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The impact of smart connectivity features on customer engagement in electric vehicles

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ABSTRACT

Sustainable transportation is one of the solutions to global warming because road transport is responsible for a considerable part of the total carbon emissions. Electric vehicle (EV) technology is still developing, and most of the available brands market them as either environmentally friendly or operationally economical compared to internal combustion engine based traditional vehicles. However, the adoption rates of electric vehicles across the globe are meager. Customer engagement (CEN) is one of the emerging concepts for gaining and retaining users of a product. This research analyzes CEN in EVs based on more engaging features and technologies, i.e., smart connectivity features. Unfortunately, this vital research area remains unexplored in academia. The role of customer experience and customer brand value is also analyzed in relation to smart connectivity features and CEN. The study uses partial least square-based structural equation modeling to analyze the collected data through a web-based survey. The results show that smart connectivity features have a significant positive impact on CEN in EVs. Smart connectivity features also have a significant indirect effect on CEN through customer experience. Further, customer brand value has a direct impact on customer experience, and customer brand value also has a significant indirect effect on CEN in EVs. These results have significant theoretical and managerial implications.

1. Introduction

In 2019, the 7.2 million electric vehicles (EVs) in operation worldwide avoided the use of around 600,000 barrels of petroleum products per day, and 53 t CO_2 equivalent emissions globally which would have been emitted if EVs had not replaced petroleum-powered vehicles (IEA, 2020). Although the market share of EVs has expanded on average by 60% annually during 2014–2019 (IEA, 2020), the penetration rate of this environmentally friendly technology is very low as EVs accounted for only 2.5% of the total global vehicle sales in 2019, with the exception of Norway (55.9%) and Netherlands (15.1%) (Gersdorf et al., 2020). From an economic point of view, countries (such as Norway) which offer generous subsidies on the purchase of EVs and provide other incentives such as tax cuts and road toll exemption etc. witness high EV adoption rates (Bjerkan et al., 2016; Rietmann and Lieven, 2019). Moreover, high per capita income countries have high adoption rates (Rietmann and Lieven, 2019). On the social side, a broader social network of early adopters has the potential to increase EV penetration and social acceptance. For example, a three nations (China, Brazil, and Russia) study indicated that two important factors for EV purchase intention are the width of the social network of the respondents, and if they knew someone who owned an EV (Habich-Sobiegalla et al., 2018) which shows the importance of EV experience of existing customers and their word-of-mouth to encourage others in their social circle to purchase EVs.

Technological immaturity such as battery technology and the resulting short driving range of EVs had been cited as one of the main barriers to EV adoption (Haddadian et al., 2015; Rietmann and Lieven, 2019). However, despite significant improvements in EV technology during the last decade, such as about 100% increase in the energy density of EV batteries and around 85% reduction in battery cost (IEA, 2020), the percentage of EV sales is significantly lower (2.5%) compared to traditional vehicles (O'Neill et al., 2019). One reason might be too much focus on improving EV technology but less attention towards the consumers (Larson et al., 2015). Although users still value traditional parameters of a vehicle, the rapid development of EV technologies along with artificial intelligence (AI) and the internet of things has changed rules of the game. The scene has shifted to an internet and communication technologies fueled scenario for gaining and sustaining automobile users. Moreover, with the proliferation of smart handheld devices, the paradigm has moved to a more data-

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driven, experience-based (Andersson and Mattsson, 2015), connected and autonomous environment (Buehler, 2018). An increasing number of customers demand smart connectivity features (SCF) in their vehicles (Daziano et al., 2017). The presence of these features enables consumers to interact with their vehicles, i.e. human-to-machine (H2M) interaction, connect to the company, form online communities, co-create (Storbacka, 2019), and spread the word on their favorite social media platforms (Yakhlef and Nordin, 2020). The integration of SCFs constantly give information to manufacturers and service providers to know more about customer likes and dislikes in a co-creative manner (Carlson et al., 2018; Tseng and Harmon, 2018; Vatsalan et al., 2017). This customization of products and services based on the analysis of big data collected through SCFs could lead to enhanced customer experience (CEX) and ultimately, customer engagement (CEN). As design and materials are getting standardized due to advanced manufacturing technology, it can be projected that in the near future, services (such as software and data packages), and user experience will define product differentiation in the transportation sector (Kuang et al., 2018; Pallaro et al., 2017).

Previous research indicates that consumers show a willingness to pay a significant amount of premium for automation and internet connectivity features in their cars (Daziano et al., 2017). The market for EVs in 2022 is expected to give profits worth approximately \$150 billion (Baker et al., 2016). In the race for gaining the market share, already established automotive brands have heavily invested in the R&D for EVs apart from new start-ups springing all over the world. As a result, several models of EVs at various levels of autonomy and connectivity are already in the market produced by traditional automakers such as BMW, GM, Nissan, Toyota, and Hyundai, etc. as well as new entrants like Tesla, Neo, Xpeng Motors, WM motors and so on (Ullah et al., 2018). A PwC study pointed out that by the year 2022, smart connectivity features will be a significant factor in revenue of the automobile industry, and car dashboards will become the 5th screen in peoples' lives apart from the mobile phone, TV, computer and cinema (Baker et al., 2016). However, most of the research in EVs is focused on charging infrastructure, driving range, pricing and government subsidies, and the experiential or hedonic dimension is mostly ignored. The use of connectivity features such as social media platforms is prevalent among the consumers, and it might trigger them to adopt new technology (Agostin et al., 2020). Still, research on their purpose and the mechanisms of CE based on these appealing features is limited (Carlson et al., 2018) and more so in EVs.

