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Does Value Co-Creation Really Matter? An Investigation of Italian Millennials Intention to Buy Electric Cars

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Abstract: The present research aims to explore the determinants of (full) electric vehicle (EV) buying intention of Italian millennials focusing on the role that value co-creation initiatives might play in the buying decision-making process. Value co-creation initiatives in the EV domain are studied employing an enhanced version of the Theory of Reasoned Action which, in addition to the traditional variables of the model, also includes perceived importance of cars' attributes. Structural Equation Modeling (SEM) is used to analyze the data collected though an online survey on 523 Italians aged 18–35. The outcomes provide recommendations to tailor proper initiatives to encourage millennials' buying intention of electric vehicles supporting private companies in favoring the adoption of wide-spread pro-environmental behaviors among Italian youngsters.

Keywords: value co-creation; electric vehicles (EVs); car attributes; Theory of Reasoned Action

1. Introduction

Awareness of the necessity to protect the environment against transport-caused pollution is proved by the multiple greenhouse gas reduction plans developed by policy makers all over the world. According to the EEA (European Environment Agency) [1], in the EU member States, 96% of the transport sector depends on oil. Transport accounts for about a third of all energy consumption, for more than a fifth of greenhouse gas emissions, and is also responsible for a large share of urban air pollution and noise nuisance, which contribute to worsening the quality of life of all European citizens. Therefore, the European Commission has settled a 60% greenhouse gas emissions reduction target for transport to be reached by all EU members by 2050 [2]. However, despite the struggles of the European countries to meet the requirements of the EU policy, air pollutant concentrations are still too high, and air quality problems persist.

The large-scale adoption of alternative-fuel vehicles (AFVs), that is vehicles running on a fuel other than traditional gasoline or diesel, represents a means for achieving an emission free mobility in the future [3]. Among others, AFVs include vehicles whose engine is powered by ethanol, butanol, methanol, and, of course, electricity. In the domain of electricity-alimented cars, which use electricity either as their primary fuel or to improve the efficiency of conventional vehicle performance, three different main types of cars exist. Hybrid electric vehicles (HEVs) are mostly powered by a combustion engine, alimented by conventional or alternative fuel, and an electric motor that exploits energy stored in a battery. The battery is charged by driving, through the internal engine and does not need to be plugged in to charge. Plug-in hybrid electric vehicles (PHEVs), while still boasting of a combustion engine and an electricity-alimented motor, can be plugged in to a grid by means of a cable to recharge the battery. Finally, all-electric or full-electric vehicles (EVs) are exclusively powered by a battery that stores the electric energy. In this case, batteries are charged by plugging the vehicle into an electric power source [4]. Differently from HEVs and PHEVs, EVs—the product category this article focuses on—are considered a disruptive innovation, which entails radical modifications in people's driving behavior. Energy storage, power capability, safety as well as life expectancy of the battery are elements that contribute to the poorer driving performance of all electric vehicles compared to combustion engine cars, ultimately preventing their broad diffusion. In addition to rising buying costs for consumers, the current battery technology is characterized by limited range, low speed, and long recharging time. A further problem that constitutes a major obstacle for potential EV adopters is the development of a widespread infrastructure needed to ensure access to charging both at home and at public stations [5].

To provide complete information, it is worth noting that, even if considered a disruptive innovation nowadays, electric cars were first introduced more than a century ago. Already at the beginning of the 1900s, in fact, small-scale productions of battery-powered vehicles were started in Eastern and Northern Europe, and in the US, and soon EV manufacturers became the dominant players in the automotive sector. The first EVs were simpler to start and more comfortable, safer and faster than combustion-engine cars, and were the early luxury vehicles [6]. As witnessed by an article published in the New York Times in January 1911 [7], electric cars were quiet, easy to drive and did not emit a malodorous pollutant like the other vehicles of the time. EVs rapidly became popular with urban residents, especially women, suiting short-range driving needs, mainly within city limits. The following decades till the present time assisted to subsequent starts and stops of electric cars mainly due to the limited advances in electric car technology, which prevented solving two major—and still relevant—hurdles associated with electric driving: range restrictions and lack of an effective recharging infrastructure [6].

The increasing popularity of electric vehicles in the last twenty years can therefore be considered a "revival" of EVs and can be traced back to the rise of ecological concerns with reference to transport-related environmental harm on the part of both public authorities and citizens [5]. Witnessing the growing interest in alternative-fuel vehicles, in their literature review of the socio-economic impact of EVs, Hanke et al. [8] have monitored the number of the online searches for the words "electric cars" made on Google over the period 2004–2012. From 861,000 in 2004, they rocketed to more than 42 million eight years later. This clearly proves that alternative-fuel vehicle adoption has become a socially-wide phenomenon.

However, despite the widespread consciousness that AFVs represent an energy-efficient means of transport, and whose diffusion could help to lessen gasoline consumption and CO_2 emissions, eventually improving the environmental condition of the planet, alternative-fuel cars still represent a trivial segment of the global automotive market [9]. Based on the 2017 report of IEA (International Energy Agency) [10], the worldwide market share of EVs is far lower than 1%. Except for some virtuous countries, such as Norway, the Netherlands and Sweden, where the EV market share is 29%, 6.4% and 3.4%, respectively, in all other countries, the transport sector is largely dominated by traditional combustion engine cars.

Being (full) electric vehicles a disruptive innovation [5], millennials have been regarded as a valuable market segment with a high potential for EV adoption. People currently aged 18–35, in fact, are claimed to be inclined to use and consume products and services characterized by a high degree of novelty, being socially conscious, and holding a positive image of environmentally friendly products [11,12]. Millennials could be the target segment of EV producers in the future. However, the results of recent studies have been contradicting. Contrary to expectations, 70% of millennials would not consider buying an electric car [13]. Strengthening these results, a recent research aimed at segmenting the Italian market of full electric vehicles [5] pointed out that the youngsters held very controversial attitudes toward EVs.

Thus, despite the increasing interest in ecological moving on the part of industry operators, and the number of studies investigating the phenomenon, even on millennials, understanding the factors that might facilitate or hinder EV adoption still represents a major issue at both the theoretical and the empirical level.

With relation to Italy, according to the last available report of ACI (Automobile Club d'Italia—Italian Car Club) [14], in 2016, out of a total of 37,876,138 cars, only 126,508 were either hybrid or electric, representing slightly more than 0.3% of the entire country car fleet.

Furthermore, based on a very recent research on the so called "dieselgate" (the scandal that involved major car manufacturers caught cheating on vehicle emissions tests) [15], there are more than 100 million diesel cars in Europe, twice as many as in the rest of the world, and Italy carries the heaviest burden in terms of number of premature deaths due to small particle pollution from light duty diesel cars. Our country definitely must cope with urgent environmental challenges related to the increase in greenhouse gas emissions due to the massive circulation of traditional combustion engine vehicles. The usefulness of this investigation resides first in the fact that researches in this field at the country level are still very few and its results could be useful for car manufacturers but also interesting for policy makers. Furthermore, given that the whole Europe must cope with huge environmental issues due to the massive circulation of combustion engine cars, the present study could represent a first step in the investigation of electric vehicle adoption that could be potentially replicated in other countries providing valuable outcomes at both the industry and the governmental level.

