energies

MDPI

Article

What Influences Chinese Consumers' Adoption of Battery Electric Vehicles? A Preliminary Study Based on Factor Analysis

Wei Wei [1], Ming Cao [2], Qianling Jiang [2], Sheng-Jung Ou [1] and Hong Zou [3,*]

[1] College of Design, Chaoyang university of technology, Taichung 41349, Taiwan; s10612904@gm.cyut.edu.tw (W.W.); sjou@cyut.edu.tw (S.-J.O.)
[2] School of Design, Jiangnan University, Wuxi 214000, China; caoming@jiangnan.edu.cn (M.C.); jiangqianling@jiangnan.edu.cn (Q.J.)
[3] Department of Culture and Arts Management, Honam University, Gwangju 62399, Korea
* Correspondence: 20188273@my.honam.ac.kr; Tel.: +82-01026660250

Received: 23 December 2019; Accepted: 21 February 2020; Published: 27 February 2020

Abstract: The rapid development of automobile industry in China did improve people's quality of life. However, it has also damaged the ecological environment. The emission of a large amount of automobiles is one of the serious air pollution sources. In recent years, the shortage of petrochemical energy, the rapid rise of harmful particles in the air (e.g., PM2.5 and PM10), and the increasing worse atmospheric environment are becoming obstacles to China's sustainable development. Battery electric vehicles (BEVs) are recognized as an ideal alternative to conventional cars. This study aims to explore the factors that can promote consumers' adoption of BEVs and to construct domains of these factors. Firstly, an open web questionnaire and semi-structured interviews were conducted to widely collect factors that promote consumers' purchase of BEVs. Then, questionnaire survey and exploratory factor analysis were used to construct domains of promoting consumers' purchasing willingness. A total of six factors that promote consumers' adoption of BEVs were obtained. Finally, the research results can provide references for the Chinese government and the BEV manufacturers in the development and promotion of EVs.

Keywords: electric cars; purchasing decisions; exploratory factor analysis; environment

1. Introduction

Our planet is paying a heavy price for climate change and action is needed to be taken to reach a more sustainable development model [1]. According to the intergovernmental panel on climate change (IPCC), the transport sector produced 7.0 GtCO2eq of direct greenhouse gas (GHG) emissions (including non-CO_2 gases) in 2010 and, hence, was responsible for approximately 23% of total energy-related CO_2 emissions (6.7 $GtCO_2$) [2]. In the past decades, various aspects of low-carbon transportation technologies have been studied to reduce carbon emissions [3]. Therefore, there are many potential alternatives to conventional diesel/gasoline internal combustion engines [4]. Electric vehicles (EVs) have become representative new-energy vehicles [5]. EVs are increasingly popular as an effective component of sustainable transport systems by reducing reliance on fossil fuels and reducing transport-related emissions [6,7]. From the perspective of sustainable development, China has implemented the policy of exempting the purchase tax of battery electric vehicles (BEVs) [8]. Additionally, the central and local governments have subsidized the purchase of BEVs. The BEV market has developed rapidly since 2011 with various subsidy policies for consumers and BEV manufacturers. While the sales of BEVs growing rapidly, the proportion of BEVs of the whole car market is still low. Recently, China's central and local governments have gradually increased their requirements for subsidies for the purchase of BEVs. As a result, sales of EVs had fallen for three consecutive months from June 2019 [9].

On the face of it, the decline in sales of EVs is caused by a reduction in subsidies, but obviously there are deeper reasons. There are many factors that affect consumers' BEV purchase behavior, including product attributes, policy attributes, and city infrastructure [10]. In addition, psychological factors such as personal attitude and environmental value are also important [11,12]. Obviously, the factors influencing the consumers' purchase of BEVs and conventional fuel vehicles are different.

The purpose of this study is to explore the factors that promote consumers' purchase of BEVs in China. These factors can provide references for policy making to promote the adoption of BEVs and BEV manufacturers to improve product competitiveness.

2. Literature Review

2.1. Research Background

The automobile industry is an important pillar of China's national economy. With the rapid development of China's economy, the automobile industry has also been maintaining a high-growth rate. China has a large population and a large demand for automobiles. The development of automobile industry will bring more serious energy shortage and environmental pollution. The adverse effects of energy and environmental pressures have boosted the cultivation and development of BEVs. To promote green technologies, such as BEVs, requires not only technological upgrades, but also major changes in political regulations, tariff and pricing regimes, and user behavior [13]. China has given substantial financial subsidies and preferential policies to BEV manufacturers in recent years. The government also provide consumers with price subsidies and preferential policies. However, the current market penetration of EV is relatively low despite the implementation of many strong governmental policies [14]. Consumers' resistance to BEVs is considered as a barrier to promotion of BEVs [1]. The expectation is that better knowledge of consumer preferences for BEVs can make these policies more effective and efficient [14]. In order to promote the adoption of BEVs, it is necessary to find out which factors could promote consumers' adoption, because consumers' adoption is the key to the success (or failure) of the BEV industry [15].

2.2. Factors Influencing Consumers' Adoption of EVs

Research on consumers' adoption of EVs started earlier in developed countries than in developing countries like China [5]. There are many studies on the factors influencing consumers' adoption of new-energy cars, of which research objects include hybrid electric vehicles [16–20], hydrogen-fuel vehicles [20–22], and BEVs. Liao et al. conducted a literature review on consumers' preference for EVs in 2016. Based on the differences in focusing factors, theories, and models, they divided studies concerning EV adoption into two categories: economic and psychological. The most widely applied methodology among economic studies is discrete choice analysis in which EV adoption is described as a choice among a group of vehicle alternatives described by their characteristics or "attributes" [14]. These given characteristics or "attributes" do lead to limitations of research scope. An open questionnaire survey along with semi-structured interview with BEV owners were taken to collect not only attributes of BEVs but also any other factors influencing consumers' adoption. Psychological researches can help speculate what factors consumers care about. Cheron and Zins found that expectancies and perceived risks affect EV purchase decisions [23]. Tu and Yang discovered that perceived usefulness and perceived ease of use had influence on consumers' purchase intention [24]. Bockarjova and Steg found that severity (environment and energy), vulnerability (environment and energy), rewards, self-efficacy (environment and energy), response-efficacy, and costs were important factors influencing consumers' adoption of EVs [25]. Klockner's research proved that the awareness of the need, responsibility, personal norms, attitudes, and perceived behavioral control, knowledge, planning ability, and intentions will influence consumers' adoption of EVs [26]. According to Peters and Dutschke, relative ease, compatibility, ease of use, trialability, observability, and social norm would influence consumers' adoption of EVs [27]. Dynamic performance and cruising performance were found to have influence on consumers' adoption of EVs in line with Skippon's research [28]. In a word, there would be a correspondence between consumers' psychological attributes and physical characteristics of BEV, which could be important for our judgment of the data collected from respondents. We made an update of list of recent researches on consumers' adoption of BEV based on Bigerna and Micheli's work [1], as shown in Table 1.

