM vehicles. Among the wide range of perceived value dimensions [29], this study showed that a four-dimension conceptual approach (i.e., quality, emotional value, price and social value) [30–32] is suitable to capture the meaning of the concept. Therefore, this study adds to earlier research on the impact of perceived value on consumers' intention to use transport means [18,19,27,28].
2. The model posited in this study merged PERVAL with two consumer attitude antecedents identified as two of the dimensions of EM vehicle performance most valued by consumers [38–43]. To date, no other study has evaluated the attitude of consumers towards EM vehicles on the basis of customers' perceived value and vehicle performance. The outcome of this analysis is a model

that is easy to use and one that explains to a large extent the diversity of consumer attitudes and their intentions to purchase EM vehicles.

3. This study identified emotional value and value for money as key motivating factors for consumers to purchase EM vehicles. These results are in line with earlier studies carried out in a different cultural context (e.g., China and Malaysia [18,56]) and appear to hold true for the Spanish market too. The findings of this analysis indicate that potential buyers of EM vehicles are influenced primarily by emotions and the experience of driving an EM vehicle, followed by the product's value for money. Thus, this study makes a significant contribution to current knowledge on EM vehicle adoption, as it adds to the findings of earlier research and provides an improved understanding of their validity in a different cultural context.
4. This research showed that rapid vehicle acceleration and low engine noise are two key characteristics, which have a positive influence on consumer attitude. These results expand the findings of earlier studies [42,43,49] and contribute significantly to the literature, given that no other research study to date has evaluated the direct effect of vehicle performance on consumer attitudes towards EM vehicles. Therefore, the findings of this study improve our understanding of the attitude antecedents and, accordingly, the determinants of consumers' behaviour [24] in this respect.
5. Contrary to one of the hypotheses tested as part of this analysis, product quality did not have a significant influence on consumer attitudes. Although earlier studies have shown that perceptions of quality have an influence on purchase decisions of internal combustion engine vehicles [57] and hybrid vehicles [58], this particular research finding may be explained by the fact that the study was carried out with potential consumers who had yet to test drive the vehicles and, as such, had limited information on this particular factor. In fact, a number of earlier studies have suggested that test driving of EM vehicles tends to have a significant impact on consumers' perceptions and attitudes towards these vehicles [59]. In addition to this, given the low market share of EM vehicles at present, the effects of peer-to-peer communication as regards information sharing among customers are lower than for more established alternatives in the market, i.e., internal combustion engine vehicles. This has, in effect, an adverse impact on the possibility of quality perceptions influencing product purchase intentions in the particular case of EM vehicles in Spain [58]. Therefore, this study makes a distinct contribution to the literature by stressing the importance of promoting the product's quality actively, particularly for innovative solutions such as EM vehicles.
6. The social dimension did not have a significant level of influence on consumer attitudes towards EM vehicles. This is in spite of the fact that a number of studies have shown that social factors are key in influencing people's attitudes towards new technologies [60] including EM vehicles [14]; this study showed that social value does not have any effect. This may be due in part to the low market share currently enjoyed by EM vehicles in Spain as well as the general lack of information about this consumer segment, which reduces any social pressures that consumers may have experienced with regards to purchasing EM vehicles. Consequently, in line with earlier research [31,61], this study showed that for the embryonic stages of the market development of innovative technologies such as EM vehicles, social factors are not crucial as regards the adoption of these technologies by customers.