The present research aims therefore to explore the determinants of electric vehicle buying behavior of Italian millennials focusing on the role that value co-creation initiatives implemented by the car manufacturer might have on buying intention. The influence of value co-creation initiatives on behavioral intention in the EV domain are studied employing an enhanced version of the Theory of Reasoned Action which, in addition to the traditional variables of the model, also includes perceived influence exerted by cars' attributes. The manuscript is organized as follows. Section 2 provides the theoretical background and the hypotheses at the basis of our conceptual model; Section 3 presents the characteristics of the sample and the measures used in the investigation; Section 4 illustrates the statistical results; and Section 5 provides the discussion of the findings, managerial suggestions, as well as limitations of the study and hints for future research. The outcomes of the investigation provide recommendations to tailor proper and applicable initiatives to encourage millennials' buying intention of electric vehicles, supporting private companies in favoring the adoption of wide-spread pro-environmental behaviors among Italian youngsters.

2. Theoretical Background and Hypotheses

2.1. Streams of Literature on AFV Buying Behavior

Based on a recent literature review on consumer preferences for AFVs [16], studies regarding electric vehicle adoption can be basically classified into two major groups: studies of an economic type and of a psychological type. The first widely adopt the discrete choice analysis methodology, where consumers are required to make decisions between alternative vehicles based on the preference they hold for dissimilar cars' attributes, such as speed, recharging time, price, etc. [17–19]. Simply said, the aim of these studies is to estimate the influence that different attributes—denoted by different consumer preference levels—exert on the decision to adopt an electric vehicle.

Differently, psychological studies focus on consumer individual traits, such as beliefs, attitudes, emotions, personal and moral norms, perceived behavioral control and social pressure, environmental concern, etc. [4], to reveal if and to what extent these factors have an impact on intentions for EV adoption.

In the latter literature stream, researchers have been mainly focusing on the barriers preventing consumers from adopting an electric car [16,20] to overcome them and provide recommendations to both car manufacturers and policy makers with the aim of finding ways to enhance AFV adoption.

Some of the barriers are product-related, such as car performance (limited speed, lengthy battery recharging time, and high price), while others are still related to the product but are considered of a contextual type, such as the charging infrastructure or government policies. Some barriers are instead consumer-related, such as socio-demographic and psychological characteristics, as well as driving habits.

With relation to our study, it can be definitely included in the psychological research stream, as it entails some consumer psychological traits and investigates the relevance that some product attributes have in the consumer EV decision to buy. Furthermore, to the best of the authors' knowledge, no previous study on EVs has considered the role that consumer involvement in possible value co-creation projects provided by car manufacturers might play in the decision-making process of purchasing an electric car. Hence, the manuscript value added can be found especially in the exploration of the role that co-creation initiatives might play in the consumer purchase decision-making.

2.2. Electric Car Attributes

Starting from the 1990s, a growing number of scholarly contributions have been focusing on EVs as a consequence of the attention that consumers increasingly pay to environmental issues [4,20,21]. EV attributes, such as price, fuel cost, range, fuel availability, service station refueling cost, emission reduction and battery cost have been deemed important as elements influencing consumer purchase intention and behavior [22–24]. In particular, it has been claimed that high purchase price, long recharging time and limited driving range can constitute barriers to purchasing EVs [25–29]. In addition to considering the still limited available "model variety" [18] and the narrow charging network ("hardware facilities") [30], some authors [23,27] recognize that the major barriers to EV adoption are mainly represented by the battery lifetime and its overall cost. Indeed, in their latent class random utility model, Hidrue et al. [18] demonstrate that extending battery duration would enhance consumers' willingness to buy an EV despite the higher price of electric cars compared to traditional fuel vehicles. Accordingly, our first is hypothesis:

Hypothesis (Hp.) 1a. *Perceived importance of barriers is negatively related to EV buying intention.*

Over time, also benefits have been studied with relation to EV intention to buy. In this domain, Hidrue et al. [18] finds that the economic benefits related to low consumption affect consumers intention to buy an EV more than their willingness to be green or protect the environment. Mairesse et al. [31] claim that the "driving experience" (engine noise, maximum speed, acceleration and design) and "vehicle quality" (safety, reliability, and comfort) can positively influence the willingness to buy electric cars. According to Miao et al. [21], improving the EV service quality (technical and functional quality) and the customer value positively affect customer satisfaction and the post-purchase for EV. In particular, among technical quality (TQ) and functional quality (FQ) attributes, the authors identify the following sub-attributes: maximum speed, charging time, charging network, energy consumption per 100 km, unit cost of maintenance, guarantee deposit used, warm service, clear lease contract. Lai et al. [20] demonstrate that economic benefits (i.e., low running costs and maintenance costs) are among the main factors affecting the adoption of full electric cars. Finally, Mairesse et al. [31] suggest that consumer purchasing decisions are led by overall attitudes towards "objective" car attributes. Therefore, we posit the following hypothesis:

Hp. 1b. *Perceived importance of benefits is positively related to EV buying intention.*

Schuitema et al. [32] and Rezvani et al. [4] relate the willingness to buy EVs to technological innovation, identifying three different attributes: instrumental, hedonic and symbolic. In particular, Schuitema et al. [32] demonstrate that instrumental attributes (i.e., purchase price, running costs, reliability, performance, driving range and recharging time) positively influence the adoption of an EV. Such features are important in that they are connected to other attributes resulting from possessing and using electric cars including gratification of driving (hedonic attributes) and identity resulting from possessing and using electric cars (symbolic attributes). Moreover, according to the same authors, instrumental attributes are strongly linked to new technologies that they ascribe to the possibility to take advantage of the realized EV best performance in terms of functionality or utility. According to Wood and Moreau [33] and Rezvani et al. [4], technological innovation is a very important factor in order to generate consumers' emotions, which influence innovation appraisal and thus buying decision-making. Finally, Turrentine and Kurani [34] suggest that some consumers are attracted by new technologies while Han et al. [35] define EVs a particular kind of innovation. According to this point of view it can be stated that the technological innovation interest can play an important role in determining the intention to buy an EV, especially for millennials, even if the literature reports contradicting results for this target. Accordingly, our third hypothesis is:

Hp. 1c. *Perceived importance of innovative technological services is positively related to EV buying intention.*