This research is based on CEN theory, which postulates that the interaction between customers and a brand can lead to positive/negative experiences that have hedonic effects on the customers and result in behaviors such as product recommendations, word-of-mouth, repurchase, and feedback/suggestions for product improvement. (Kumar et al., 2019). The main aim of this study is to examine how connectivity in EVs can enhance user experience and user engagement behavior. The first objective of this research is to empirically verify the effect of SCFs on CEX and CEN in EVs. Secondly, the mediating effect of customer brand value (CBV) on the relationship between SCFs and CEX is also empirically tested. The results could lead to a more precise understanding of the usefulness of SCFs for CEX and, ultimately, CEN in EVs. To our knowledge, this will be the first study to empirically verify the relationship between SCFs and CEN in EVs.

2. Literature review

CEN is defined as the non-transactional and sustained involvement of customers with a brand and includes behaviors such as positive word of mouth, feedback for product improvement, assisting other users of the product, recommendations, etc. (Pansari and Kumar, 2017; Prentice et al., 2018; van Doorn et al., 2010; Verhoef et al., 2010). Those companies which can keep customers engaged using multiple touchpoints, including online channels, can retain more than 85% of their customers, compared to around 30% for companies that cannot keep their customers engaged (Lee et al., 2019). As per a Gallup survey, engaged customers bring in up to 23% more revenue by involving in various engagement behaviors and actively disengaged customers cost a reduction of around 13% in the revenues of firms (Pansari and Kumar, 2017). Therefore, companies are increasingly looking for ways to improve CEN. In terms of strategies for enhancing CEN, there are three approaches that evolved over time (Barari et al., 2020). First, there is a functional approach of firms using economic incentives such as discount coupons and rewards for customer referrals to promote word of mouth and loyalty (Harmeling et al., 2017). This functional approach may be short-lived as it is based on short term economic incentives. Second, there is a relational strategy in which firms try to create positive experiences whenever customer interact with various touchpoints of a brand. Finally, in a transformational approach, firms can use various Internet and communication technologies (ICTs) such as social media, online communities, AI to enhance CEN behavior (Barari et al., 2020).

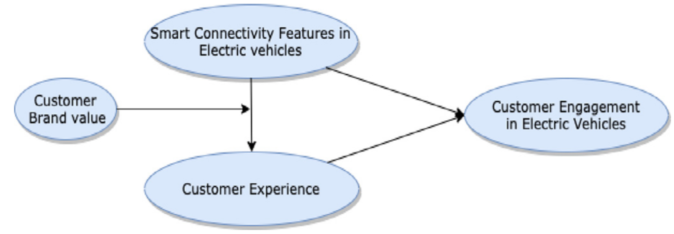

Fig. 1. Conceptual framework.

Safety concerns might arise while discussing the use of smart car technologies. However, Birrell and Fowkes (2014) demonstrate that the use of in-vehicle information systems does not pose safety issues. Similarly, privacy concerns may arise due to big data collection by the companies, but at the same time, big data analysis enables a brand to customize its services and customer encounters so that it could lead to a more effective relationship between the customer and the brand (Steinhoff et al., 2019). The theoretical framework of this study is based on relational and transformational approaches to CEN. Fig. 1 shows a framework of the proposed relationships, and in the following subsections, literature related to the proposed relationships is discussed.

2.1. Smart connectivity features and customer engagement in electric vehicles

"Smart" means the ability of a device to interact with users and other devices through internet connectivity (Foroudi et al., 2018). "Automation" refers to "the programming of vehicle components to function on its own without user input" (Gordon and Lidberg, 2015). "Connectivity" is "the communication between the car and its surroundings, including infrastructure, electronic devices, other vehicles, and the users" (Shladover, 2017; Ullah et al., 2018). The Society of Automobile Engineers and ISO recognizes five categories of vehicle automation depending on the complexity of the automation. A vehicle with driver assistance such as lane-keeping and cruise control is at Level 1 automation. Level 2 automation include freeway autopilot feature with human supervision (SAE, 2019; Li et al., 2016). For smart connectivity features, mobile phone applications which connect the user with the vehicle, virtual assistant, online diagnostics, social media accounts, and pages where users can give feedback and suggestions, and online user communities were used. These online platforms provide an environment for the users of the product to interact with other users and the company and hence serves as an organic way for CEN without compromising the autonomy of the users because of no forced involvement from the company (Prentice et al., 2018). It has been argued that sharing applications and platforms help with stakeholder engagement in green product development (Cristina et al., 2019). Likewise, social media such as Facebook pages in the banking sector were found to have various patterns of CEN that lead to product recommendations by the users (Potdar et al., 2018).