## 5.2. Practical Implications

The findings of this study have several important implications for practitioners as regards motivating factors for consumers to adopt EM vehicles through initiatives building on perceived value and perceived performance. In view of the results obtained in this study, it may be inferred that the sensations and feelings that the product awakens in the consumer are worthy of further consideration. These issues can be built upon by practitioners especially through communication strategies that emphasize issues such as the pleasure derived from driving an EM vehicle, as well as

associated positive feelings related to customers' personal commitment to environmental sustainability. For instance, in 2018, Fisker Inc. launched a model called "EMotion" and Honda developed a new concept of car called "NeuV", alluding in its marketing to the car's 'ability' to read its driver's emotions. Similarly, the creation of positive customer experiences by vehicle manufacturers in the car sales showroom and beyond is of paramount importance here. For instance, Audi is developing virtual showrooms, where some of their newest models are showcased using virtual reality (VR) so that visitors and potential customers may experience a 360 degree view of these vehicles inside as well as outside, listen to their engines and even open their doors in this virtual environment. On the other hand, Tesla's marketing emphasis is on an integrated approach to the customer experience journey, where online technologies play a crucial role.

Parallel to this, test drives of these vehicles will allow customers to validate functional factors, including acceleration and low engine noise. Although the more traditional approach to (physical) test drives is still used by some manufacturers (e.g., Jaguar with their I-Pace model); others, like BMW, are using VR technologies to allow potential buyers to experience new vehicle models and even customise them to their own needs and preferences. Moreover, given the significant influence that these functional factors have on consumers' attitudes, it is important that the marketing of these vehicles emphasizes these attributes and that relevant comparisons are made with traditional internal combustion engine vehicles. For instance, after years of little publicity as regards electric vehicles, Jaguar and Audi have started to advertise some of their new models in mainstream media. In spite of this, it is important to consider that legislation in the EU and the US has forced manufacturers to introduce fake engine noise in their electric vehicles on the grounds of safety. For example, Jaguar's I-Pace model makes a fake engine noise when the driver hits the throttle.

Finally, manufacturers of EM vehicles should optimise their supply chains and negotiate with relevant governments for the introduction of new policies and sector-specific investment incentives to reduce prices and improve the value for money of EM vehicles. For instance, technology development and manufacturing costs could be reduced if manufacturers engaged in a more collaborative relationship with regards to common standards, which could lead to price reductions affecting the purchase and maintenance of EM vehicles. As a practical example of this, Volkswagen worked with ANSYS to optimize the battery cooling system and aerodynamic drag loss of its ID.R all-electric racing vehicle.

### *5.3. Future Research and Limitations*

Finally, although this study provides a significant contribution to existing knowledge, it is not exempt from its own limitations, including the fact that the research was carried out only in Spain. Therefore, the generalisability of the findings to other consumer cultures would depend on a widening of this study to other world regions in order to obtain relevant cross-country comparisons. In addition, data collection was conducted through an online survey platform using a quota sampling method. Future studies could use random sampling to avoid possible selection bias problems. Similarly, as discussed earlier, consumer attitudes may change after testing a product [57]. Future research studies should address this by, for instance, testing the model proposed here before and after consumers test drive an EM vehicle. This is of particular importance, given that earlier studies have shown that potential links may exist between consumers' personal characteristics and their intention to purchase an EM vehicle [47,62]. Further research on this topic should also evaluate the impact of other factors on the model developed here. These factors include antecedents of the perceived value such as motivation, involvement, and knowledge, as well as moderator variables such as consumer media exposure [12,63], age [55], gender and driving experience, among others. Furthermore, future research could apply this customer-perceived value model not just to evaluate the acceptance of EM vehicles but also to apply it to the selection of relevant research and development projects in this context [64].

## 6. Conclusions

This study explored factors influencing customers' intention to purchase EM vehicles within the theoretical frameworks of perceived value and reasoned action. A behavioural model was proposed to evaluate the effect of the PERVAL scale's four dimensions on consumer attitudes, incorporating two functional EM vehicle performance dimensions. The model proposed here was tested empirically using structural equation modelling analysis with data from an online survey of 404 participants in Spain. The results obtained showed that emotion, price, acceleration and low engine noise had a significant influence on consumer attitudes, which in turn have a positive impact on their intention to purchase EM vehicles. However, the hypothesized positive effects of quality and social value on consumer attitudes were not supported by the results of this research. Therefore, this study confirmed the determinant roles of both perceived value and two technical performance characteristics of EM vehicles (i.e., vehicle acceleration and low engine noise levels) in promoting the intention to adopt, through their effect on consumer's attitude.

