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Consumer preferences for electric vehicles in lower tier cities of China: Evidences from south Jiangsu region

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ABSTRACT

China is the world biggest market of electric vehicles (EVs) in terms of production and sales. Existing studies on consumer preferences for EVs in China have generally focused on first-tier cities, while little attention has been paid to the lower tier cities. This exploratory study investigates consumer preferences for EVs in lower tier cities of China, by collecting stated preference (SP) data in two second-tier cities and three third-tier cities in the south Jiangsu region of China. The discrete choice modeling analysis shows that Chinese consumers in lower-tier cities are generally sensitive to monetary attributes, charging service and driving range of EVs. They also perceive Chinese vehicle brands to be disadvantaged compared with European brands. When comparing the differences in second-tier versus third-tier cities, we find that consumers in third-tier cities are more sensitive to purchase price, subsidy of purchase, and coverage of charging stations than their second-tier counterparts. This study also highlights the role of different psychological effects, such as symbols of car ownership, normative-face influence, and risk aversion, in shaping consumer preferences for EVs in lower-tier cities of China. Our results provide important implications for contextualizing government policies and marketing strategies in line with the different sizes and characteristics of the cities in China.

1. Introduction

The Chinese car market experienced exponential growth in the first decade of the 21st century, and became the world's largest car market in 2009 (Qian and Soopramanien, 2014). This has made the use of automobiles, generally internal combustion engine vehicles (ICEVs), a primary source of air pollution and carbon emissions in China (Wan et al., 2015). Similar to many other economies, China chose to promote the research and development (R&D) and marketization of electric vehicles (EVs) as part of its national sustainable-development strategy because EVs are currently considered one of the most promising green technologies for helping reduce carbon emissions (Sang and Bekhet, 2015). At the end of 2016, China was the world's biggest EV market in production and sales (Ministry of Industry and Information Technology of China, 2017).

China represents a highly diversified market with hundreds of cities at different stages of development. China's megacities or first-tier cities,[1] each with a population of more than 10 million people, are currently leading the EV market in China. Table 1 presents the top seven Chinese cities in EV sales in 2017, and five of them were first-tier ones (Ways, 2018). Existing literature on EV adoption in China is generally based on data collected in first-tier cities. For example, Dagsvik and Liu (2009) analyze Chinese consumers'

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[1] The State Council of China (2014) categorizes Chinese cities into five classes based on urban population: first-tier cities (more than 10 million urban population each); second-tier cities (5 to 10 million urban population each); third-tier cities (1 to 5 million urban population each); fourth-tier cities (0.5 to 1 million urban population each); fifth-tier cities (fewer than 0.5 million urban population).

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Table 1
Top Chinese cities in EV sales* (in 1000).

2017 Rank	City (tier#)	2017		2016		Annual sale growth
		EV sales	Market share	EV sales	Market share	
1	Beijing (1)	58.7	10.6%	63.0	19.4%	−6.8%
2	Shanghai (1)	55.3	10.0%	42.2	13.0%	30.9%
3	Shenzhen (1)	40.0	7.2%	25.2	7.7%	59.1%
4	Tianjin (1)	31.3	5.7%	17.9	5.5%	75.6%
5	Hangzhou (2)	26.3	4.8%	15.1	4.6%	74.6%
6	Hefei (3)	22.4	4.0%	7.8	2.4%	186.8%
7	Guangzhou (1)	22.1	4.0%	17.7	5.4%	25.2%
National		553.7		325.0		70.4%

Data source: Ways 2016 New Energy Vehicle Market Report (http://www.way-s.cn/news_c2_33.html), Ways 2017 New Energy Passenger Vehicle Market Report (http://mp.weixin.qq.com/s/ErQ_5CP0WrF1jXjQGNS2uQ), and Daas-Auto 2017 New Energy Passenger Vehicle Annual Report (http://www.daas-auto.com/reportDe/465.html).
Note:
* EV sales here only include the sales of both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) and exclude the sales of hybrid electric vehicles (HEVs).
# The classification of city tiers is based on the urban population of each cities, following the official standard from the State Council of China (2014).

preferences for alternative fuel vehicles (AFVs) over gasoline cars based on data collected in Shanghai, the biggest city in China. Similarly, Helveston et al. (2015) collected survey data in four cities in China (Beijing, Shanghai, Shenzhen and Chengdu), three of which are first-tier cities, to compare consumer preferences on various EV technologies in China and the United States (US). More recently, She et al. (2017) and Wang et al. (2018) examine the factors that influence the consumer EV adoption in two first-tier cities, Tianjin and Shanghai, respectively.