According to Miao et al. [21], among services related to EV, an important role is played by "personal communication" attributes. The authors classify these attributes demonstrating their positive effect on EV adoption. According to Yang et al. [36] and Li et al. [30], inefficient supporting facilities can negatively affect the intention to buy an EV. David [37] and Rezvani et al. [4] suggest that the EV market shows several technological differences when compared to the traditional market of fuel vehicles and the level of consumer knowledge on EV characteristics and performance is quite low. Then, the presence of professional and efficient pre- and post-sale consulting services, professional pre-sale consulting staff and easy access to all information necessary to make a decision, in addition to clear lease contract conditions, could positively influence the intention to buy an EV. Based on these insights, our hypothesis is:

Hp. 1d. *Perceived importance of pre- and post-sale services is positively related to EV buying intention.*

2.3. The Theory of Reasoned Action

A large body of literature considers EV adoption a rational behavior under human volitional control, i.e., the result of a conscious and deliberate decision of a person to make an effort in performing that behavior. Consequently, to predict people's intention to purchase EVs, multiple studies adopt rational-choice-based models [4], which assume individuals being able to evaluate and ponder the consequences of their actions before taking them and perform those that provide the most desirable outcomes [38]. Among these models, the Theory of Reasoned Action [39]—either in its original or in extended versions, mostly the Theory of Planned Behavior [40]—have been successfully used to predict numerous pro-environmental behaviors, such as using energy-saving light bulbs and unbleached paper [41], staying at green hotels [42], consuming organic food [43], recycling [44], etc. This is why the TRA (and the TPB) have also been adopted in the domain of alternative-fuel vehicles buying behavior [45].

The core concept of the TRA is intention to behave, which is considered predictive of overt behavior. The factors influencing intention are attitude toward the behavior in question (ATT), subjective norm (SN) and, in the case of the TPB, the individual's perceived behavioral control (PBC), which is the perceived feasibility of the decision [46].

In the models, attitude refers to the overall—positive or negative—evaluation of the investigated behavior and it is assumed that the more positive the attitude, the more likely the intention to behave [39]. In the field of alternative fuel car purchase intention, ATT has been found positively related to both hybrid-electric [9] and full electric vehicles [47]. Accordingly, our hypothesis is the following:

Hp. 2a. *Attitude is positively related to EV buying intention.*

Subjective norm is the person's perceived social pressure exerted by salient referents in performing the behavior and the higher the perceived pressure, the more likely the behavioral intention [39].

With relation to SN and EV adoption intention, contradicting outcomes have been reported by Jeon et al. [48]. In their multi-country research, they found that important others influence was statistically significant in China but not in Korea, suggesting that the factors impacting intention to adopt may vary based on country-related elements, such as consumer culture, economic situation, etc. The impact of social influence in AFV buying has been instead confirmed by studies achieved in Canada [49], Germany [50], and Sweden [51]. Then our hypothesis is:

Hp. 2b. *Subjective norm is positively related to EV buying intention.*

2.4. Value Co-Creation

In the last 15 years, the term "value co-creation" has been extensively used in the literature [52] assuming dissimilar meanings and with reference to different disciplinary fields (e.g., management [53], marketing [54,55], and business networks [56]). Nevertheless, today, value co-creation is still one of the concepts more "ill-defined and elusively used" (p. 1521), not only in the service marketing domain—in which Grönroos has tried to define it [57,58]—but also in the broader context of management studies. Besides the persisting terminological fuzziness, some fundamental premises of value co-creation are yet recognized. According to the Service-Dominant Logic [54], the value co-creation perspective adopted in the present research, marketing thought has moved from a view dominated by goods, where physical outputs and separate transactions were the main focus (goods-dominant logic), to a view dominated by services, where immateriality, exchange activities, and relationships are fundamental (service-dominant logic). Service becomes the basis of each exchange and value. Instead of being created by firms and destroyed by consumers—who should no longer be labeled "consumers—value is always exclusively and phenomenologically settled by the beneficiary in a context where all involved actors are resource integrators [59] taking part in a co-creation process [55]. The marketing basic assumption changes and moves from a "marketing to" to a "marketing with" other actors collaborating in complex networks [60].

With specific reference to co-design and development, as well as co-production, the customer involvement and participation extent is claimed to depend on various factors [61]: (1) expertise, in that expert customers are more likely to participate in co-production; (2) control, when beneficiaries want to "codirect outcomes", co-production is more likely to happen; (3) tangible capital, when actors have the tangible capital to perform the desired coproduction activities, this can more easily happen; (4) risk taking, co-production involve some kind of risk—i.e., physical, psychological and/or social—and the beneficiary, depending on the situation, can enhance or reduce it; (5) psychic benefits, which represent the primary motive to collaborate in a context where value co-creation and coproduction cannot be easily distinguished; and (6) economic benefits, co-production can more easily happen when actors think that co-production rewards them adequately, considering the time spent in collaborating [60].

Product complexity (i.e., newness, highly technological features, management difficulty, and unaccustomed using behavior) may represent obstacles in co-creation processes. Complex products—as EVs are—may lead customers to rely on firm resources [62] also because they probably do not have the expertise needed to participate in co-production or the tangible capital necessary to carry out the desired co-production activities. Furthermore, they could also feel the time spent in developing such activities—a great amount—will not be adequately rewarded [60,61].

Despite this, in the automotive sector, different co-creation initiatives have been achieved giving rise to successful results. The Audi virtual lab, for example, is an online platform where a community of individuals share thoughts and opinions about cars. The carmaker exploits people contributions mainly in the stage of concept development, inviting the community members to evaluate, comment and propose improvements of developing product concepts [63]. In Canada, Volkswagen has adopted a co-creation strategy to engage people in creating ads for the company's Golf compact car. Through Facebook, individuals have supported Volkswagen in developing the script for the ad, choosing the actors, and selecting the jingle [64]. Fiat's concept car was launched in Brazil in 2010. Named Fiat Mio, the vehicle was the result of a widespread co-creation initiative that involved 17,000 subscribers in more that 120 countries who submitted more than 11,000 ideas [64].

Although there is little information on the effect of value co-creation in the green industry, the literature shows that, in general, co-creation increases trust toward companies and eventually rises consumer intention to purchase products [65].