Practitioners use various kinds of tactics in CEN initiatives related to ICTs. ICTs are used to engage consumers with each other in online communities, mobile APPs and AI for creating interaction between user and product/company. Internet penetration can help transition from a green attitude to sustainable behavior, i.e. sustainable consumption (Wang and Hao, 2018) while blogging, tweeting, and reviews are used to amplify CEN (Harmeling et al., 2017). Hollebeek (2019) discuss the use of social media interactive platforms to conceptually enhance engagement in business to business (B2B) context. Although, the context of CEN is different from actor engagement (AE) in a B2B context, both the concepts are considered closely linked in a broader network context of engagement between "entities". (Alexander et al., 2018; Brodie et al., 2019). For example on a micro level, ICT act as an enabler for the interaction of various actors in a service ecosystem including other users, and service providers and serves as a platform for enhancing engagement (Storbacka et al., 2016). Dolan et al. (2019) studied the effects of Facebook pages of wine brands on CEN behavior and discovered that informational content on these pages has a more significant positive effect on CEN behaviors of liking and sharing the content than relational content. The use of information technology has been found to enhance CEN in consumers at the organizational level (Chen et al., 2018). Therefore, it is hypothesized that:

H1a: Smart connectivity features in electric vehicles have a significant effect on customer engagement.

2.2. Smart connectivity features and customer experience in electric vehicles

As more and more people become technology savvy, they demand more for their products and devices to be connected to their handheld devices digitally (Carlson et al., 2018). Kumar et al. (2019) proposed that use of technologies (such as internet connectivity and social media) enable companies to focus on customizing their services to the specific needs of their customers which may improve CEX. A 2016 Mckinsey study reveals that more than 60% of customers intend to pay a premium for vehicle management systems, and around 85% Chinese customers in volume brand segment indicated to change their automobile brand for connectivity features (Mckinsey, 2016). Internet connectivity and related technologies have enabled companies to use multiple channels to shape their customers experience (Kumar et al., 2019). Some companies such as Tesla and NIO offer an AI virtual and onboard assistant, which impersonates the car, and the users can interact with them. This experience may lead to the impression that the vehicle is directly interacting with the user which is identified as human-to-machine (H2M) interaction (Storbacka, 2019; Storbacka et al., 2016). These H2M interactions are AI enabled and therefore, technologies such as big data analysis and machine learning can enable brands to optimize these interactions for increased engagement. Even though, there is a risk of negative user-generated content which may lead to damaging the image of a brand and may serve as a double-edged sword (Azer and Alexander, 2020; Goh et al., 2013), online brand communities on social media platforms such as Facebook, Instagram etc. serve as an effective strategy for enhancing CE behavior (Yang et al., 2019). Similarly, the presence of companies on social media platforms has become ubiquitous, which is mostly welcomed by consumers if they perceive it as adding value to their products (Yakhlef and Nordin, 2020). These AI and social media tools have the potential of enhancing CEX by making a hedonic connection between the vehicle and its user if carefully executed without compromising the autonomy of the consumer (Yakhlef and Nordin, 2020). Informational and emotional content by marketers on social media can influence customer sentiments beyond actual performance in the case of sports events (Meire et al., 2019). Similarly, the application of internet & communication technology features in various products including EVs may enhance CEX ranging from already existing technologies that involve projecting real environment to virtual reality (Flavián et al., 2019). A previous study concluded that smart technologies have a positive effect on CEX in retail settings and observed that the use of intelligent technologies is prevalent in practice but lacks academic research (Foroudi et al., 2018). Based on the above-stated arguments and literature, it is hypothesized that:

H1b: Smart connectivity features in electric vehicles have a significant effect on customer experience.

2.3. Customer experience and customer engagement in electric vehicles

According to service-dominant logic (i.e. S-D logic), the value of a product or service is experientially determined by the user (Vargo and Lusch, 2008). More recently, the S-D logic-based argument suggests the use of multiple interactive touchpoints and processes to shape the CEX of a product, which might ultimately lead to CEN (Hollebeek et al., 2019). Therefore, successful companies dedicate their resources to orchestrate tactics and technologies to create and continually update CEX of their products to keep them engaged (Homburg et al., 2017). CEX is recognized as the central dimension of digital strategy (Holotiuk and Beimborn, 2017). From the Resource-Based View (RBV) perspective, companies should utilize all resources to sustain their competitive advantage, which in the modern age includes AI, communication technologies, big data analytics (Hazen et al., 2016) and social media. Automobiles are high on cognitive, lifestyle, emotional, pragmatic, and relational components. By applying S-D logic and RBV, we could argue that the application of SCFs with emotional and functional dimensions can shape and sustain consumers' positive experiences, which has the potential to enhance CEN. Generally, positive encounters with, and the pleasant experience of a brand has been found to increase CEN (van Doorn et al., 2010) and vice versa (Beckers et al., 2017). Therefore, we hypothesize:

H2: Customer Experience has a significant impact on customer engagement in electric vehicles.

2.4. Customer brand value

CBV is defined as "the differential effect of a customer's brand knowledge, brand attitude, purchase intention, and brand behavior in response to the marketing of a brand" (Kumar and Pansari, 2016). Therefore, CBV has a "perceived" non-functional and emotional component in its nature. Previous studies considered CBV as the dependent variable in relation to CEN and CEX (Yu, 2019; Ramaswamy and Ozcan, 2016; Merrilees, 2016). However, in this study it is taken as a mediating variable between SCFs and CEX because of the following arguments. First, EV technology has recently emerged as a viable alternative to internal combustion engine-based vehicles, and new entrants, as well as already established brands, have their EV models in the market. Confirmation bias means the tendency of humans to maintain their previously held opinions, look for information to confirm their beliefs, and even discount contradictory information (Bronfman et al., 2015; Medin et al., 1995). A recent study in "Nature Neuroscience" showed that people tend to discount disconfirming information that goes against their existing beliefs even if they are false (Kappes et al., 2020). Therefore, confirmation bias suggests that SCFs in already established brands may lead to more pleasurable experience compared to new, less known brands. Second, studies indicate the role of branding as a contributor to user experience and the use of ICT initiatives of a brand. For example, a recent study hinted in the same direction by concluding that mobile phone APPs of more identifiable brands are adopted and used more quickly because of practical and non-functional esteem (which includes CBV) attributed to them (Arya et al., 2019). Based on the above arguments, we hypothesize:

H3: Customer brand value moderates the relationship between smart connectivity features and customer experience in electric vehicles.