The results of this study suggest that governments and manufacturers should adopt social and product marketing strategies focused on emotions in order to promote a wider use of EM vehicles. Similarly, these marketing strategies should focus on specific product attributes such as performance and value for money in terms of energy consumption.

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## References

- White, L.V.; Sintov, N.D. You are what you drive: Environmentalist and social innovator symbolism drives electric vehicle adoption intentions. *Transp. Res. Part A Policy Pract.* **2017**, *99*, 94–113. [[CrossRef](#)]
- Li, W.; Long, R.; Chen, H. Consumers' evaluation of national new energy vehicle policy in China: An analysis based on a four paradigm model. *Energy Policy* **2016**, *99*, 33–41. [[CrossRef](#)]
- Zhang, X.; Xie, J.; Rao, R.; Liang, Y. Policy incentives for the adoption of electric vehicles across countries. *Sustainability* **2014**, *6*, 8056–8078. [[CrossRef](#)]
- Yang, T.; Long, R.; Li, W.; Rehman, S.U. Innovative application of the public–private partnership model to the electric vehicle charging infrastructure in China. *Sustainability* **2016**, *8*, 738. [[CrossRef](#)]
- Grauers, A.; Sarasini, S.; Karlstrom, M. Why Electromobility and What Is It? In *Systems Perspectives on Electromobility*; Sandén, B., Wallgren, P., Eds.; Chalmers University of Technology: Gothenburg, Sweden, 2013; pp. 10–21.
- Rezvani, Z.; Jansson, J.; Bodin, J. Advances in consumer electric vehicle adoption research: A review and research agenda. *Transp. Res. Part D Transp. Environ.* **2015**, *34*, 122–136. [[CrossRef](#)]
- Shafiei, E.; Thorkelsson, H.; Ásgeirsson, E.I.; Davidsdottir, B.; Raberto, M.; Stefansson, H. An agent-based modeling approach to predict the evolution of market share of electric vehicles: A case study from Iceland. *Technol. Forecast. Soc. Chang.* **2012**, *79*, 1638–1653. [[CrossRef](#)]
- Heffner, R.R.; Kurani, K.S.; Turrentine, T.S. Symbolism in California's early market for hybrid electric vehicles. *Transp. Res. Part D Transp. Environ.* **2007**, *12*, 396–413. [[CrossRef](#)]
- Kahn, M.E. Do greens drive Hummers or hybrids? Environmental ideology as a determinant of consumer choice. *J. Environ. Econ. Manag.* **2007**, *54*, 129–145. [[CrossRef](#)]
- Gallagher, K.S.; Muehlegger, E. Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. *J. Environ. Econ. Manag.* **2011**, *61*, 1–15. [[CrossRef](#)]
- Noppers, E.H.; Keizer, K.; Bolderdijk, J.W.; Steg, L. The adoption of sustainable innovations: Driven by symbolic and environmental motives. *Glob. Environ. Chang.* **2014**, *25*, 52–62. [[CrossRef](#)]