Considering this, we put forward the following hypothesis:

Hp. 3. *Co-creation involvement positively influences EV buying intention.*

Furthermore, consumers should be positively affected by the possibility and/or opportunity to contribute to overcome barriers to purchase, especially when they are involved in making suggestions and recommendations to product improvements. Thus, our hypothesis is the following:

Hp. 4a. *The higher is the perceived importance of barriers, the higher is the co-creation involvement.*

This same thought can be applied to benefits, this time however considering that benefits can positively affect value co-creation. Therefore, the following hypothesis can be put forward:

Hp. 4b. *The higher is the perceived importance of benefits, the higher is the co-creation involvement.*

The availability of innovative technological services could represent a further incentive to collaboration, therefore we suppose that:

Hp. 4c. *The higher is the perceived importance of innovative technological services, the higher is the co-creation involvement.*

Pre- and post-sale services seem necessary when the consumers are not perfectly aware about the peculiar features and characteristics of a new product as an EV. Therefore, we propose the following hypothesis:

Hp. 4d. *The higher is the perceived importance of pre- and post-sale services, the higher is the co-creation involvement.*

Attitude toward buying an EV and perceived social pressure may influence the inclination of people to being involved in co-creation activities, therefore our further hypotheses are:

Hp. 5a. *Attitude positively influences value co-creation involvement.*

Hp. 5b. *Subjective norm positively influences value co-creation involvement.*

Factors facilitating or hindering EV buying behavior can be related to value co-creation initiatives. In particular, value co-creation involvement can be thought as a mediator between these factors and intention to buy an electric car. This given, our hypotheses are as follows:

Hp. 6a. *Perceived importance of barriers is positively mediated by value co-creation involvement.*

Hp. 6b. *Perceived importance of benefits is positively mediated by value co-creation involvement.*

Hp. 6c. *Perceived importance of innovative technological services is positively mediated by value co-creation involvement.*

Hp. 6d. *Perceived importance of pre- and post-sales services is positively mediated by value co-creation involvement.*

Coming to the TRA constructs, it can be said that both attitude and subjective norm are supposed to be positively related to buying intention and that it has been supposed that both are positively affected by value co-creation; therefore, the final hypotheses are:

Hp. 7a. *Attitude is positively mediated by value co-creation involvement.*

Hp. 7b. *Subjective norm is positively mediated by value co-creation involvement.*

3. Materials and Methods

3.1. The Sample

Data for this investigation were collected by means of an online survey conducted during July–September 2017. Two filter questions were asked at the beginning of the questionnaire to select respondents based on their age and place of residence: Non-millennials and people not living in the central regions of Italy were excluded from the survey, which involved therefore only Italian individuals aged 18–35 living in the center of the country. The decision to circumscribe the sample including only youngsters living in the central regions of Italy was because the authors exploited their personal online channels (mail, Facebook profile, etc.) to circulate the questionnaire. Given that all authors live and work in universities in the center of the country, it was highly probable that the respondents would have been almost totally resident in this area, therefore the decision to limit the investigation from a geographical point of view was deemed appropriate. The sampling method was thus of a purposive type. In all, 637 questionnaires were returned. After the data cleaning, 523 complete questionnaires were considered valid for elaboration and were analyzed.

3.2. The Measures

Measures for the model were adapted from the existing scales from prior research. Some rewordings of scale items were made to adjust to the context of EV adoption (Table 1). Attitude (ATT) toward buying EVs was assessed by using a four-item, 5-point semantic differential scale with the stem "For me, buying an EV in the next 2 years is . . . ": harmful/beneficial; foolish/wise; unnecessary/essential; difficult/easy. Subjective norm (SN) was measured by obtaining the respondents' level of agreement to the statements: "My parents/friends think that I should buy an EV within the next 2 years" based on a 5-point Likert scale where 1 = completely disagree and 5 = completely agree. The perceived importance of technological services (TS), Barriers, Benefits, and Pre- and post-sale services (PPSS) was operationalized by gaining the interviewees' assessment of the influence that EVs characteristics and complementary services would have in their purchasing decision, and were assessed using 7-, 5-, 3-, and 4-item 5-point Likert scales, respectively, where 1 = definitely no and 5 = definitely yes. Value co-creation (VCC) involvement was assessed using a 6-item 5-point Likert scale where 1 = not at all important and 5 = extremely important, measuring the importance that the respondents, once involved in a co-creation process by the car manufacturer, would give to some aspects of the relationship (e.g., the car manufacturer takes into serious considerations provided ideas and tips, clearly explains the benefits coming from the co-creation project, etc.). Behavioral intention (BI) was operationalized as the agreement with sentences related to the person's will to buy an EV within the next 2 years (i.e., I intend/will make an effort to/want to buy an electric car within the next two years) and was measured on a 3-item 5-point Likert scale, where 1 = totally disagree and 5 = totally agree. Finally, we also included 2 control variables that might influence the adoption behavior: gender and net household income per year. Firstly, we used a dummy variable for the gender, with gender = 1 for male and gender = 0 for female. Then, given that the adoption decision is influenced also by the financial capacity of the family [9], the income was another control variable. We used a discrete variable for the net household income per year, with net household income per year = 1, 2, 3, 4 and 5 for less than 15,000€, 15,001€–30,000€, 30,001€–45,000€, 45,001€–60,000€ and more than 60,000€, respectively. Table 1 shows the socio-demographic characteristics of the sample.

Table 1. The socio-demographic characteristics of the sample.

Variable	Percentage
Gender	
Male	51.43
Female	48.57
Occupation	
Entrepreneur/manager/freelance professional	4.21
Employee	20.84
Worker	6.50
Student	52.39
Housewife/man	1.72
Unemployed	14.34
Net household income	
less than 15,000€	13.19
15,001€–30,000€	57.55
30,001€–45,000€	19.69
45,001€–60,000€	5.54
more than 60,000€	4.02

4. Results

4.1. Results of the Measurement Model

Table 2 describes the measures and the properties of all the constructs used in the study. Since some of these were adapted from earlier work, we re-validated each construct (internal reliability, discriminant validity and convergent validity). Internal reliability was examined by the Cronbach's α. The constructs SN, ATT, TS, PPSS, VCC and BI had a Cronbach's α higher than 0.7, therefore above the usual threshold of 0.7, accepted in the literature [66]. The indicator highlighted a high level of internal consistency for these constructs. Items were factor-analyzed using maximum likelihood estimation and varimax rotation. Standardized factor loadings varied between 0.70 and 0.96, all above the threshold of 0.5 suggested by the literature [67]. In the construct ATT, the items x5 (Essential) and x6 (Easy) are deleted after confirmatory factor analysis and varimax rotation because they were found to significantly load on more than one factor, specifically on the SN construct. The constructs Barriers and Benefits had a Cronbach's α lower than 0.7, of 0.31 and 0.30, respectively. Moreover, no other combination of the items related to the two constructs had a satisfactory reliability. We therefore decided to overcome the low level of internal consistency by adding each item as a single variable within the model. In particular, this allows keeping explanatory power of the proposed conceptual model.

Table 2. Measures description and properties.