3. Methods

The study follows deductive methodology and builds hypotheses based on theoretical framework built on existing literature. Keyword search was used in the main research databases such as Elsevier, Wiley, Sage, Emerald publisher, Taylor and Francis, Springer, EBSCO, and Google Scholar to identify peer-reviewed articles, and conference papers related to our variables. Then a survey questionnaire (Appendix A) was designed. The survey link was sent to the members of the online communities of EV owners. For measuring CEN, the scale was based on the work of (Pansari and Kumar, 2017) and included items for satisfaction, "overall, I'm satisfied with my car brand", recommendations "I recommend my car brand to someone who seeks my advice on cars" and "I encourage friends and relatives to buy and use my car brand", and word-of-mouth "I say positive things about my car to others"(Brüggen et al., 2011). The scale for SCFs was adapted from Lin and Hsieh's scale of self-service technology (Lin and Hsieh, 2011) and included items related to the functionality and use of SCFs in EVs. The scale for CEX is based on experiential value (Mathwick et al., 2001) and includes items from functional value and hedonic value scales (De Vries and Carlson, 2014). The scale for CBV is based on Kumar (Kumar, 2013) and included items related to brand image and brand advocacy. The details of the items of each scale is given in Table 1 of the results and discussion section. All the questions were based on a five-point Likert scale. A pilot study with 50 questionnaires was conducted to check the reliability of the survey questionnaire and the suitability of the items (Hinkin, 1998). After pilot testing, the link to the online survey was sent to 2235 users of EVs and users of online communities for electric car users, of which 309 responses were received hence a response rate of 13.8%. However, 20 questionnaires were removed during data screening because of more than 15% missing data and unengaged responses and while responses with missing data fewer than 15% were filled based on the median for the series (Hair et al., 2017). Therefore, a total of 289 responses were included in the analysis with a final response rate of around 12.9%, which is comparable with the response rate of 10.6% to around 16% for web-based data collection from individuals (Baruch and Holtom, 2008). PLS-SEM was conducted on Smart PLS 3.2.7 for analyzing data. PLS-SEM is used because of its high statistical power compared to covariance-based SEM (CB-SEM) to identify relationships in a model when they are present (Hair et al., 2019). First, the measurement model was checked for reliability, method bias, convergent validity, and discriminant validity. Then a path model was constructed according to the proposed model, and the partial least square algorithm was run to estimate the model. Effect sizes, total and specific, and total indirect effects were estimated. Then bootstrapping procedure was run to find out the significance of the values (Hair et al., 2017).

4. Results and discussion

One of the assumptions for SEM is the normality of the data used for analysis. As our data for all the variables, except for demographic questions were collected through ordinal scale (5-point Likert scale) therefore only kurtosis is required to be measured, which was well below the critical value of less than 3. So, it is assumed that the data is normal.

4.1. Constructs' reliability and validity

To assess the validity measurement model, covariance-based criteria such as composite reliability and average variance explained is used. Based on bootstrapping results, the items with insignificant weights and outer loadings of less than 0.5 were removed to improve the reliability and predictability of the model (Hair et al., 2017; Hinkin, 1998) The factor loadings are all above 0.7, as shown in Table 1 below.

Discriminant validity shows whether the constructs or scales for individual variables/factors measure the same or different variables (Hair et al., 2017). As shown in Table 1, the composite reliability values of all variables are higher than 0.70, which is the minimum desirable value for a construct to have convergent validity. Instead, all the CR values are more significant than 0.80, which means all the constructs have high convergent validity based on CR value.

The Cronbach's Alpha values of all the scales range from 0.83 to 0.91, which shows strong reliability of the scales. Similarly, the composite reliability ranges from 0.88 to 0.94. The AVE values of the scales are above 0.6, which shows that the scales are reliable and valid.

High collinearity could be an indicator of redundancy in formative factors and common method bias (Kock, 2015). No collinearity problems in our measurement model were found as all VIFs were well below the critical value of 5 (Hair et al., 2017; Kock, 2015).

Two criteria are used to check for discriminant validity. First, the cross-loadings were analyzed to see whether the items load strongly only on one scale or with other factors as well. The items of smart connectivity features SCF1, SCF2, SCF3, SCF4, SCF5 load strongly on its own scale and have loadings lower than 0.5 on the other scales. Similarly, the items for the construct brand value, i.e., CBV1, CBV2, CBV3, and CBV4 load strongly on CBV, i.e., have higher loadings that range between 0.88 and 0.913 and has lower loadings on other scales. The same is evident for the items of CEN and CEX. Secondly, the Fornell-Lacker criteria were used to assess the discriminant validity of the scales (Refer to Table 2). The squared AVE on the diagonal is higher than the values on the left, which shows that the scales have good discriminant validity.