12. Moons, I.; De Pelsmacker, P. An extended decomposed theory of planned behaviour to predict the usage intention of the electric car: A multi-group comparison. *Sustainability* **2015**, *7*, 6212–6245. [[CrossRef](#)]
13. Kim, S.; Lee, J.; Lee, C. Does driving range of electric vehicles influence electric vehicle adoption? *Sustainability* **2017**, *9*, 1783. [[CrossRef](#)]
14. Nosi, C.; Pucci, T.; Silvestri, C.; Aquilani, B. Does Value Co-Creation Really Matter? An Investigation of Italian Millennials Intention to Buy Electric Cars. *Sustainability* **2017**, *9*, 2159. [[CrossRef](#)]
15. Rodríguez-Brito, M.; Ramírez-Díaz, A.; Ramos-Real, F.; Perez, Y. Psychosocial Traits Characterizing EV Adopters' Profiles: The Case of Tenerife (Canary Islands). *Sustainability* **2018**, *10*, 2053. [[CrossRef](#)]
16. Liao, F.; Molin, E.; Timmermans, H.; van Wee, B. Consumer preferences for business models in electric vehicle adoption. *Transp. Policy* **2019**, *73*, 12–24. [[CrossRef](#)]
17. Rietmann, N.; Lieven, T. A comparison of policy measures promoting electric vehicles in 20 countries. In *The Governance of Smart Transportation Systems*; Springer: Cham, Switzerland, 2019; pp. 125–145. [[CrossRef](#)]
18. Jiang, S. Purchase Intention for Electric Vehicles in China from a Customer-Value Perspective. *Soc. Behav. Personal.* **2016**, *44*, 641–655. [[CrossRef](#)]
19. Wang, Y.; Douglas, M.A.; Hazen, B.T.; Dresner, M. Be green and clearly be seen: How consumer values and attitudes affect adoption of bicycle sharing. *Transp. Res. Part F Traffic Psychol. Behav.* **2018**, *58*, 730–742. [[CrossRef](#)]
20. Expansión. España: Matriculaciones de Vehículos Nuevos. 2019. Available online: <https://datosmacro.expansion.com/negocios/matriculaciones-vehiculos/espana> (accessed on 14 May 2019).
21. Ministerio para la Transición Ecológica. Plan Nacional Integrado de Energía y Clima (PNIEC) 2021–2030. 2019. Available online: <https://www.idae.es/informacion-y-publicaciones/plan-nacional-integrado-de-energia-y-clima-pniec-2021-2030> (accessed on 15 April 2019).
22. ANFAC. *Las Matriculaciones de Vehículos Electrificados, Híbridos y de Gas Crecen un 37% en Abril*; Asociación Española de Fabricantes de Automóviles de Camiones: Madrid, Spain, 2019. Available online: <http://www.anfac.com/noticias.action> (accessed on 12 May 2019).
23. Zeithaml, V.A. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *J. Mark.* **1988**, *52*, 2–22. [[CrossRef](#)]
24. Fishbein, M.; Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*; Addison-Wesley: Reading, MA, USA, 1975. [[CrossRef](#)]
25. Ozaki, R.; Sevastyanova, K. Going hybrid: An analysis of consumer purchase motivations. *Energy Policy* **2011**, *39*, 2217–2227. [[CrossRef](#)]
26. Ajzen, I. The theory of planned behaviour. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [[CrossRef](#)]
27. Lai, W.T.; Chen, C.F. Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement. *Transp. Policy* **2011**, *18*, 318–325. [[CrossRef](#)]
28. Chen, C.F. Investigating structural relationships between service quality, perceived value, satisfaction, and behavioral intentions for air passengers: Evidence from Taiwan. *Transp. Res. Part A Policy Pract.* **2008**, *42*, 709–717. [[CrossRef](#)]
29. Sweeney, J.C.; Soutar, G.N. Consumer perceived value: The development of a multiple item scale. *J. Retail.* **2001**, *77*, 203–220. [[CrossRef](#)]
30. Sánchez-Fernández, R.; Iniesta-Bonillo, M.Á. The concept of perceived value: A systematic review of the research. *Mark. Theory* **2007**, *7*, 427–451. [[CrossRef](#)]
31. Turel, O.; Serenko, A.; Bontis, N. User acceptance of wireless short messaging services: Deconstructing perceived value. *Inf. Manag.* **2007**, *44*, 63–73. [[CrossRef](#)]
32. Walsh, G.; Shiu, E.; Hassan, L.M. Replicating, validating, and reducing the length of the consumer perceived value scale. *J. Bus. Res.* **2014**, *67*, 260–267. [[CrossRef](#)]
33. Collier, J.E.; Sherrell, D.L.; Babakus, E.; Horkey, A.B. Understanding the differences of public and private self-service technology. *J. Serv. Mark.* **2014**, *28*, 60–70. [[CrossRef](#)]
34. Kim, J.; Park, E. Beyond coolness: Predicting the technology adoption of interactive wearable devices. *J. Retail. Consum. Serv.* **2019**, *49*, 114–119. [[CrossRef](#)]
35. Molinillo, S.; Muñoz-Leiva, F.; Pérez-García, F. The effects of human-game interaction, network externalities, and motivations on players' use of mobile casual games. *Ind. Manag. Data Syst.* **2018**, *118*, 1766–1786. [[CrossRef](#)]