Measures	Item Description	Std. Fact. Load.
Subjective Norm (SN) α = 0.93 AVE = 0.87 Ajzen and Fishbein [39]	*To what extent do you agree with the following statements?*	
	x1: My parents think that I should purchase an electric car within the next two years.	0.93
	x2: My friends think that I should purchase an electric car within the next two years.	0.93
Attitude (ATT) α = 0.85 AVE = 0.76 Ajzen and Fishbein [39]	*Purchasing an electric car in the next two years i*	
	x3: Wise	0.95
	x4: Beneficial	0.78
	x5: Essential	*i.d.*
	x6: Easy	*i.d.*

Table 2. *Cont.*

Measures	Item Description	Std. Fact. Load.
Technological Services (TS) α = 0.94 AVE = 0.67 Rezvani et al. [4]; Schuitema et al. [32]; Wood and Moreau [33]; Turrentine and Kurani [34]; Han et al. [35]	*To what extent the following services could affect your decision to purchase an electric car?*	
	x7: Voice assistant	0.80
	x8: Intelligent music system and radio that suggests tracks	0.70
	x9: 3D holographic projection on the windshield (direction, traffic)	0.86
	x10: 3D holographic projection on the windshield to identify the parking lot	0.89
	x11: Charging station and other geolocation services	0.83
	x12: Obstacles detection system	0.81
	x13: Control and monitoring of the electric car (monitoring of car components and real-time assistance provided by the car manufacturer)	0.81
Barriers α = 0.31 AVE = n.a. Hidrue et al. [18]; Bunch et al. [22]; Chéron and Zins [23]; Brownstone and Train [24]; Ewing and Sarigöllü [25]; Dagsvik et al. [26]; Erol-Kantarci et al. [27]; Egbue and Long [28]; Kochhan [29]; Li et al. [30]	*To what extent the following attributes could affect your decision to purchase an electric car?*	
	x14: (Limited) model variety	-
	x15: Speed (max 130 km/h)	-
	x16: Network of charging stations (9,000 in Italy)	-
	x17: Average recharging time (from 8 h to 12 h)	-
	x18: Price	-
Benefits α = 0.30 AVE = n.a. Hidrue et al. [18]; Miao et al. [21]; Mairesse et al. [31]	*To what extent the following attributes could affect your decision to purchase an electric car?*	
	x19: Low consumption	-
	x20: No noise	-
	x21: Reduction of maintenance costs	-
Pre- and Post-Sale Services (PPSS) α = 0.94 AVE = 0.79 Rezvani et al. [4]; Miao et al. [21]; Li et al. [30]; Yang et al. [36]; Diamond [37]	*To what extent the following attributes could affect your decision to purchase an electric car?*	
	x22: Efficient pre-sale assistance services	0.93
	x23: Easy access to all information necessary for the purchase	0.94
	x24: Efficient post-sale assistance services	0.85
	x25: Clarity of the contract terms for the purchase and the car maintenance	0.82
Value Co-Creation (VCC) α = 0.97 AVE = 0.81 Kaur Sahi et al. [68]	*If you were involved in the initiative of a car manufacturer that allows you to contribute to a project for the development and design of an electric car, how important would you consider the following aspects?*	
	x26: The company manufacturer takes into serious consideration your ideas and tips for improving the electric car	0.81
	x27: Have the feeling to participate actively to the creation and/or the improvement of the car and/or complementary services	0.82
	x28: Be involved concretely in the design phase of the characteristics of the electric car	0.89
	x29: The manufacturer explains clearly the benefits (prizes, discounts, gifts, acknowledgments, etc.) that you could get participating in the project	0.96
	x30: The manufacturer adapts and adjusts the product following your directions, maybe realizing a product that is better than what you expected	0.95
	x31: The manufacturer clearly explains the characteristics that the products and/or services developed together will have	0.94

Table 2. *Cont.*

Measures	Item Description	Std. Fact. Load.
Behavioral Intention (BI) α = 0.92 AVE = 0.83 Han [42]	*To what extent do you agree with the following statements?*	
	x32: I intend to buy an electric car in the next two years.	0.94
	x33: I will make an effort to buy an electric car in the next two years.	0.90
	x34: I want to buy an electric car in the next two years.	0.89

Note: *N* = 523; i.d. = item deleted.

Discriminant validity was examined using two techniques: the square root of the average variance extracted (AVE) [69] and cross-loadings. AVE square roots for each construct were all higher than the correlation between the construct and each other [69] (Table 3), and the factor loadings were higher than cross-loadings. These results suggested that we have satisfactory discriminant validity.

Finally, the convergent validity was ensured by AVE values for each construct higher than 0.5, as accepted in the literature [69]. This indicates satisfactory convergent validity of the measurements. These results indicate that the reliability and validity of the measurements in this study are acceptable. This evidence allows us to use the average items scores for each construct in subsequent analyses.

The variance inflation factor (VIF) was run to test for multicollinearity among the variables. The mean VIF of 1.33 was acceptable and far below the cut-off value of 10.0 recommended by the literature [70].

The descriptive statistics and correlation matrix of the variables and the constructs analyzed in the study are shown in Table 3.

Table 3. Descriptive statistics and correlation.

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
[1]	BI	**0.689**							
[2]	SN	0.550	**0.757**						
[3]	ATT	0.566	0.549	**0.578**					
[4]	TS	−0.027	0.057	0.041	**0.449**				
[5]	Barriers: Model variety (x14)	0.023	0.045	−0.010	0.226	–			
[6]	Barriers: Speed (x15)	0.002	−0.003	0.053	0.007	0.049	–		
[7]	Barriers: Network of charging stations (x16)	−0.125	−0.122	0.031	0.152	0.039	0.027	–	
[8]	Barriers: Average recharging time (x17)	−0.034	−0.026	0.035	0.095	0.025	0.173	0.223	–
[9]	Barriers: Price (x18)	−0.012	−0.032	−0.027	−0.061	−0.014	0.075	0.053	0.224
[10]	Benefits: Low consumption (x19)	−0.098	−0.032	0.059	0.162	−0.015	0.229	0.178	0.089
[11]	Benefits: No noise (x20)	−0.071	0.012	0.055	0.124	0.059	0.143	0.104	0.101
[12]	Benefits: Reduction of maintenance costs (x21)	−0.015	0.025	0.049	0.123	0.071	0.079	0.173	0.194
[13]	PPSS	−0.078	0.023	0.105	0.197	−0.037	0.061	0.187	0.152
[14]	VCC	−0.133	0.061	0.039	0.330	−0.051	0.089	0.205	0.055
[15]	Income	0.038	−0.005	0.004	0.049	0.073	−0.011	0.003	−0.038
[16]	Gender	−0.016	−0.015	−0.036	0.104	0.106	−0.001	0.032	−0.001
	Mean	2.965	2.015	3.885	3.064	3.862	3.220	4.289	4.042
	St. Dev.	1.183	0.954	1.024	1.057	1.049	1.179	0.892	0.970
	Min	1	1	1	1	1	1	1	1
	Max	5	5	5	5	5	5	5	5

Note: *N* = 523; Correlation coefficients greater than 0.089 in absolute value are statistically significant at 95%. Values in bold on the diagonal are the square root of the AVE.