4.2. Path model estimation

Fig. 2 shows the results of the PLS algorithm. The R square value of 0.542 indicates that the model explains a significant variation in CEN. First, SCF has a significant direct impact on CEN, and SCF also explains a significant variation in CEX. Similarly, CEX has a strong positive influence on CEN. The strongest path coefficient in the model is between CEX and CEN, i.e., 0.61, followed by the path coefficient for SCF and CEX, which is 0.43. However, the moderating effect of brand value on the relationship between SCF and CEX is very low, and the direct relationship between brand value and CEX is relatively more prominent.

Table 1
Constructs, reliability, and validity statistics.

Construct		Outer loadings	Cronbach's Alpha	Composite Reliability	Average Variance Explained
Customer Experience			0.839	0.886	0.61
CEX1	I feel joy when I use the smart features of my car brand	0.796			
CEX2	I feel excited when I use the smart features of my car brand	0.81			
CEX3	I feel that my car brand offered me features that produce the best results for me	0.782			
CEX4	My feelings towards my car brand are very positive	0.806			
CEX5	I feel secure because of the safety features in my car	0.704			
Customer Engagement			0.91	0.931	0.691
CEN1	Overall, I am satisfied with my car brand	0.796			
CEN2	I say positive things about my car to others	0.845			
CEN3	I encourage friends and relatives to buy and use my car brand	0.888			
CEN4	I recommend my car brand to someone who seeks my advice on cars	0.813			
CEN5	I provide feedback about my experiences with the brand to the firm	0.84			
CEN6	I often participate in online community discussions for my car brand	0.802			
Smart Connectivity Features			0.894	0.921	0.701
SCF 2	My car's internet connectivity is useful.	0.866			
SCF1	I often use virtual assistant of my electric car	0.835			
SCF3	I find remote diagnostics tool of my electric car useful	0.818			
SCF4	I frequently use the mobile phone App of my car	0.853			
SCF5	I often visit the social media accounts (WeChat, Weibo, Twitter, Facebook, etc.) of my car brand	0.813			
Customer Brand value			0.915	0.94	0.797
CBV1	Owning the products/services of this car brand makes me happy	0.913			
CBV2	I am a part of this brand and mention it in my conversations	0.888			
CBV3	I discuss the benefits that I get from this brand with others.	0.912			
CBV4	The next car I buy will be of the same brand	0.856			

Table 2
Discriminant validity Fornell-Lacker criteria.

	Customer brand value	Customer engagement	Customer experience	Smart connectivity features
Customer brand value	0.893			
Customer engagement	0.409	0.831		
Customer experience	0.462	0.718	0.781	
Smart connectivity features	0.467	0.517	0.527	0.837

4.2.1. Total effects

CEX has the strongest total effect (0.61) on CEN, followed by SCFs (0.43). However, SCFs impact both; CEX and CEN and therefore seem to be a strong determinant in our model. The moderating effect of CBV is very weak and found to be non-significant later in the bootstrapping results.

4.2.2. Model fit indicators

The indicators used to assess model fit in covariance-based structural equation modeling such as normative fit index and comparative fit index, and chi-square are co-variance based and they are not directly applicable for partial least square estimation of the model (Hair et al., 2017) The most relevant indicator for model fit in partial least square estimation can be SRMR. The proposed model has an SRMR value of 0.059, which is below the acceptable cap of 0.08.

4.2.3. Effect size

The f square value shows the strength of the relationship between two variables. CEX has the strongest effect size on CEN (0.584) followed by SCFs on CEN (0.216). However, the moderating effect of brand value is very low on CEX (0.016), which suggests a direct positive relationship between brand value and CEX.

4.3. Bootstrapping of measurement model

To assess the significance of the PLS algorithm results, the bootstrapping procedure was run for the model with 5000 bootstrapping samples, with replacement. Table 3 shows the importance of items in each construct. As shown, all the relationships are significant at a *P*-value of 0.00 with T statistics value of well above the minimum threshold of 1.96 at 95% confidence interval. This shows that all the items load well on their respective scales, and therefore the measurement model is reliable.

4.4. Bootstrapping of the path model

As shown in Fig. 3 and Table 4, the *T*-value of the relationship between the CBV and CEX is 4.76 at a *P*-value of 0.00, so the relationship is significant. Similarly, the *T* value for the relationship between CEX and CEN is 12.3 at a *P*-value of 0.000, so the relationship is significant at 95% confidence interval. However, the moderating effect of brand value on smart connectivity features and CEX is insignificant because the T statistic is 1.3, which is lower than the critical importance of 1.96, and *P*-value is 0.184, which is more than 0.05. The relationship between SCFs and CEN is significant as per the bootstrapping results with a *T* value of 3.6 and a *P*-value of 0.000. Similarly, the relationship between SCFs and CEX is significant, with a *T* value of 6.75 and a *P*-value of 0.000. Therefore, all the relationships except the moderating effect of brand value on