However, future growth in the Chinese automobile market and particularly its EV market will increasingly come from second-tier and smaller cities (Wang et al., 2012; Woetzel et al., 2012). Table 1 shows that the second- and third-tier cities began to demonstrate stronger market-growth potential given their higher growth rates in EV sales in 2017. In comparison, the market shares of most first-tier cities have been decreasing and their annual sales growth rates were typically lower than the national average rate. This effectively means that more sales have been achieved in lower-tier cities, which highlights the importance of investigating consumer preferences for EVs in lower-tier cities of China, a market that has received little attention in the existing literature.

In reviewing the literature, we also note that consumer preferences for EVs may be related to three aspects: product/service attributes (referred to hereafter as “car instrumentality”), government transport policies, and consumer psychology (Lieven, 2015; Schuitema et al., 2013). First, the instrumentalities of EVs (e.g., purchase price and driving range) have been frequently examined in the literature (e.g. Hackbarth and Madlener, 2013; Qian and Soopramanien, 2011) and are usually found to be important, generally because they are directly “associated with users’ experiences derived from owning and using EVs” (Schuitema et al., 2013, p. 39). Second, vehicle adoption is largely influenced by government transport policies (Helveston et al., 2015). Transport policies related to EVs usually include monetary incentives (e.g., purchase subsidies), and non-monetary incentives (e.g., improvement of charging infrastructure), and traffic regulations (e.g. access to bus lanes) (Lieven, 2015). Third, car purchase and use are often related more to psychological motivation than to the car instrumentality (Steg, 2005). In China, consumer researchers have highlighted the importance of “face” influence (Qian and Yin, 2017) and word-of-mouth (WOM) communication (Zhang et al., 2011b), and have found that expensive cars, as socially visible possessions, are valued as essential status symbols that can help gain “face” (Helveston et al., 2015; Zhang, 2012).

This study aims to fill the gap in the literature on consumer preferences for EVs in non-first-tier cities in China, through an exploratory study in south Jiangsu region. We collected stated preference (SP) data in two second-tier and three third-tier cities of this region and identify the key influencing factors for EV adoption in these cities. This study further compares whether the potential adopters of EVs in third-tier cities have different preferences for the attributes compared to those in second-tier ones. This study contributes to literature by providing new understanding of consumer adoption preferences for EVs in the lower tier cities of China. Given that these cities currently have a low adoption level of EVs but represent future market potential, the empirical evidence from this study has practical implications for wider EV adoption in these urban areas of China.

The remainder of the paper is organized as follows. Section 2 introduces the research context of the south Jiangsu region by discussing the key features of five cities in this region, and then we propose a set of research hypotheses in Section 3. Section 4 describes the research method, including SP-experiment design and data collection procedure. Section 5 presents the results of our analysis including the tests of research hypotheses. The final section summarizes the main contributions of this study and discusses the key implications.

2. Research context of south Jiangsu region

To examine consumer preferences for EVs in lower tier cities, we collected empirical evidence from south Jiangsu region, which consists of five cities: Nanjing, Zhenjiang, Changzhou, Wuxi and Suzhou. The five cities in this region are spatially close to each other,

Fig. 1. Geographic location of research cities. Note: Retrieved from Google Map (https://map.google.com).

Table 2
Basic information of five cities in south Jiangsu region.

City (tier[#])	Urban/township population in 2015 (1000)[*]	Area size (km²)[*]	GDP in 2015 (billion CNY)[*]	No. of cars per household[*]	No. of subway lines (and stations)[†]	No. of fast charging stations[‡]
Nanjing (2)	6,704	6,587	972	0.764	7 (139)	565
Suzhou (2)	7,951	8,657	1,450	1.042	3 (93)	549
Wuxi (3)	4,909	4,627	852	0.729	2 (45)	165
Changzhou (3)	3,291	4,372	527	0.631	/	329
Zhenjiang (3)	2,158	3,840	350	0.368	/	149

Data sources:
* 2016 Jiangsu Statistical Yearbook (http://www.jssb.gov.cn/2016nj/indexc.htm).
† Gaode map (http://ditu.amap.com), retrieved May 1, 2017.
‡ Charging Bar (http://www.bjev520.com/jsp/beiqi/pcmap/do/index.jsp), retrieved May 1, 2017.
# The classification of city tiers is based on the urban population of each cities, following the official standard from the State Council of China (2014).

with a maximum neighboring distance of 72 km between Changzhou and Zhenjiang (see the map of this region in Fig. 1).