Table 1. Recent researches on factors influencing consumers electric vehicle (EV) adoption.

References	Authors (Year)	Country Investigated	Key Findings
[10]	Li et al. (2020)	China	Battery warranty, battery depreciation rate, operation cost
[24]	Chen et al. (2020)	Denmark, Finland, Iceland, Norway, and Sweden	Experience with EVs, fuel economy, financial savings, environmental value, vehicle-to-grid capability
[29]	Mukherjee and Ryan(2020)	Ireland	University degree, long-distance commuting
[30]	Bjerkan et al. (2016)	Norway	High purchase costs
[31]	Barth et al. (2016)	Germany	Purchasing cost, driving range, charging time
[32]	Beck et al. (2017)	Australia	Driving range, government incentives, climate change
[33]	Dumortier et al. (2015)	United States	Battery cost, driving range
[34]	Huang and Qian (2018)	China	Monetary attributes, charging service, driving range, coverage of charging stations
[35]	Adepetu and Keshav (2015)	United States	Driving range, battery capacity, purchasing cost
[36]	Chu et al. (2019)	China and Korea	Environmental concern, fuel costs, government subsidies, usage satisfaction, operation cost, charging convenience
[37]	Dorcec et al. (2019)	Croatia	Battery innovation, network of chargers, charging tariffs
[38]	Higgins et al. (2017)	Canada	Age, education, fuel economy
[39]	Shahraki et al. (2018)	China	Charging infrastructure
[40]	Biresselioglu et al. (2018)	European Union	Charging infrastructure
[41]	Xydas et al. (2016)	United Kingdom	Charging infrastructure
[42]	Plötz et al. (2017)	Germany and United States	Driving range
[43]	Nicholas and Tal (2017)	United States	Charging infrastructure
[44]	Morrissey et al. (2016)	Ireland	Charging infrastructure
[45]	Caperello et al. (2015)	United States	Charging infrastructure
[46]	Langbroek et al. (2017)	Sweden	Environmental sustainability
[47]	Wang et al. (2017)	China	Financial incentive policy measures
[48]	Moon et al. (2018)	Korea	Charging time and purchase costs
[49]	Ferguson et al. (2018)	Canada	Maintenance costs

From the list of literature, we can find that consumer groups in different regions care about different aspects of BEVs. Liao et al. also mentioned in their study that the research on adoption preference assumes that the preference is stable, while the preference for EV should change from time to time [23]. There are two reasons for this. Firstly, EVs are relatively new, and different groups of people will adopt them according to their acceptance of innovation. People have different preferences at different time nodes, so consumers' preferences may change with time [50]. Secondly, people's preferences will be affected by technological advances, increased understanding of EVs, higher market share, greater social influence and other factors. If consumers' purchase preferences do change significantly, the results of related research based on static preferences will only apply to specific time periods. Hence, it is necessary to rediscover factors that promote consumers' adoption of BEVs at this turning point of market and policy environment in China.

3. Methods

This study aims to identify factors that influence consumers' adoption of BEVs. Open questionnaire survey and semi-structured interview were employed to collect data. This study is divided into two phases. The first phase includes consumer surveys and interviews with BEV owners. The goal is to collect as many influential factors, which affect consumers' adoption of BEVs, as possible. The results of the first phase will serve as the basis for the second-phase questionnaire. In the second phase, the construct of factors that influence consumers' adoption of BEVs are obtained through principal component analysis and then named. In the following part, all the answers derived from respondents' answers will be called "item", and the construct derived from principal component analysis will be called "factor".

3.1. First-Phase Questionnaire Survey and Interview

The first-phase questionnaire and interview were conducted during November 6, 2019 and November 17, 2019. The sampling method was convenience sampling. All the respondents were invited to fill out the questionnaire through web link sent by authors. Respondents were confirmed to have some knowledge of conventional vehicles and BEVs by answering a self-assessment question. The open questionnaire included three questions: (1) Were you involved in the family car purchase decision? (2) Would you consider buying an electric car? (3) What do you think are the factors that promote consumers' purchase of EVs? A total of 345 samples were recovered, of which 46.96% were male and 53.04% were female. Respondents aged under 25 accounted for 62.32%, respondents aged from 26 to 30 accounted for 11.59%, respondents aged from 31 to 40 accounted for 19.42%, and respondents aged over 40 accounted for 6.67%. A total of 77.39% of the respondents indicated their family already own a car. As this study seeks to explore the factors that drive consumers to buy EVs, samples were considered invalid for expressing complete reluctance to purchase electric vehicles. Those that said they would not participate in the car purchasing decision process were also considered invalid. A total of 172 valid samples were collected after deleting the invalid ones. Among them, 46.58% were men, 53.42% were women, respondents aged under 25 accounted for 38.95%, respondents aged from 26 to 30 accounted for 18.02%, respondents aged from 31 to 40 accounted for 31.98%, and respondents aged over 40 accounted for 11.05%. One-hundred percent of the respondents indicated their family already own a car.

The semi-structured interview serves as a supplement to the questionnaire survey results. Due to time and financial constraints, the researchers recruited only nine respondents who owned EVs by inviting friends or paying volunteers with convenience sampling method. The respondents were all male. The interview outline and schedule were sent to the respondents before the interview. Limited by geographical location, the interview was conducted via telephone interview and the recording was saved. The profile of the respondents is listed in Table 2.

Table 2. Profile of respondents.

Number	Gender	Age	Vehicle Model	Duration of Ownership
1	Male	27	Tesla Model X	7 months
2	Male	26	Tesla Model S	18 months
3	Male	32	Tesla Model S	11 months
4	Male	32	Nio ES8	6 months
5	Male	36	Nio ES8	5 months
6	Male	30	Geely EV450	9 months
7	Male	37	Geely EV350	5 months
8	Male	31	Roewe Ei5	12 months
9	Male	24	Chery eQ1	7 months

Five main questions of the interview designed based on the purpose and scope of the study are shown in Table 3.

Table 3. Questions of semi-structured interview.

Number	Question Description
1	Have you ever used a petrol/diesel-powered car before?
2	Why did you choose to buy an electric car?
3	Do you have any concerns before you buy an electric car?
4	What characteristics are you feel satisfied with the battery electric vehicle (BEV) you purchased?
5	What did you find unsatisfactory after you purchased the electric car?