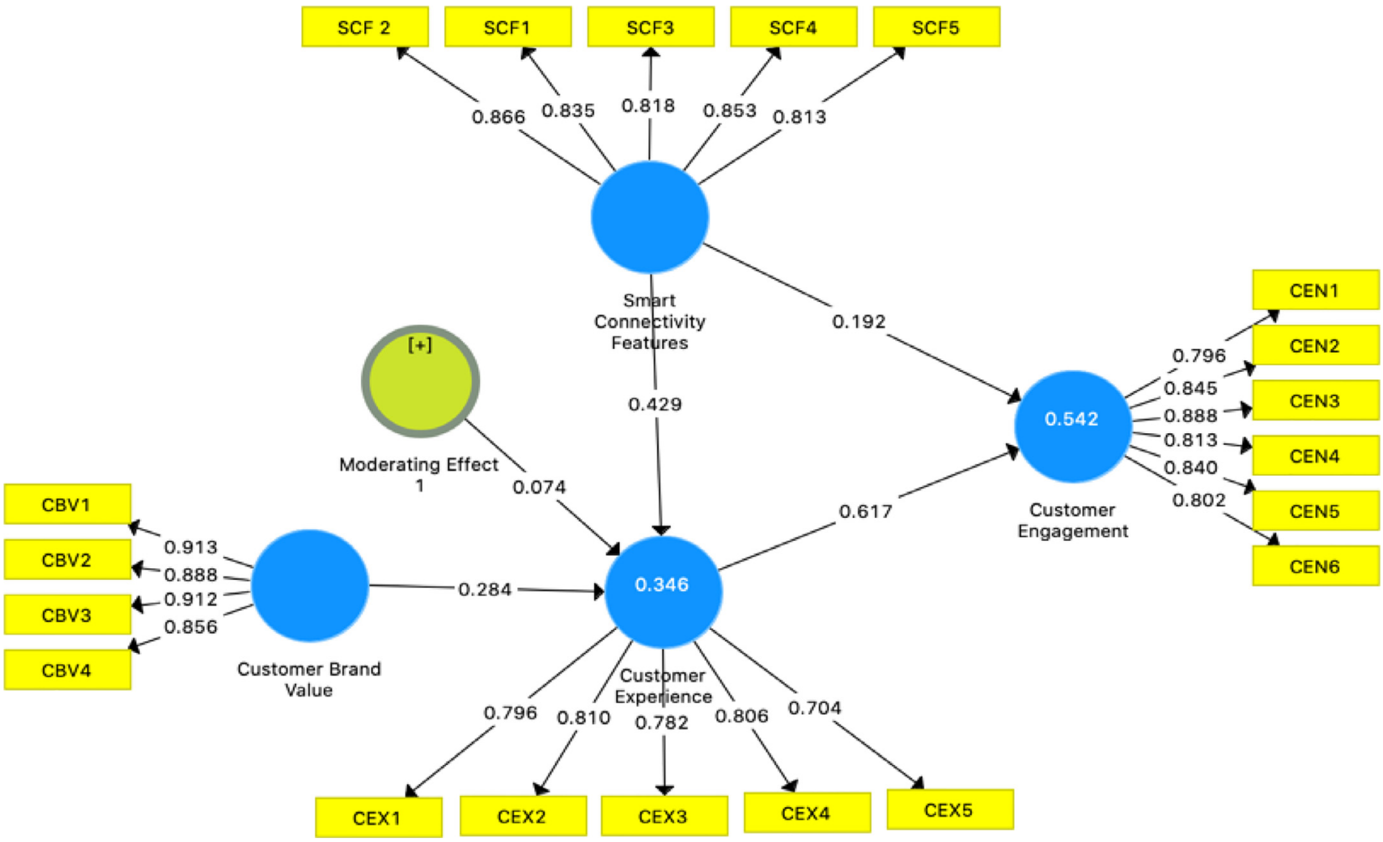

Fig. 2. PLS algorithm results of the model.

Table 3
Bootstrapping result of the measurement model.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	*P* values
CBV1 <- Customer Brand Value	0.913	0.912	0.015	61.564	0.000
CBV2 <- Customer Brand Value	0.888	0.886	0.020	43.706	0.000
CBV3 <- Customer Brand Value	0.912	0.911	0.013	70.403	0.000
CBV4 <- Customer Brand Value	0.856	0.856	0.023	37.330	0.000
CEN1 <- Customer Engagement	0.796	0.796	0.025	32.301	0.000
CEN2 <- Customer Engagement	0.845	0.845	0.027	31.308	0.000
CEN3 <- Customer Engagement	0.888	0.887	0.015	58.175	0.000
CEN4 <- Customer Engagement	0.813	0.812	0.027	30.449	0.000
CEN5 <- Customer Engagement	0.840	0.840	0.023	36.707	0.000
CEN6 <- Customer Engagement	0.802	0.801	0.025	31.854	0.000
CEX1 <- Customer Experience	0.796	0.795	0.028	28.327	0.000
CEX2 <- Customer Experience	0.810	0.808	0.028	28.480	0.000
CEX3 <- Customer Experience	0.782	0.781	0.034	23.118	0.000
CEX4 <- Customer Experience	0.806	0.806	0.028	29.175	0.000
CEX5 <- Customer Experience	0.704	0.704	0.030	23.472	0.000
SCF 2 <- Smart Connectivity Features	0.866	0.865	0.017	51.100	0.000
SCF1 <- Smart Connectivity Features	0.835	0.834	0.023	36.313	0.000
SCF3 <- Smart Connectivity Features	0.818	0.818	0.029	27.998	0.000
SCF4 <- Smart Connectivity Features	0.853	0.854	0.019	44.585	0.000
SCF5 <- Smart Connectivity Features	0.813	0.813	0.028	29.115	0.000