36. Truong, Y. A cross-country study of consumer innovativeness and technological service innovation. *J. Retail. Consum. Serv.* **2013**, *20*, 130–137. [[CrossRef](#)]
37. Yang, K.; Jolly, L.D. The effects of consumer perceived value and subjective norm on mobile data service adoption between American and Korean consumers. *J. Retail. Consum. Serv.* **2009**, *16*, 502–508. [[CrossRef](#)]
38. Kang, M.J.; Park, H. Impact of experience on government policy toward acceptance of hydrogen fuel cell vehicles in Korea. *Energy Policy* **2011**, *39*, 3465–3475. [[CrossRef](#)]
39. She, Z.Y.; Sun, Q.; Ma, J.J.; Xie, B.C. What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China. *Transp. Policy* **2017**, *56*, 29–40. [[CrossRef](#)]
40. Han, L.; Wang, S.; Zhao, D.; Li, J. The intention to adopt electric vehicles: Driven by functional and non-functional values. *Transp. Res. Part A Policy Pract.* **2017**, *103*, 185–197. [[CrossRef](#)]
41. Skippon, S.M. How consumer drivers construe vehicle performance: Implications for electric vehicles. *Transp. Res. Part F Traffic Psychol. Behav.* **2014**, *23*, 15–31. [[CrossRef](#)]
42. Skippon, S.; Garwood, M. Responses to battery electric vehicles: UK consumer attitudes and attributions of symbolic meaning following direct experience to reduce psychological distance. *Transp. Res. Part D Transp. Environ.* **2011**, *16*, 525–531. [[CrossRef](#)]
43. Schmalfuß, F.; Mühl, K.; Krems, J.F. Direct experience with battery electric vehicles (BEVs) matters when evaluating vehicle attributes, attitude and purchase intention. *Transp. Res. Part F Traffic Psychol. Behav.* **2017**, *46*, 47–69. [[CrossRef](#)]
44. Mohamed, M.; Higgins, C.; Ferguson, M.; Kanaroglou, P. Identifying and characterizing potential electric vehicle adopters in Canada: A two-stage modelling approach. *Transp. Policy* **2016**, *52*, 100–112. [[CrossRef](#)]
45. Petschnig, M.; Heidenreich, S.; Spieth, P. Innovative alternatives take action—Investigating determinants of alternative fuel vehicle adoption. *Transp. Res. Part A Policy Pract.* **2014**, *61*, 68–83. [[CrossRef](#)]
46. Shi, H.; Wang, S.; Zhao, D. Exploring urban resident’s vehicular PM<sub>2.5</sub> reduction behavior intention: An application of the extended theory of planned behavior. *J. Clean. Prod.* **2017**, *147*, 603–613. [[CrossRef](#)]
47. Wang, N.; Yan, R. Research on consumers’ use willingness and opinions of electric vehicle sharing: An empirical study in Shanghai. *Sustainability* **2016**, *8*, 7. [[CrossRef](#)]
48. Zhang, X.; Bai, X.; Shang, J. Is subsidized electric vehicles adoption sustainable: Consumers’ perceptions and motivation toward incentive policies, environmental benefits, and risks. *J. Clean. Prod.* **2018**, *192*, 71–79. [[CrossRef](#)]
49. Moons, I.; De Pelsmacker, P. Emotions as determinants of electric car usage intention. *J. Mark. Manag.* **2012**, *28*, 195–237. [[CrossRef](#)]