The processing of answers collected from valid questionnaires is as follows: (1) List all the collected items by number; (2) split those items that contain more than one key feature (e.g., policy attributes, BEV characteristics) to make sure that each item contains only one key feature; (3) categorize all the items based on key features within each items; (4) merge the items with similar descriptions and meanings, then calculate the frequency of each item. The processing of answers collected from interview is as follows: (1) Turn the recording into a verbatim transcript; (2) derive items from verbatim transcript and list all the collected items by number, make sure that each item contains only one key feature; (3) categorize all the items based on key features within each item; (4) merge the items with similar descriptions and meanings, then calculate the frequency of each items. The questions of the semi-structured interview were asked and answered in Chinese. In this study, those items with a frequency less than 3 after they were merged were deleted. After that, 32 items were derived from the result of first-phase questionnaire survey and interview, which serves as the basis of the second-phase questionnaire survey.

3.2. Second-Phase Questionnaire Survey and Factor Analysis

The second-phase questionnaire was conducted during November 20, 2019 and November 26, 2019. All the respondents were confirmed to have some knowledge of conventional vehicles and BEVs by answering a self-assessment question. Furthermore, respondents were invited to fill out the questionnaire through web link sent by authors. The questionnaire consists of two parts: The basic information of the respondents and the items, which were derived from the result of the first phase, that promote consumers' adoption of BEVs. The respondents' basic information included gender, age, education, and whether they had bought an electric car. The second-phase questionnaire used a Likert's seven-point scale, with 1 representing strong disapproval and 7 representing strong approval. The collected data were analyzed by principal component analysis, and the extracted factors were tested by independent sample t test and one-way ANOVA for demographic variables. Respondents to both questionnaires were Chinese and they filled in questionnaires online. The questions of the questionnaire were asked in Chinese.

Before the formal questionnaire survey, 50 respondents were asked to participate pre-test to collect data for item analysis. The item analysis process was divided into two steps. In the first step, the corrected item total correlation >0.5 was used as the judging criteria, it was found that all 32 items met the requirement. In the second step of item analysis, the principal component analysis was adopted to extract only one factor from all items, items with extracted communality <0.3 were considered not suitable for further factor analysis, and then deleted [51].

In the formal test, 490 valid samples were collected through online questionnaires, and the sample size has reached the suitable scale for factor analysis [52,53]. A total of 60.4% of respondents were male and 39.6% were female. Respondents aged under 30 accounted for 21.22%, respondents aged 31 to 50 accounted for 53.27%, respondents aged over 50 accounted for 25.51%. A total of 31.02% of respondents had a high school education or below, respondents with college and bachelor's degrees account for 60.41%, respondents with graduate degree accounted for 8.57%. A total of 12.44% of respondents were from cities with traffic restrictions, and the rest were from cities without traffic restrictions. Respondents with monthly income below 5000 RMB accounted for 42.04%, respondents with monthly income of 5001–10,000 RMB accounted for 36.33%, respondents with monthly income above 10,001 RMB accounted for 21.63%. Ninety-five respondents had already purchased EVs, accounting for 19.4% of all respondents, and the male:female ratio was 60%:40% which was close to the gender ratio of the total respondents.

The principal component analysis (PCA) and maximum variance (MAA) methods in factor analysis were used to extract factors promoting consumers' adoption of BEVs. In principal component analysis, there are two methods to extract factors, Method 1 is to extract factors with eigenvalues greater than 1, and Method 2 is based on the given number of factors. Results of both methods were compared and the more suitable one was chosen. The extracted factors were then named according to the included items. Independent sample t-test and one-way ANOVA were used to test whether there were significant differences between different levels of user demographic variables on each factor. Demographic variables included gender, age, education, restrict of city transition, income level, and whether purchased an electric car or not.

4. Results and Discussion

4.1. Results of First-Phase Questionnaire Survey and Interview

In the first phase, a total of 457 items were obtained from online questionnaire, and 36 items were left after being merged (Table 4).

Table 4. Items derived from the first-phase questionnaire.

Number	Item Description	Frequency
1	Q1. Battery electric vehicles (BEVs) are environmentally friendly.	121
2	Q2. BEVs are energy efficient.	61
3	Q3. Electricity is cheaper than petrol/ diesel.	48
4	Q4. Maintenance cost for BEVs is low.	28
5	Q5. BEVs are cheap.	25
6	Q6. The endurance mileage of the electric car is up to your expectation.	22
7	Q7. BEVs are trends of future development.	17
8	Q8. The government subsidizes the purchase of BEVs.	13
9	Q9. BEVs have good acceleration performance.	10
10	Q10. BEVs could free the country from its energy constraints.	10
11	Q11. The transition of BEVs will not be restricted.	9
12	Q12. BEVs are safe.	9
13	Q13. In some cities it is easier to get a license plate.	7
14	Q14. The government promoted the purchase of BEVs.	7
15	Q15. The shape of BEVs is variable.	7
16	Q16. There is no purchase tax on BEVs.	6
17	Q17. The charging infrastructure for BEVs in cities are expanding.	4
18	Q18. BEVs can recharge as fast as you expected.	4
19	Q19. The BEVs' battery life attenuates as expected.	4
20	Q20. BEVs make less noise.	4
21	Q21. It is my wish that China's environment will become better.	4
22	Q22. Many people around me have bought BEVs.	4
23	Q23. BEVs are trendy.	4
24	Q24. BEVs have more features.	4
25	Q25. People around me feel good after they bought BEVs.	3
26	Q26. I want to support domestic electric car brands to help the rise of the Chinese automobile industry.	3
27	Q27. BEVs leave people a strong feeling of technology.	3
28	Q28. It gives me a sense of national pride that more Chinese brands are manufacturing BEVs.	3
29	Maintenance of the mechanical structure of BEVs is simple.	2
30	The spatial design of BEVs is reasonable.	2
31	BEVs make people feel novel.	2
32	BEVs have green license plates (China's petrol-powered cars have blue ones).	2
33	I hate the smell of gasoline.	2
34	The user experience of BEVs' on-board computer is good.	1
35	The driving experience of BEVs is good.	1
36	BEVs are more likely get license plates with a preferred combination of numbers and letters.	1

Those items with a frequency less than 3 after being merged were deleted, leaving 24 items after deletion. During the collection of first-phase questionnaire, a semi-structed interview was conducted to collect more factors.

A total of 73 items were derived from the interview results, and 19 items were left after being merged (Table 5).

Those items derived from the semi-structed interview with a frequency less than 3 were deleted. After merging the same items, a total of 32 items were collected from the open questionnaire semi-structure interview, which were used as the basis of the second-phase questionnaire.

Table 5. Items derived from semi-structured review.