Table 4
Path coefficients bootstrapping results.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	*P* values
Customer Brand Value -> Customer Experience	0.284	0.286	0.060	4.766	0.000
Customer Experience -> Customer Engagement	0.617	0.617	0.050	12.301	0.000
Moderating Effect 1 -> Customer Experience	0.074	0.070	0.056	1.330	0.184
Smart Connectivity Features -> Customer Engagement	0.192	0.192	0.053	3.598	0.000
Smart Connectivity Features -> Customer Experience	0.429	0.429	0.063	6.755	0.000

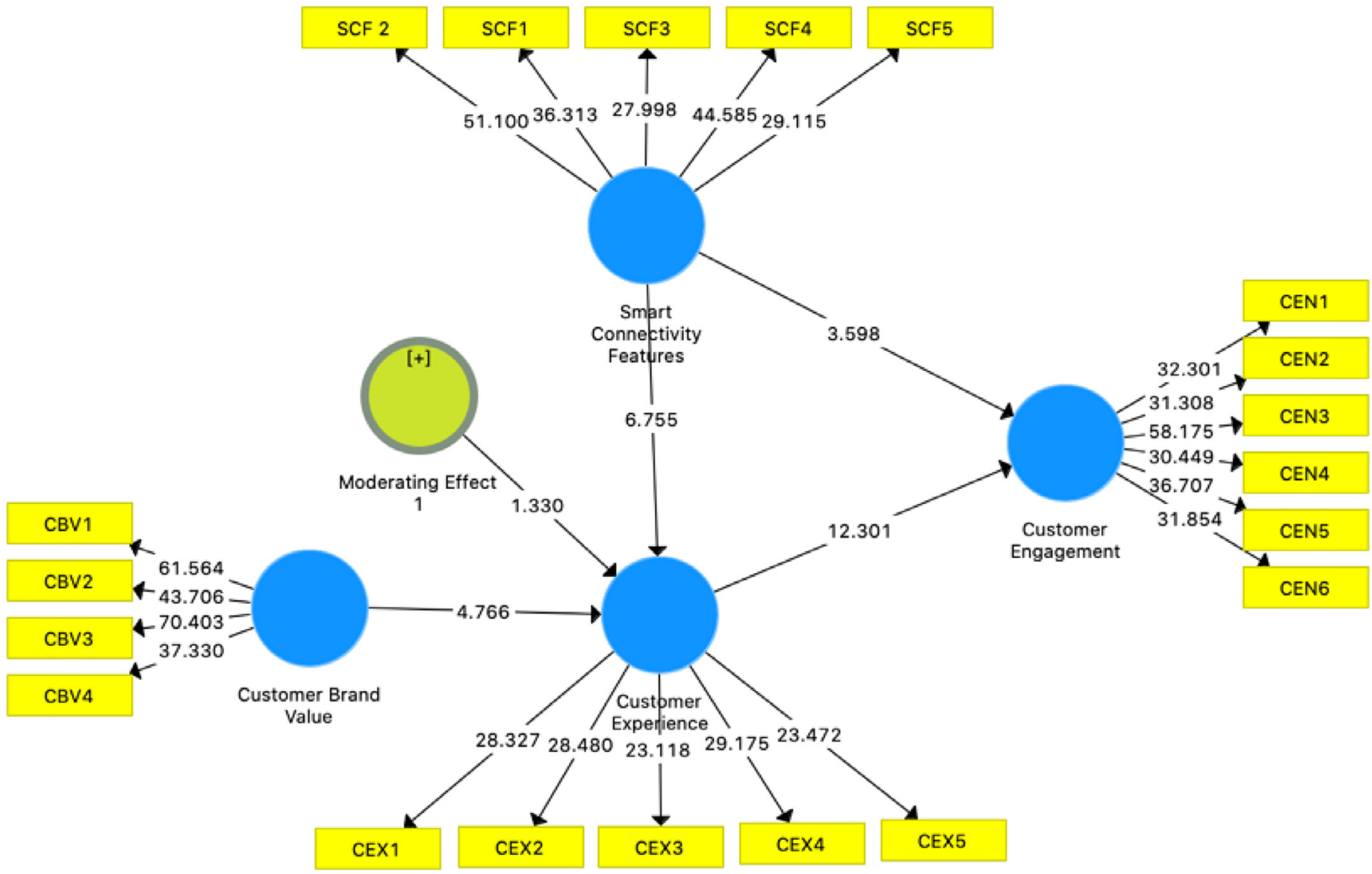

Fig. 3. Bootstrapping results.

the relationship between SCFs and CEX are well above the threshold value of 1.96 at a 95% confidence interval.