50. Barbarossa, C.; De Pelsmacker, P.; Moons, I. Personal Values, Green Self-identity and Electric Car Adoption. *Ecol. Econ.* **2017**, *140*, 190–200. [[CrossRef](#)]
51. Fornell, C.; Larcker, D.F. Structural equation models with unobservable variables and measurement error: Algebra and statistics. *J. Mark. Res.* **1981**, *18*, 382–388. [[CrossRef](#)]
52. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 7th ed.; Pearson Education Limited: Essex, UK, 2018.
53. Falk, R.F.; Miller, N.B. *A Primer for Soft Modeling*; University of Akron Press: Akron, OH, USA, 1992.
54. Lai, I.; Liu, Y.; Sun, X.; Zhang, H.; Xu, W. Factors influencing the behavioural intention towards full electric vehicles: An empirical study in Macau. *Sustainability* **2015**, *7*, 12564–12585. [[CrossRef](#)]
55. Bigerna, S.; Micheli, S. Attitudes Toward Electric Vehicles: The Case of Perugia Using a Fuzzy Set Analysis. *Sustainability* **2018**, *10*, 3999. [[CrossRef](#)]
56. Sang, Y.N.; Bekhet, H.A. Modelling electric vehicle usage intentions: An empirical study in Malaysia. *J. Clean. Prod.* **2015**, *92*, 75–83. [[CrossRef](#)]
57. Devaraj, S.; Matta, K.F.; Conlon, E. Product and service quality: The antecedents of customer loyalty in the automotive industry. *Prod. Oper. Manag.* **2001**, *10*, 424–439. [[CrossRef](#)]
58. Heutel, G.; Muehlegger, E. Consumer learning and hybrid vehicle adoption. *Environ. Resour. Econ.* **2015**, *62*, 125–161. [[CrossRef](#)]
59. Jensen, A.F.; Cherchi, E.; Mabit, S.L. On the stability of preferences and attitudes before and after experiencing an electric vehicle. *Transp. Res. Part D Transp. Environ.* **2013**, *25*, 24–32. [[CrossRef](#)]
60. Kalinic, Z.; Marinkovic, V.; Molinillo, S.; Liébana-Cabanillas, F. A multi-analytical approach to peer-to-peer mobile payment acceptance prediction. *J. Retail. Consum. Serv.* **2019**, *49*, 143–153. [[CrossRef](#)]

61. Liébana-Cabanillas, F.; Molinillo, S.; Ruiz-Montañez, M. To use or not to use, that is the question: Analysis of the determining factors for using NFC mobile payment systems in public transportation. *Technol. Forecast. Soc. Chang.* **2019**, *139*, 266–276. [[CrossRef](#)]
62. Nosi, C.; Pratesi, C.A.; D'agostino, A. A benefit segmentation of the Italian market for full electric vehicles. *J. Mark. Anal.* **2014**, *2*, 120–134. [[CrossRef](#)]
63. Chen, C.C.; Chen, C.W.; Tung, Y.C. Exploring the Consumer Behavior of Intention to Purchase Green Products in Belt and Road Countries: An Empirical Analysis. *Sustainability* **2018**, *10*, 854. [[CrossRef](#)]
64. Lee, S.; Cho, C.; Choi, J.; Yoon, B. R&D Project Selection Incorporating Customer-Perceived Value and Technology Potential: The Case of the Automobile Industry. *Sustainability* **2017**, *9*, 1918. [[CrossRef](#)]



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