4.2. Results of the Structural Model

We used structural equation modeling to verify our hypotheses. The model was tested in STATA 15 [71]. Table 4 shows the non-standardized results of the path analysis on the hypothesized structural equation model. The goodness-of-fit test statistics of the model indicated good fit in line with all threshold values accepted in the literature [66]: χ^2 = 1033.16; df(χ^2) = 453; χ^2/df = 2.281; CFI = 0.957; TLI = 0.951; AIC = 41,880.27; RMSEA = 0.049; p(RMSEA < 0.05) = 0.578; SRMR = 0.070; R^2 (BI) = 0.495; R^2 (VCC) = 0.272.

Table 4. Path analysis.

Paths	Overall Model	
	Coeff.	**S.E.**
Total effects		
BI		
← SN	0.412 ***	0.066
← ATT	0.527 ***	0.064
← TS	0.042	0.048
← Barriers: Model variety (x14)	−0.020	0.040
← Barriers: Speed (x15)	0.014	0.036
← Barriers: Network of charging stations (x16)	−0.079	0.048
← Barriers: Average recharging time (x17)	−0.007	0.044
← Barriers: Price (x18)	−0.016	0.041
← Benefits: Low consumption (x19)	−0.035	0.046
← Benefits: No noise (x20)	−0.036	0.035
← Benefits: Maintenance costs (x21)	0.018	0.054
← PPSS	−0.081 **	0.040
← VCC	−0.130 ***	0.047
← Income	0.032	0.045
← Gender	0.032	0.081
VCC		
← SN	0.096	0.064
← ATT	−0.064	0.057
← TS	0.304 ***	0.049
← Barriers: Model variety (x14)	−0.110 ***	0.041
← Barriers: Speed (x15)	0.021	0.037
← Barriers: Network of charging stations (x16)	0.135 ***	0.050
← Barriers: Average recharging time (x17)	−0.021	0.046
← Barriers: Price (x18)	−0.099 **	0.042
← Benefits: Low consumption (x19)	0.280 ***	0.046
← Benefits: No noise (x20)	0.074 **	0.036
← Benefits: Maintenance costs (x21)	0.028	0.055
← PPSS	0.171 ***	0.041
Indirect effects (by mediation of VCC)		
BI ← SN	−0.013	0.009
BI ← ATT	0.008	0.008
BI ← TS	−0.040 **	0.016
BI ← Barriers: Model variety (x14)	0.014 *	0.007
BI ← Barriers: Speed (x15)	−0.003	0.005
BI ← Barriers: Network of charging stations (x16)	−0.018 *	0.009
BI ← Barriers: Average recharging time (x17)	0.003	0.006
BI ← Barriers: Price (x18)	0.013 *	0.007
BI ← Benefits: Low consumption (x19)	−0.037 **	0.015
BI ← Benefits: No noise (x20)	−0.010 *	0.006
BI ← Benefits: Maintenance costs (x21)	−0.004	0.007
BI ← PPSS	−0.022 **	0.010

N = 523. * $p < 0.100$; ** $p < 0.050$; *** $p < 0.001$. Method of estimation is maximum likelihood. χ^2 = 1033.16; df(χ^2) = 453; χ^2/df = 2.281; CFI = 0.957; TLI = 0.951; AIC = 41,880.27; RMSEA = 0.049; p(RMSEA < 0.05) = 0.578; SRMR = 0.070; R^2 (BI) = 0.495; R^2 (VCC) = 0.272.

Figure 1 shows the standardized results of the structural model.

The mediator effect of VCC has been proven by calculating the goodness-of-fit indices of the non-mediated model: χ^2 = 750.59; df(χ2) = 293; χ^2/df = 2.562; CFI = 0.947; TLI = 0.940; AIC = 35,695.63; RMSEA = 0.055; p(RMSEA < 0.05) = 0.056; SRMR = 0.071; R^2 (BI) = 0.476. Each index shows a worse level than the mediated model. Figure 2 shows the effects of decomposition for the explanatory variables-Value Co-Creation-Behavioral Intention indirect path as recommended by Preacher et al. [72]. It provides 95% bootstrap confidence intervals for these indirect effects.

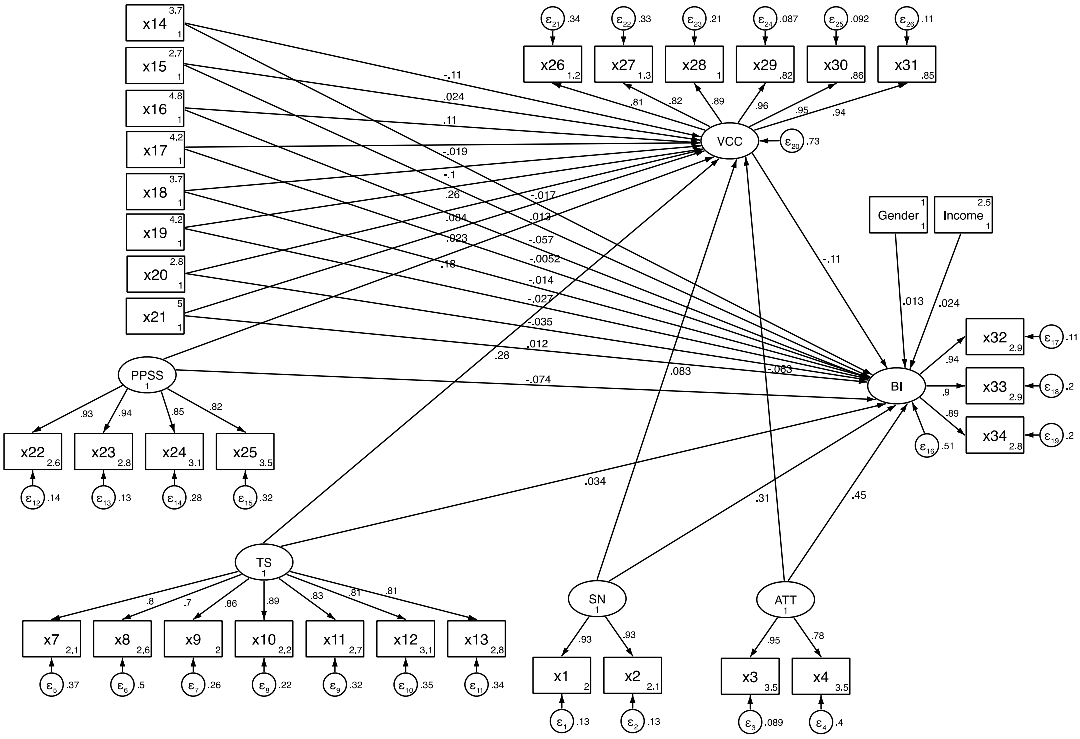

Figure 1. Standardized results of the structural equation model.

Figure 2 shows full mediation of VCC between TS, x14, x16, x18, x19, x20 and BI, respectively. Moreover, it shows a partial mediation of VCC between PPSS and BI [73]: this last mediation exists and is partial because both indirect and direct relationships are significant.

Table 4 shows the synthesis of the hypothesized relationships, the expected signs, the resulting signs, and the statistical significance of the results.