The purpose of this analysis is to highlight the role of smart connectivity features in EVs for enhancing CEX and CEN. Similarly, the role of customer brand value as a mediating variable for SCFs in enhancing CEX is analyzed. It's evident from the results that SCFs play a significant role in enhancing CEX and CEN in EVs. The results are supported by previous conceptual studies (Merrilees, 2016; Ullah et al., 2018) and comparable quantitative studies in other industries (Zhang et al., 2014; Carlson et al., 2018, 2019; Solem and Pedersen, 2016). The impact of CBV on CEX is another significant improvement to the current literature on the use of SCF in enhancing CEN. This is specifically important for new EV brands which are springing all over the world. The results suggest that not only substantial efforts are needed to make EV models more engaging by equipping them with SCF, but the efforts may not bear the desired results to improve CEX to a greater extent. It doesn't mean that SCF alone cannot make more engaging EV models but branding efforts may enhance CEX due to the perceived value associated with well-known brands (such as Tesla). However, our results suggest that CBV has no moderating role in enhancing CEX through SCF, which means new brands may use SCF as effectively as already established brands to make EV models more engaging. Classic automobile brands may show an unwillingness to change and overcome their technological boundaries due to many decades of conditioning (Baker et al., 2016). Similarly, new entrants to the EV market are born in the modern age of communication technologies and are mostly supported by internet technology companies which may make them more innovative compared to already established traditional car brands. This phenomenon is evident in the recent offers of new Chinese EV brands such as NIO, (NIO ES8 2020), WM (WM Motor - EX6 Plus, 2020), and Xpeng (Xpeng P7 2020). All of these new EV brands boast smart connectivity features such as mobile platforms integrated with the electric car software, an onboard virtual assistant which can interact with the users through voice commands and even create an ecosystem of smart devices connecting household items and mobile phones to the EV software. These brands are backed by technology giants like Baidu, Alibaba Group, and Tencent Group rather than traditional car manufacturers.

4.5. Practical and theoretical implications

This is the first articles to empirically verify the impact of SCFs on CEX and CEN in EVs; therefore, the research has serious implications for practitioners as well as academia. The results indicate, to keep their customers engaged and sustain them, EV manufacturers should focus on incorporating smart connectivity features in their cars. This strategy should be used while the EV technology evolves, and with the process, new EV brands emerge. Similarly, branding is essential for new entrants to the market because consumers' experience of their vehicles is going to be based on their branding efforts. Creating more engaging EVs could lead to sustainable use and wider adoption of this green technology.

From the theoretical perspective, this article starts a discussion in the academic community on the effectiveness of ICT for engaging customers in EVs. Although, some EV makers such as Tesla, Xpeng motors and NIO seem to be aware of the potential of ICTs as engaging technologies which is evident in their car models, academic research lags behind in the field. A more theoretically grounded understanding of the use of various connectivity and automation features in EVs may lead to a more effective use of these engaging technologies.

4.6. Limitations

This research is the first empirical study conducted on the role of smart connectivity features in enhancing CEN in EVs. The data were collected online from the communities of electric car users. Therefore, respondents may be more technology savvy compared with average EV users; therefore, the effect of SCFs may be more pronounced in our results.

5. Conclusions

The paper empirically tests a model for the use of smart connectivity features in EVs and their role in enhancing customer experience and customer engagement. The study found that smart connectivity features have a significant impact on customer engagement both, directly and indirectly through customer experience. Similarly, customer brand value has been found to impact customer experience directly. However, the proposed moderating role of customer brand value on the relationship between smart connectivity features and customer experience is not validated by the data.

Further studies are needed for a deep dive into the field. For example, more variables and functions should be included to increase the accuracy of the model and with larger sample size. The study can be replicated in different regions of the world to study the effect of cultural dimension. There is a need to study how technological advancement of a country might play a role in SCFs affecting EV user experience as the masses may be more technology savvy in using the features provided by the EVs. Similarly, longitudinal studies should be conducted to study the impact of SCF on user engagement over time.

Declaration of Competing Interest

None

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Appendix A

Questionnaire: All responses to the questions will be kept confidential and anonymous and will only be used for the purpose of academic analysis.

1=Disagree Strongly, 2=Disagree, 3= Neither Agree nor Disagree, 4=Agree, 5=Agree Strongly

1. I often use virtual assistant of my electric car

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

2. My car's internet connectivity is useful.

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

3. I find remote diagnostics tool of my electric car useful

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

4. I frequently use the mobile phone App of my car.

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

5. I often visit the social media accounts (Wechat, Weibo, Twitter, Facebook, Instagram, etc.) of my car manufacturer

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

6. I often participate in online community discussions for my car brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

7. I encourage friends and relatives to buy and use my car brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

8. I say positive things about my car to other people

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

9. I recommend my car brand to someone who seeks my advice on cars.

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

10. My feelings towards my car brand are very positive

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

11. Overall, I am satisfied with my car brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

12. I feel satisfied that my car brand offered me features that produce the best results for me

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

13. I feel joy when I use the smart features my car brand offered me

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

14. I feel excited when I use the smart features my car brand offered me

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

15. I feel secure because of the safety features in my car

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

16. my car's driving range is enough for my daily use

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

17. My car is more economical compared to gasoline cars

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

18. I am grateful to my car brand for providing such a product/service that create the best results for me

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

19. My car brand has compassion for its customers

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

20. The next car i buy will be of the same brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

21. Next time I buy a car I will use another electric vehicle brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

22. Owning the products/services of this car brand makes me happy

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

23. I do not actively discuss this brand on any media

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

24. I discuss the benefits that I get from this brand with others.

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

25. I am a part of this brand and mention it in my conversations

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

26. I provide feedback about my experiences with the brand to the firm

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

27. I provide suggestions for improving the performance of the brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

28. I provide feedback/suggestions for developing new products/services for this brand

1	2	3	4	5
Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly

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