Number	Item Description	Frequency
1	Q3. Electricity is cheaper than petrol/ diesel.	9
2	Q6. The endurance mileage of the battery electric vehicles (BEVs) is up to your expectation.	8
3	Q9. BEVs have good acceleration performance.	8
4	Q29. BEV brands offer longer battery warranties or free battery replacements.	6
5	Q7. BEVs are trends of future development.	6
6	Q1. BEVs are environmentally friendly.	6
7	Q27. BEVs leave people a strong feeling of technology.	6
8	Q30. BEVs make people feel novel.	5
9	Q31. The driving experience of BEVs is good.	4
10	Q32. I have environmentally friendly values.	3
11	Recharging BEVs is convenient.	2
12	In some cities it is easier to get a license plate.	2
13	The transition of BEVs will not be restricted.	2
14	BEVs are safe.	1
15	The service of BEVs is humane.	1
16	BEV is suitable to be the second car after owning a conventional fuel car.	1
17	BEVs have more features.	1
18	BEVs are cheap.	1
19	There is no purchase tax on BEVs.	1

4.2. Item Analysis of the Second-Phase Questionnaire

The results of item analysis are shown in Table 6. After deleting Q1 and Q7, there were a total of 30 items left for the formal questionnaire survey.

Table 6. Item analysis results.

Item Number	Corrected Item Total Correlation	Extracted Communality
Q1	0.502	0.277
Q2	0.593	0.376
Q3	0.639	0.453
Q4	0.740	0.593
Q5	0.660	0.478
Q6	0.602	0.387
Q7	0.477	0.248
Q8	0.699	0.529
Q9	0.803	0.673
Q10	0.571	0.358
Q11	0.637	0.455
Q12	0.708	0.527
Q13	0.708	0.547
Q14	0.737	0.574
Q15	0.698	0.510
Q16	0.653	0.469
Q17	0.666	0.479
Q18	0.646	0.445
Q19	0.646	0.438
Q20	0.763	0.609
Q21	0.650	0.467
Q22	0.624	0.415
Q23	0.691	0.497
Q24	0.786	0.646
Q25	0.770	0.622
Q26	0.770	0.628
Q27	0.757	0.600
Q28	0.758	0.613
Q29	0.707	0.528
Q30	0.716	0.535
Q31	0.825	0.707
Q32	0.574	0.353

4.3. Analysis of the Appropriateness and Reliability of the Second-Phase Questionnaire Results

The KMO and Bartlett's sphericity results show that KMO value is 0.949 and approximate chi-square of Bartlett's spherical test is 12549.662, degrees of freedom is 435, and the p-value is 0.000 (significant). The results indicate the correlation coefficient and net correlation coefficient of all the items in this study have a good sampling adequacy. These items are suitable for factor analysis [54]. The test results of this study show that the Cronbach's α of the overall scale is 0.964, indicating a good internal consistency [55].

4.4. Factor Analysis of the Second-Phase Questionnaire

Four factors were extracted by Method 1, and the initial eigenvalues of each factor were respectively: factor = 14.906, factor 2 = 2.235, factor 3 = 1.789, factor 4 = 1.599. A total of 68.430% variance was explained by four factors, and the explained variance of each factor is 49.687%, 7.449%, 5.964%, and 5.330%. After the maximum variance rotation, the proportion of variance explained by each factor changed, and the proportion difference of explained variance between each factor is more balanced. Proportion of variance explained by factor 1 decreased from 49.687% to 20.541%, proportion of variance explained by factor 2 increased from 7.449% to 19.897%, proportion of variance explained by factor 3 increased from 5.964% to 14.114%, proportion of variance explained by factor 4 increased from 5.330% to 13.878%, the commonality and relative position of the factors did not change, and the sum of the eigenvalues and the total explained variance remained the same. However, when researchers tried to name each factor, they found that the items in factor 2 were complicated and difficult to name. Therefore, this study tried to extract six factors according to the number of original categories. The initial eigenvalues of each factor extracted by Method 2 are: Factor 1 = 14.906, factor 2 = 2.235, factor 3 = 1.789, factor 4 = 1.599, factor 5 = 0.904, factor 6 = 0.882. These six factors explained 74.384% of the total variance, factor 1 accounted for 49.687%, factor 2 accounted for 7.449%, factor 3 accounted for 5.964%, factor 4 accounted for 5.330%, factor 5 accounted for 3.014%, factor 6 accounted for 2.940%. After maximum variance rotation, the proportion of variance explained by each factor was rebalanced, proportion of variance explained by factor 1 decreased from 49.687% to 19.377%, proportion of variance explained by factor 2 increased from 7.449% to 13.181%, proportion of variance explained by factor 3 increased from 5.964% to 12.876%, proportion of variance explained by factor 4 increased from 5.330% to 12.447%, proportion of variance explained by factor 5 increased from 3.014% to 8.948%, proportion of variance explained by factor 6 increased from 2.940% to 7.554%. The comparison of the eigenvalues and proportion of explained variance of the two extraction methods are shown in Table 7. Compared with Method 1, the proportion of explained variance of factor 1, factor 3, and factor 4 decreased less in Method 2, while the increase of proportion of explained variance of factor 5 and factor 6 was accompanied by a significant decrease of proportion of explained variance of factor 2. It is found that items classified by Method 2 are more reasonable than by Method 1. Therefore, the results of Method 2 were adopted in this study (Table 8).

Table 7. Eigenvalues and extraction of squared loadings comparison.

Method 1			**Method 2**		
Number	**Eigenvalue**	**% of Variance**	**Number**	**Eigenvalue**	**% of Variance**
Factor 1	6.162	20.541%	Factor 1	5.813	19.377%
Factor 2	5.969	19.897%	Factor 2	3.954	13.181%
Factor 3	4.234	14.114%	Factor 3	3.863	12.876%
Factor 4	4.163	13.878%	Factor 4	3.734	12.447%
Total		68.430%	Factor 5	2.684	8.948%
			Factor 6	2.266	7.554%
			Total		74.384%

Table 8. Summary of principal component analysis using varimax method.

Item Number	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Q27	0.766	0.227	0.216	0.125	0.176	0.104
Q9	0.747	0.170	0.228	0.233	0.166	0.029
Q15	0.742	0.140	0.127	0.117	0.089	0.364
Q31	0.740	0.234	0.369	0.226	0.113	0.008
Q24	0.740	0.172	0.272	0.197	0.266	0.114
Q30	0.737	0.200	0.219	0.168	0.008	0.336
Q23	0.717	0.287	0.138	0.097	0.021	0.344
Q20	0.705	0.313	0.215	0.096	0.249	0.055
Q21	0.206	0.806	0.125	0.214	0.122	−0.050
Q28	0.314	0.755	0.125	0.188	0.257	0.109
Q32	0.231	0.736	0.203	0.173	0.003	0.153
Q26	0.318	0.733	0.112	0.152	0.236	0.143
Q2	0.221	0.592	0.303	0.118	0.259	0.239
Q18	0.258	0.177	0.816	0.100	0.230	0.101
Q6	0.363	0.104	0.775	0.137	0.199	−0.038
Q19	0.280	0.099	0.706	0.122	0.147	0.267
Q29	0.115	0.449	0.631	0.119	0.147	0.092
Q12	0.365	0.183	0.630	0.235	0.083	0.187
Q11	0.117	0.157	0.088	0.831	0.186	0.042
Q13	0.194	0.223	0.091	0.775	0.239	0.086
Q16	0.255	0.213	0.162	0.713	0.163	0.294
Q8	0.217	0.131	0.241	0.679	0.112	0.425
Q17	0.106	0.363	0.433	0.473	0.278	0.132
Q3	0.228	0.286	0.247	0.251	0.703	0.035
Q4	0.252	0.117	0.257	0.421	0.677	0.187
Q10	0.109	0.368	0.208	0.168	0.655	0.259
Q5	0.249	0.149	0.264	0.405	0.602	0.248
Q22	0.392	0.127	0.099	0.247	0.227	0.722
Q14	0.343	0.208	0.198	0.400	0.228	0.579
Q25	0.253	0.182	0.332	0.339	0.263	0.564
Eigenvalue	5.813	3.954	3.863	3.734	2.684	2.266
% of explained variance	49.687%	7.449%	5.964%	5.330%	3.014%	2.940%
% of explained variance after varimax	19.377%	13.181%	12.876%	12.447%	8.948%	7.554%
Total % of explained variance	74.384%					
Cronbach's α of all items	0.964					
Cronbach's α of each factor	0.942	0.895	0.890	0.888	0.879	0.867