ATT and SN positively influence BI confirming Hp. 2a and Hp. 2b, respectively. With relation to Hp. 1, Barriers (Hp. 1a), Benefits (Hp. 1b) and TS (Hp. 1c) do not have a statistically significant direct effect on BI. Instead, PPSS does have a significant direct effect on BI, however with sign opposite to that hypothesized (Hp. 1d). VCC negatively influences BI (Hp. 3), confirming what has been found so far in the literature for complex products.

Some Barriers (Hp. 4a) significantly affect VCC: x16 (network of charging stations) with the expected sign, and x14 (model variety) and x18 (price) with opposite signs.

Some Benefits (Hp. 4b) positively affect VCC confirming what expected: x19 (low consumption) and x20 (no noise). Equally, TS (Hp. 4c) and PPSS (Hp. 4d) positively influence the VCC.

ATT (Hp. 5a) and SN (Hp. 5b) do not associate significantly with VCC.

Some Barriers have a significant indirect effect on BI, once mediated by VCC intention (Hp. 6a): x14 (model variety) and x18 (price) with the expected sign, and x16 (network of charging stations) with opposite sign to that hypothesized.

The Benefits (Hp. 6b) x19 (low consumption) and x20 (no noise) indirectly affect BI but with sign opposite to that expected.

TS (Hp. 6c) and PPSS (Hp. 6d) indirectly impact on BI, even in this case with sign opposite to that expected. Finally, ATT (Hp. 7a) and SN (Hp. 7b) do not have a significant indirect effect on BI. The results of the analysis are shown in Table 5.

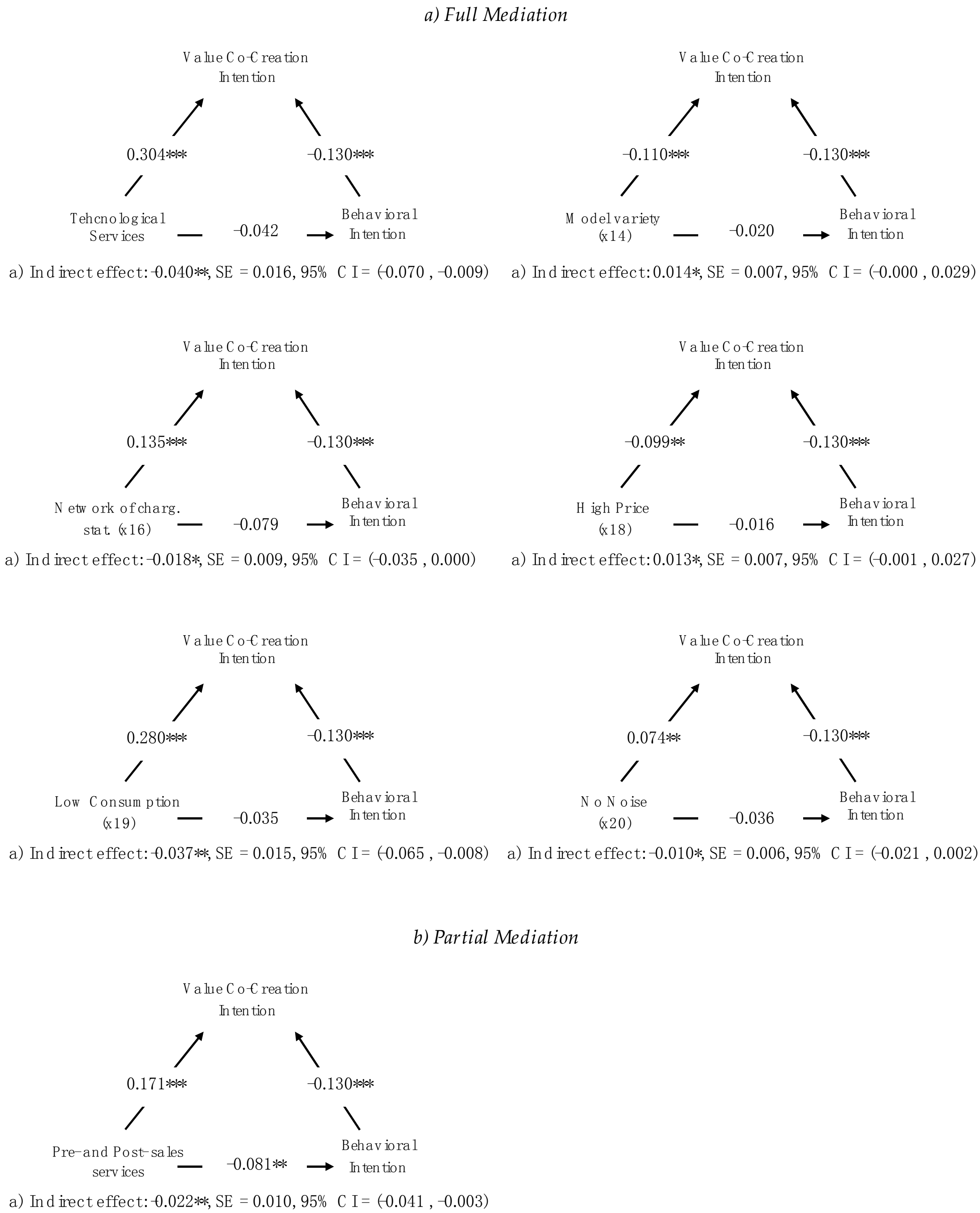

Figure 2. Effects Decomposition for Explanatory Variables-Value Co-Creation Intention-Behavioral Intention indirect path. Note: Number of respondents is 523; Statistical significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$. a) Full Mediation; b) Partial Mediation.

Table 5. Path analysis.

Hypothesis	Expected Sign	Resulting Sign	Statistical Significance
Hp. 1a			
x14	–	–	No
x15	–	+	No
x16	–	–	No
x17	–	–	No
x18	–	–	No
Hp. 1b			
x19	+	–	No
x20	+	–	No
x21	+	+	No
Hp. 1c	+	+	No
Hp. 1d	+	–	Yes
Hp. 2a	+	+	Yes
Hp. 2b	+	+	Yes
Hp. 3	+	–	Yes
Hp. 4a			
x14	+	–	Yes
x15	+	+	No
x16	+	+	Yes
x17	+	–	No
x18	+	–	Yes
Hp. 4b			
x19	+	+	Yes
x20	+	+	Yes
x21	+	+	No
Hp. 4c	+	+	Yes
Hp. 4d	+	+	Yes
Hp. 5a	+	+	No
Hp. 5b	+	–	No
Hp. 6a			
x14	+	+	Yes
x15	+	–	No
x16	+	–	Yes
x17	+	+	No
x18	+	+	Yes
Hp. 6b			
x19	+	–	Yes
x20	+	–	Yes
x21	+	–	No
Hp. 6c	+	–	Yes
Hp. 6d	+	–	Yes
Hp. 7a	+	–	No
Hp. 7b	+	+	No

5. Discussion, Managerial Implications and Hints for Future Research

The research provides interesting findings and enhances scholarly and managerial knowledge on millennials intention to buy EVs under different points of view.

First, corroborating prior studies on electric car adoption, our results confirm that both attitude [9,47] and subjective norm [49–51] have an impact on EV buying intention. Specifically, the more positive is the attitude, the higher is the behavioral intention, and the greater is the perceived social pressure, the higher is the intention to purchase the car. To enhance EV adoption, through appropriate communication initiatives, car manufacturers should therefore favor the formation of positive associations with electric vehicles. Furthermore, the influence of salient referents—in our case parents and friends—in the millennials' purchasing decision suggests that communication targets should not only be single individuals, but also families and group of peers, such as university mates, that could represent more profitable target audiences given the reciprocal influence that they might exert on each other.

With relation to electric cars' attributes, our findings are instead contradicting. The investigated barriers and benefits, including the explored novel technological services, do not seem to play a role in the millennials' decision-making. The only attribute that has been found to influence them, and negatively, is constituted by pre- and post-sale services.

A first possible explanation of such result can reside in the newness of the product and the asymmetrical information that young consumers hold onto EVs, which are a disruptive innovation [5]. In this case, given the early market phase for EVs, millennials could be unable to correctly assess their associated benefits and barriers, which turn out to be irrelevant in their decision-making.

Furthermore, while controverting a large body of literature addressing EV buying behavior, which prove the relevance of functional attributes on intention to adopt, our outcomes are compliant with what has been found in those research attempts that are not exclusively grounded in rational choice-based models. Some authors [34,74] have in fact ascertained that consumers rely only on a small set of attributes when it comes to making car choices and, instead of engaging in a highly rational and cognitively demanding decisional process, they end up employing heuristics or rules of thumb to make buying decisions. Additionally, other scholars [4,45,75] have demonstrated that the emotional and affective components of decision-making play a fundamental role in influencing consumer buying intention and behavior of EVs included. This seems to hold true also among Italian youngsters whom were recently found to be influenced by affective reactions in the domain longevity annuity buying intention that is commonly assumed to be a rational decision-making process [76]. Such considerations could also explain why pre- and post-sale services were found to have a negative impact on EV buying intention. Due to the included items, the construct was basically conceived as an informational support along the pre- and post-purchasing, as well as in the usage phase (easy access to information, clarity of contract terms, etc.). However, if it is true that other than mere cognitive factors exert an influence on millennials' buying decision, instead of benefits enriching the car offering, such services could be perceived as a burden in the purchasing process, ending up encumbering the cognitive effort needed to make the buying decision. If this holds true, communication of an informative type may not be the most effective in targeting millennials and more emotion-based and engaging messages should be conveyed.

A further reason that could explain these results may derive from the fact that due to their young age, millennials—or at least a large portion of them—could not be the purchasers of the car but only the users. First, very often the decision to by a car is a shared decision, made at the household level and does not entails only single individuals [77]. Second, given that the majority of our sample is constituted by college students (52%), it is likely that the greatest part of the respondents will be neither the actual purchasers of the EVs, nor those who will sustain the expenses for the car maintenance and charging. Instead of investigating single individuals, future research could profitably study the decision-making process that is achieved at the family level, considering the different roles played by the household members and the factors that most impact their decision-making. At the managerial level, this would again suggest that communication initiatives should not be directed to single millennials but should involve their entire family conceiving and transmitting messages that suit the different members' decisional process.

The involvement in co-creation initiatives does not increase the propensity of millennials to buying an electric car. A possible explanation can be again traced back to the product newness and the information asymmetry of millennials with relation to electric vehicles. The success of co-created products is in fact strongly dependent on the ability of manufacturers to involve knowledgeable participants in the different phases of the co-creation process (design, development, production, etc.) [61]. Especially in innovative settings, it has been ascertained that consumers' perception of product quality provided by user-driven firms is lower than that delivered by trusted providers (i.e., traditional car manufacturers) [78]. In our case, it could be that millennials, who are relatively informed and expert about EVs, neither trust their competencies nor believe that being involved in co-creation initiatives would provide enough benefits and product improvements to incentivize their car purchase. Furthermore, considering the influence that the vehicle's attributes exert on the involvement in co-creation initiatives, the findings show that whereas model variety and price negatively impact co-creation involvement, charging network, consumption, noise, and technological services, which are more strictly functional and performance-related attributes, increase the involvement in co-creation initiatives. Such a result suggests that the millennials who deem more important the car's technical attributes in their purchasing decision are also those who would more likely engage in co-creation projects. This could be related to the perceived risk that they associate to the car purchase and specifically a performance risk that is, according to a consolidated body of literature [79], the failure of the product to perform as expected. Co-creation activities could represent an attempt to reduce such perceived functional risk. When it comes to innovative products, however it has been demonstrated [80] that co-creation may provide contradicting results. In some cases, in fact, performance-related expectations of consumers are based on the experience they have with the product they are accustomed to—fuel cars in our case—and these could be disconfirmed by the novel product, even in the case they were personally involved in its design and development. In situation of uncertainty, as is the case with co-created innovative products, consumers are said to face more performance risk and expect a lower quality product. Especially when consumers have limited product-related technical knowledge, once they become co-creators of value, they are said to also become more vulnerable to the potential risks associated with the design, development, production, delivery and usage of goods [81]. This could explain why, once mediated by value co-creation, all the examined functional attributes negatively impact the intention to buy an electric vehicle.

The results suggest that co-creation initiatives should be carefully achieved by EV producers. Whereas they could probably enhance the involvement of more expert consumers, able to provide effective recommendations and suggestions based on their expertise, they might discourage "standard" customers.

6. Conclusions and Limitations

As far as the authors know, the present paper is one of the first attempts that tries to analyze the role that value co-creation plays in buying intention of EVs. Therefore, its value can be found in deepening a research field that hopefully represents a novel and fruitful stream of study. Besides providing some useful thoughts on value co-creation and buying intention, our research results should be interpreted with caution. First, our study focuses on Italian millennials living in the center of Italy due to the purposive sampling methodology adopted. The socio-demographic characteristics of our sample surely influenced the provided answers. In particular, since the questionnaire was diffused through the investigators' personal online network, we acknowledge that the share of respondents attending university is disproportionally higher compared to the average university attendance at the country level. Further research should investigate wider populations living in different countries and having different socio-demographic characteristics. Furthermore, our framework investigated the rational-based choices made by millennials, without investigating the possible role that emotions could play in the purchasing decision process. Future research could fruitfully investigate these variables. Finally, the co-creation initiatives investigated in this work involved a high degree of cognitive effort on the part of consumers, being the activities related to co-design or co-development. It might be interesting investigating less cognitive-demanding opportunities to co-create to ascertain whether the results would be the same.

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