In conclusion, this study extracts six factors from 30 items by principal component analysis, and 74.384% of the total variance is explained. Factor 1 has 8 items, factor 2 has 5 items, factor 3 has 5 items, factor 4 has 5 items, factor 5 has 4 items, factor 6 has 3 items. The Cronbach's α values of each factor are as follows: factor 1 = 0.942, factor 2 = 0.895, factor 3 = 0.890, factor 4 = 0.888, factor 5 = 0.879, factor 6 = 0.867, indicating that all six factors have good internal consistency.

The items included in factor 1 are: Q27, Q9, Q15, Q31, Q24, Q30, Q23, Q20. BEVs have better acceleration performance and lower operating noise due to the use of electric motors. The lower-placed battery pack gives the vehicle a lower center of gravity, which brings a better driving experience. Additionally, most BEVs use more intelligent interactive systems and avant-garde design concepts, bringing consumers a sense of technology, novelty, and trend. Hence, factor 1 is named "design". Obviously, consumers in China pay great attention to the usage experience of BEVs, which caters to Chu et al.'s research results [36]. Factor 1 accounts for the largest proportion of total explained variance, indicating that consumers focus more on own preferences when choosing BEVs and vehicle attributes are the most important part for BEV manufacturers.

The items included in factor 2 are: Q21, Q28, Q32, Q26, Q2. Electricity is considered cleaner than fossil fuels such as gasoline. Consumers' expectation of environmental quality, environmentally friendly values and emphasis on energy efficiency all demonstrate consumers' environmental beliefs [56]. Results of Nordic (developed area) research show that environmental value has significant influence on consumers' adoption of EVs [24]. In recent years, China has been adhering an environmentally friendly developing policy, which echoes consumers' environmental beliefs. As BEVs gradually gain consumers' acceptance, many homegrown automobile manufacturers have emerged with governmental incentive policies. Both policies seem to have had their due effect. Consumers' desire for a better national environment and support for the development of the national automobile industry both can be understood as a national consciousness, so factor 2 is named "national awareness".

The items included in factor 3 are: Q18, Q6, Q19, Q29, Q12. Charging a BEV is not as easy and quick as refueling a petrol-powered one. Therefore, shorter charging time and longer travel distance would boost consumers' confidence in BEVs. The battery material along with physical and chemical properties of battery determine that battery attenuation is an unavoidable problem at the current stage. Therefore, reasonable battery attenuation rate and reliable battery after-sales service have become factors that promote consumers' adoption. Battery is one of the core components of BEVs, and continuous battery innovation can increase consumer confidence in adoption [37]. Hence, factor 3 is named "battery".

The items included in factor 4 are: Q11, Q13, Q16, Q8, Q17. In China, consumers can obtain license plates for BEV after purchasing. In June 2019, the National Development and Reform Commission, the Ministry of Ecology and Environment, and the Ministry of Commerce jointly issued "Resources Recycling Plan for Promoting Smooth Update of Key Consumer Products (2019–2020)", which clearly emphasized that local governments should not restrict city transition of BEVs. Additionally, Chinese government updates the "Catalogue of New-energy Vehicle Exempted from Vehicle Purchase Tax" and "Recommended Model Catalogue for Promotion and Application of EVs" regularly, consumers can buy the cars listed in these catalogues at subsidized prices without purchase tax. Generally, consumers can charge their vehicles through household charging piles given away by manufacturers for free at their home. "The Guidelines for The Development of EV Charging Infrastructure (2015–2020)" issued by the state puts forward the goals for the development of public charging piles: By 2020, 12,000 centralized charging and battery-changing stations will be built, and 4.8 million charging piles will be scattered to meet the recharging needs of 5 million BEVs nationwide. The construction of charging infrastructure attract attention from consumers in USA, EU, and UK, as well as China [40,41,43]. In China, the construction of charging infrastructure especially depends on the support of government policies. It shows that the government's policy support for the purchase and use of BEVs is very comprehensive. Hence, factor 4 is name "government policy".

The items included in factor 5 are: Q3, Q4, Q10, Q5. Generally, BEVs cost less per mile than fuel cars [57]. The maintenance costs of conventional cars vary greatly from one to another. It does raise consumers' concerns about maintenance costs of BEVs. Coupled with the relatively simple mechanical structure, the maintain costs of BEVs is usually lower than that of same-level conventional cars. Therefore, governments and manufacturers need to let consumers know more about the usage cost of BEVs to eliminate consumer concerns [10]. Now the government is encouraging consumers to buy BEVs, not only subsidizing the purchase price of some models, but also exempting the purchase tax, so the purchase cost of EVs will be cheaper than fuel cars. Hence, factor 5 is named "cost of purchase and use".

The items included in factor 6 are: Q22, Q14, Q25. Two of the three items mentioned that information shared by people close to consumers would boost their intention of purchase an electric car. Government propaganda is a more influential means in China, and Richard Taylor believes that the continuous propaganda from the government is just an application of herd mentality [56]. Hence, factor 6 is named "herd mentality".

4.5. The Influence of User Demographic on Six Factors

In this section, all independent sample t-tests and one-way ANOVA were performed separately, and each test corresponds to a separate hypothesis. A total of 36 separate tests were conducted. The results showed that there were no significant differences between different levels of restriction of transition conditions and income. Those tests with significant differences are presented as follows.

Gender, age, education, and whether purchased an electric car or not show significant differences in some factors at the 95% confidence level. As can be seen from Table 9, gender has significant differences in design, national awareness, battery, and herd mentality. Men score higher than women on four factors: design, national awareness, battery, and herd mentality. Therefore, it can be inferred that men are more concerned about the design of BEVs than women, which reminds manufacturers that they can make some optimizations based on gender difference when designing vehicles. Men tend to have a higher national awareness than women, which means women's needs may be more concentrated on vehicle attributes when buying BEVs. Men also care more about batteries and after-sales than women. Batter warranty and battery innovation are unavoidable issues for the sustainable development of the electric vehicle market, government and manufacturers should work together to push further progress in the development of battery technology.

Table 9. Summary of independent sample t test.

Factor	Group	Mean	SD	t	p (Two-Tailed)
Design	Male Female	5.3323 4.8943	1.46958 1.43460	3.257	0.001 *
National awareness	Male Female	5.9284 5.6845	1.10996 1.16204	2.334	0.020 *
Battery	Male Female	5.6014 5.2907	1.32788 1.34558	2.519	0.012 *
Herd mentality	Male Female	5.1926 4.8643	1.56927 1.39553	2.423	0.016 *
Design	Purchased Not purchased yet	5.7724 5.0114	1.14404 1.50247	5.451	0.000 *
National awareness	Purchased Not purchased yet	6.2126 5.7403	0.86973 1.17377	4.414	0.000 *
Battery	Purchased Not purchased yet	5.8021 5.4005	1.16089 1.37220	2.917	0.004 *
Government policy	Purchased Not purchased yet	5.8147 5.4618	1.24806 1.24763	2.476	0.014 *
Cost of purchase and use	Purchased Not purchased yet	5.8053 5.4994	1.12525 1.31137	2.095	0.037 *
Herd mentality	Purchased Not purchased yet	5.6211 4.9283	1.40298 1.50565	4.079	0.000 *

*** $p < 0.05$**

There are significant differences in design, national awareness, battery, government policy, cost of purchase and use, and herd mentality between those who have already bought EVs and those who have not. Respondents who have already bought an electric car scored higher on all factors. Respondents who have already bought BEVs agree that design is the factor that drives their purchase more than those who have not. The aesthetic part of the exterior design is of course different from one person to another, but BEVs usually have more functions and better human–car interaction experience. Respondents who have already bought an electric car agree that national awareness is the factor that drives their purchase more than those who have not. On the one hand, it shows that respondents who have already bought BEVs have a stronger sense of national pride and national identity, on the other hand, it also shows that they have a higher awareness of environmental protection. Respondents who have already bought BEVs scored higher on battery indicates that their approval of current battery technology and future of BEVs. Respondents who have already bought BEVs scored higher on "government policy" indicates their satisfaction with government's welfare policies for EVs. Respondents who have already bought BEVs agree more on cost of purchase and use indicates that they are more concerned about the cost, which also shows that EBVs are indeed cheaper to purchase and use than fuel cars. Hence, governments and manufacturers should put more effort into eliminating potential BEV consumers' confusion about the usage cost.

As can be seen from Table 10, respondents with different educational backgrounds have significant differences in design and national awareness. Respondents with college or bachelor degrees or below score higher on "design" than those with a graduate degree. Respondents with graduate degree score higher on "national awareness" than those with college and bachelor degrees or below. Post hoc comparison shows that respondents with a higher education level have higher approval of national awareness. With the increase of average life expectancy, elderly-friendly design ideas have been introduced in many fields. Perhaps manufacturers can optimize the vehicle design details for users of different ages. Respondents of different ages also show significant differences in design and national awareness. People aged over 50 score higher on "design" than those aged under 50. Post hoc comparison shows that older people have higher approval of design. People aged under 30 score higher on national awareness than those who aged over 31. Post hoc comparison shows that younger people have higher approval of national awareness.

Table 10. Summary of one-way ANOVA.

		Sum of squares of deviations (SS)	Degree of freedom (df)	Sum of mean squares (MS)	F	p	Post hoc comparison
Education							
Design	SS_w	23.237	2	11.619	5.475	0.004 *	Master/PhD < (Bachelor < High School or below)
	SS_b	1033.558	487	2.122			
	SS_t	1056.795	489				
National awareness	SS_w	19.180	2	9.590	7.633	0.001 *	Master/PhD > (Bachelor > High School or below)
	SS_b	611.843	487	1.256			
	SS_t	631.023	489				
Age							
		Sum of squares of deviations (SS)	**Degree of freedom (df)**	**Sum of mean squares (MS)**	**F**	**p**	**Post hoc comparison**
Design	SS_w	2	15.018	15.018	7.123	0.001 *	(Under 30 < 31–50) < over 51
	SS_b	487	2.108	2.108			
	SS_t	489					
National awareness	SS_w	2	10.579	10.579	8.448	0.000 *	Under 30 < (31–50 < over 51)
	SS_b	487	1.252	1.252			
	SS_t	489					

*** $p < 0.05$**

5. Conclusions

Under the global trend of developing green travel mode, we have to realize that conventional cars will be replaced by EVs in the coming future. BEV is a choice of EVs with advanced technology, stable performance, and affordable price. Countries around the world are actively popularizing BEVs. In recent years, the Chinese government has provided substantial financial subsidies and welfare policies for the promotion of BEVs. However, sales of BEVs have seen cliff-like drop as subsidy declines. Hence, it is necessary to explore influence factors of consumers' adoption of BEVs. The conclusions of this study are as follows:

1. This study concludes the factors and detailed items that promote consumers' adoption of BEVs in China. There are six factors in total: Factor 1 is "design", factor 2 is "national awareness", factor 3 is "battery", factor 4 is "government policy", factor 5 is "cost of purchase and use", and factor 6 is "herd mentality".
2. The factor "design" explains most of the total variance, indicating that characteristics of the cars are still the most important consideration for consumers when purchasing BEVs. What is more, national awareness, battery, government policy, cost of purchase and use, and herd mentality are all factors that can promote consumers' adoption of BEVs.
3. Men pay more attention to design and performance than women when buying BEVs, and are more susceptible to influence from surrounding people.

4. At present, consumers who had already purchased BEVs agree more with the design, battery, welfare policy, use, and purchase cost of BEVs than those who had not purchased them. Additionally, consumers who had already purchased BEVs have higher national awareness and are more susceptible to influence from surrounding people.
5. Consumers with a higher education cared less about design of BEVs and had higher recognition of national awareness than consumers with lower education.
6. Older consumers usually cared more about design than younger consumers. While the younger consumers had higher recognition of national awareness than older consumers.

Compared with other studies on consumers' purchase of BEVs, the results of this study propose a new factor "design", which is the most important consideration for Chinese consumers. BEV manufacturers could make some optimizations based on gender difference when designing vehicles and optimize the vehicle design details for users of different ages, especially for the elderly. In addition, the BEV industry, as an important part of the revitalization of the Chinese automobile industry, experienced a serious decline after the decline in national financial subsidies. For the government, it may be the best time to think about the currently broad but not sophisticated subsidy policies, and it is imperative to formulate more diversified policies, such as using the personal carbon trading (PCT) scheme and the tradable driving credits (TDC) scheme to replace those subsidy policies [10]. Manufacturers and the government should pay special attention to this special factor of national awareness. This emotional factor stems from consumers' trust and expectations of manufacturers and the government. Therefore, the government should accelerate the construction of BEV-related infrastructure, such as charging infrastructure and battery recycling facilities, to realize a more sustainable traffic mode. In addition, domestic manufacturers should not rely on government subsidies to fight price wars with foreign brands, but actually improve product quality from technical and design levels.

Author Contributions: All authors contributed to the paper. W.W., M.C., Q.J., S.-J.O., and H.Z. collected and organized data; W.W. and H.Z. wrote the manuscript with the supervision from M.C., S.-J.O. and Q.J.; and H.Z. acted as a corresponding author. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

References

1. Bigerna, S.; Micheli, S. Attitudes Toward Electric Vehicles: The Case of Perugia Using a Fuzzy Set Analysis. *Sustainability* **2018**, *10*, 3999. [CrossRef]
2. IPCC. Intergovernmental Panel on Climate Change. AR5 Climate Change 2014: Mitigation of Climate Change. Available online: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter8.pdf (accessed on 28 January 2020).
3. Lai, I.; Liu, Y.; Sun, X.; Zhang, H.; Xu, W. Factors influencing the behavioural intention towards full electric vehicles: An empirical study in Macau. *Sustainability* **2015**, *7*, 12564–12585. [CrossRef]
4. Schulte, I.; Vorst, R.V.D. Issues affecting the acceptance of hydrogen fuel. *Int. J. Hydrog. Energy* **2004**, *29*, 677–685. [CrossRef]
5. Nie, Y.; Wang, E.; Guo, Q.; Shen, J. Examining Shanghai Consumer Preferences for Electric Vehicles and Their Attributes. *Sustainability* **2018**, *10*, 2036. [CrossRef]
6. Kong, F.; Liu, X. Sustainable transportation with electric vehicles. *Found. Trends® Electr. Energy Syst.* **2017**, *2*, 1–132. [CrossRef]
7. Liu, L.; Kong, F.; Xue, L.; Yu, P.; Wang, Q. A review on electric vehicles interacting with renewable energy in smart grid. *Renew. Sustain. Energy Rev.* **2015**, *51*, 648–661. [CrossRef]
8. Yang, S.; Zhang, D.; Fu, J.; Fan, S.; Ji, Y. Market cultivation of electric vehicles in China: A survey based on consumer behavior. *Sustainability* **2018**, *10*, 4056. [CrossRef]
9. Wei, S. The Subsidy Standard of New Energy Vehicles Is Increasingly Strict, and Strengthening Its Own Strength Is the Key. Available online: http://kuaibao.qq.com/s/20191023A04DGY00?refer= (accessed on 29 October 2019).

10. Li, L.; Wang, Z.; Chen, L.; Wang, Z. Consumer preferences for battery electric vehicles: A choice experimental survey in China. *Transp. Res. Part D Transp. Environ.* **2020**, *78*, 102185. [CrossRef]
11. Choo, S.; Mokhtarian, P.L. What type of vehicle do people drive? The role of attitude and lifestyle in influencing vehicle type choice. *Transp. Res. Part A* **2004**, *38*, 201–222. [CrossRef]
12. Laidley, T.M. The influence of social class and cultural variables on environmental behaviors: Municipal-level evidence from Massachusetts. *Environ. Behav.* **2013**, *45*, 170–197. [CrossRef]
13. Sovacool, K.B. How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Res. Soc. Sci.* **2016**, *13*, 202–215. [CrossRef]
14. Tarigan, A.K.; Bayer, S.B.; Langhelle, O.; Thesen, G. Estimating determinants of public acceptance of hydrogen vehicles and refuelling stations in greater Stavanger. *Int. J. Hydrog. Energy* **2012**, *37*, 6063–6073. [CrossRef]
15. Egbue, O.; Long, S. Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy* **2012**, *48*, 717–729. [CrossRef]
16. Sallee, J. *Tax Credits and the Market for Hybrid Vehicles*; Working Paper; 2007; Available online: https://conference.nber.org/conferences/2007/si2007/EE/sallee.pdf (accessed on 28 November 2019).
17. Chandra, A.; Gulati, S.; Kandlikar, M. Green drivers or free riders? An analysis of tax rebates for hybrid vehicles. *J. Environ. Econ. Manag.* **2010**, *60*, 78–93. [CrossRef]
18. Beresteanu, A.; Li, S. Gasoline prices, government support, and the demand for hybrid vehicles in the United States. *Int. Econ. Rev.* **2011**, *52*, 161–182. [CrossRef]
19. Wouk, V. Hybrids: Then and Now. *IEEE Spectr.* **1995**, *32*, 16–21. [CrossRef]
20. Gallagher, K.S.; Muehlegger, E. Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. *J. Environ. Econ. Manag.* **2011**, *61*, 1–15. [CrossRef]
21. Min, J.K.; Park, H. Impact of experience on government policy toward acceptance of hydrogen fuel cell vehicles in Korea. *Energy Policy* **2011**, *39*, 3465–3475.
22. Liao, F.; Molin, E.; van Wee, B. Consumer preferences for electric vehicles: A literature review. *Transp. Rev. Transnatl. Transdiscipl. J.* **2017**, *37*, 252–275. [CrossRef]
23. Chéron, E.; Zins, M. Electric vehicle purchasing intentions: The concern over battery charge duration. *Transp. Res. Part A Policy Pract.* **1997**, *31*, 235–243. [CrossRef]
24. Chen, C.F.; de Rubens, G.Z.; Noel, L.; Kester, J.; Sovacool, B.K. Assessing the socio-demographic, technical, economic and behavioral factors of Nordic electric vehicle adoption and the influence of vehicle-to-grid preferences. *Renew. Sustain. Energy Rev.* **2020**, *121*, 109692. [CrossRef]
25. Bockarjova, M.; Steg, L. Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands. *Glob. Environ. Chang.* **2014**, *28*, 276–288. [CrossRef]
26. Klockner, A.C. The dynamics of purchasing an electric vehicle—A prospective longitudinal study of the decision-making process. *Transp. Res. Part F Traffic Psychol. Behav.* **2014**, *24*, 103–116. [CrossRef]
27. Peters, A.; Dütschke, E. How do consumers perceive electric vehicles? A comparison of German consumer groups. *J. Environ. Policy Plan.* **2014**, *16*, 359–377. [CrossRef]
28. Skippon, S.M. How consumer drivers construe vehicle performance: Implications for electric vehicles. *Transp. Res. Part F Traffic Psychol. Behav.* **2014**, *23*, 15–31. [CrossRef]
29. Mukherjee, S.C.; Ryan, L. Factors influencing early battery electric vehicle adoption in Ireland. *Renew. Sustain. Energy Rev.* **2020**, *118*, 109504. [CrossRef]
30. Bjerkan, K.Y.; Nørbech, T.E.; Nordtømme, M.E. Incentives for promoting battery electric vehicle (BEV) adoption in Norway. *Transp. Res. Part D Transp. Environ.* **2016**, *43*, 169–180. [CrossRef]
31. Barth, M.; Jugert, P.; Fritsche, I. Still underdetected–social norms and collective efficacy predict the acceptance of electric vehicles in Germany. *Transp. Res. Part F Traffic Psychol. Behav.* **2016**, *37*, 64–77. [CrossRef]
32. Beck, M.J.; Rose, J.M.; Greaves, S.P. I can't believe your attitude: A joint estimation of best worst attitudes and electric vehicle choice. *Transportation* **2017**, *44*, 753–772. [CrossRef]
33. Dumortier, J.; Siddiki, S.; Carley, S.; Cisney, J.; Krause, R.M.; Lane, B.W.; Rupp, J.A.; Graham, J.D. Effects of providing total cost of ownership information on consumers' intent to purchase a hybrid or plug-in electric vehicle. *Transp. Res. Part A Policy Pract.* **2015**, *72*, 71–86. [CrossRef]
34. Huang, Y.; Qian, L. Consumer preferences for electric vehicles in lower tier cities of China: Evidences from south Jiangsu region. *Transp. Res. Part D Transp. Environ.* **2018**, *63*, 482–497. [CrossRef]
35. Adepetu, A.; Keshav, S. The relative importance of price and driving range on electric vehicle adoption: Los Angeles case study. *Transportation* **2017**, *44*, 353–373. [CrossRef]

36. Chu, W.; Im, M.; Song, M.R.; Park, J. Psychological and behavioral factors affecting electric vehicle adoption and satisfaction: A comparative study of early adopters in China and Korea. *Transp. Res. Part D Transp. Environ.* **2019**, *76*, 1–18. [CrossRef]
37. Dorcec, L.; Pevec, D.; Vdovic, H.; Babic, J.; Podobnik, V. How do people value electric vehicle charging service? A gamified survey approach. *J. Clean. Prod.* **2019**, *210*, 887–897. [CrossRef]
38. Higgins, C.D.; Mohamed, M.; Ferguson, M.R. Size matters: How vehicle body type affects consumer preferences for electric vehicles. *Transp. Res. Part A Policy Pract.* **2017**, *100*, 182–201. [CrossRef]
39. Shahraki, N.; Cai, H.; Turkay, M.; Xu, M. Optimal locations of electric public charging stations using real world vehicle travel patterns. *Transp. Res. Part D Transp. Environ.* **2015**, *41*, 165–176. [CrossRef]
40. Biresselioglu, M.E.; Kaplan, M.D.; Yilmaz, B.K. Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes. *Transp. Res. Part A Policy Pract.* **2018**, *109*, 1–13. [CrossRef]
41. Xydas, E.; Marmaras, C.; Cipcigan, L.M.; Jenkins, N.; Carroll, S.; Barker, M. A data-driven approach for characterising the charging demand of electric vehicles: A UK case study. *Appl. Energy* **2016**, *162*, 763–771. [CrossRef]
42. Plötz, P.; Funke, S.; Jochem, P.; Wietschel, M. CO_2 mitigation potential of plug-in hybrid electric vehicles larger than expected. *Sci. Rep.* **2017**, *7*, 16493. [CrossRef]
43. Nicholas, M.; Tal, G. *Transitioning to Longer Range Battery Electric Vehicles: Implications for the Market, Travel and Charging*; SAE International: Brussels, Belgium, 2017.
44. Morrissey, P.; Weldon, P.; O'Mahony, M. Future standard and fast charging infrastructure planning: An analysis of electric vehicle charging behaviour. *Energy Policy* **2016**, *89*, 257–270. [CrossRef]
45. Caperello, N.; Kurani, K.; TyreeHageman, J. I Am Not An Environmentalist Wacko! Getting From Early Plug-in Vehicle Owners to Potential Later Buyers. 2015. Available online: https://phev.ucdavis.edu/files/Caperello-Interviews-11-12-14.pdf (accessed on 28 November 2019).
46. Langbroek, J.H.; Franklin, J.P.; Susilo, Y.O. Electric vehicle users and their travel patterns in Greater Stockholm. *Transp. Res. Part D Transp. Environ.* **2017**, *52*, 98–111. [CrossRef]
47. Wang, S.; Li, J.; Zhao, D. The impact of policy measures on consumer intention to adopt electric vehicles: Evidence from China. *Transp. Res. Part A Policy Pract.* **2017**, *105*, 14–26. [CrossRef]
48. Moon, H.; Park, S.Y.; Jeong, C.; Lee, J. Forecasting electricity demand of electric vehicles by analyzing consumers' charging patterns. *Transp. Res. Part D Transp. Environ.* **2018**, *62*, 64–79. [CrossRef]
49. Ferguson, M.; Mohamed, M.; Higgins, C.D.; Abotalebi, E.; Kanaroglou, P. How open are Canadian households to electric vehicles? A national latent class choice analysis with willingness-to-pay and metropolitan characterization. *Transp. Res. Part D Transp. Environ.* **2018**, *58*, 208–224. [CrossRef]
50. Rogers, E.M. *Diffusion of Innovations*; Simon and Schuster: New York, NY, USA, 2010.
51. Qiu, H.Z. *Quantitative Research and Statistical Analysis: SPSS (PASW) Data Analysis Paradigm Resolve*; Wu-Nan Book: Taipei, Taiwan, 2010; (In Chinese, semantic translation).
52. Arrindell, W.A.; Van der Ende, J. An empirical test of the utility of the observations-to-variables ratio in factor and components analysis. *Appl. Psychol. Meas.* **1985**, *9*, 165–178. [CrossRef]
53. MacCallum, R.C.; Widaman, K.F.; Zhang, S.; Hong, S. Sample size in factor analysis. *Psychol. Methods* **1999**, *4*, 84. [CrossRef]
54. Nunnally, J.C. *Psychometric Theory 3E*; Tata McGraw-Hill Education: New York, NY, USA, 1994.
55. Graham-Rowe, E.; Gardner, B.; Abraham, C.; Skippon, S.; Dittmar, H.; Hutchins, R.; Stannard, J. Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. *Transp. Res. Part A Policy Pract.* **2012**, *46*, 140–153. [CrossRef]
56. Jensen, A.F.; Cherchi, E.; Mabit, S.L. On the stability of preferences and attitudes before and after experiencing an electric vehicle. *Transp. Res. Part D Transp. Environ.* **2013**, *25*, 24–32. [CrossRef]
57. Thaler, R.H.; Sunstein, C.R. *Nudge: Improving Decisions about Health, Wealth, and Happiness*; Penguin Books: London, UK, 2009.

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).