The official standard of city classification in China categorizes cities into five tiers based on the size of urban population in each city (The State Council of China, 2014). Following this standard, Nanjing and Suzhou belong to the second-tier cities, while Wuxi, Changzhou, and Zhenjiang are the third-tier cities. Importantly, south Jiang region is the first regional zone in China that has been identified by the Central Government to demonstrate China's modernization development (National Development and Reform Commission of China, 2013). Comparing these five cities (see Table 2), although they are quite similar regarding individual wealth measured by GDP per capita,[2] Nanjing (the capital city of Jiangsu province) and Suzhou (adjacent to Shanghai) are more developed

[2] We thank one anonymous reviewer for pointing this out.

than the other three cities in other aspects such as urban population, urban size, household car ownership, and transport-related infrastructure.

In particular, these five cities differ significantly in their development of urban infrastructure such as subway network and EV charging facilities. As shown in Table 2, Nanjing and Suzhou have more developed subway networks (in relation to number of subway lines and stations) and more fast-charging stations for EVs than the other three cities. More specifically, there were 0.086 (= 565/6,587) and 0.063 (= 549/8,657) fast charging stations per squared kilometers in Nanjing and Suzhou respectively, while the density of fast charging stations in Zhenjiang and Wuxi was less than 0.04 stations per squared kilometers. It is worth note that the density of fast charging stations in Changzhou, also a third-tier city, is higher than the other two third-tier cities, because Changzhou has the largest non-state-owned EV charging service provider in China.

3. Research hypotheses

According to the recent literature reviews on EV adoption (Li et al., 2017; Rezvani et al., 2015), the consumer choice of EVs might be influenced by not only the key instrumental and policy related attributes (such as vehicle purchase price, operational cost, driving range, vehicle charging service, country-of-origin of vehicle brand, and government subsidy), but also consumer psychological factors. Further, different tiers of cities in China have remarkable differences on economic development and urban infrastructure (Sun et al., 2013), which may shape heterogeneous consumer preferences for EVs. Thus, in this section, we develop a set of research hypotheses on the influences of these key attributes and psychological factors on consumer preferences for EVs, and the heterogeneity in different tiers of cities.

3.1. Perceived importance of instrumental and policy attributes[3]

South Jiangsu region consists of two second-tier cities and three third-tier cities. From cultural materialism perspective (Harris, 1979), regions with different material infrastructures may differ significantly on the consumption values (e.g. openness) and consumer-decision making style (e.g. price consciousness) (Ralston et al., 1996; Zhou et al., 2010). The empirical study of Sun et al. (2013) shows that consumers of midsized and small cities in China are more price consciousness than those from metropolitan cities, and their differences may be associated with the different economic development levels. With regard to EVs adoption, the total cost of EV ownership may involve purchase price, operational cost, and purchase subsidy granted by the government. In this sense, we hypothesize that:

H1(a). Chinese Consumers prefer lower vehicle purchase price, lower running cost and higher government subsidy when choosing EVs.

H1(b). Chinese Consumers from third-tier cities are more sensitive to vehicle purchase price than those from second-tier cities.

H1(c). Chinese Consumers from third-tier cities are more sensitive to operational cost than those from second-tier cities.

H1(d). Chinese Consumers from third-tier cities value the government subsidies more than those from second-tier cities.

In addition to the monetary attributes, driving range anxiety is another barrier for EV adoption, which, as widely recognized in the literature, can be addressed by longer vehicle driving range and better EV charging service (Dimitropoulos et al., 2013; Rezvani et al., 2015). Furthermore, larger cities general have a higher development level on transport infrastructure, typically including city subway system, express way, and high-speed railway, than the smaller ones. Specifically, regarding the EV charging infrastructure, we find that four first-tier cities in China, namely Beijing, Shanghai, Guangzhou and Shenzhen, have the highest number of fast charging stations followed by the second-tier ones (DaaS-Auto Research Center, 2018), while many third-tier or smaller cities in China have limited or even no EV charging stations at all[4]. Due to the limited charging stations in smaller cities, the longer driving-range feature of EVs and a higher coverage of public charging stations will be more desirable for the consumers in smaller cities than those from larger cities. In addition, consumers in smaller cities would have to charge their EVs at home and thus they would value the home charging capability more than those in the larger cities who can easily charge EV in public stations. Thus we propose following hypotheses:

H2(a). Chinese Consumers prefer longer driving range, wider coverage of charging stations and the provision of home charging when choosing EVs.

H2(b). Driving range is more important for Chinese consumers in third-tier cities than those in second-tier ones.

H2(c). Coverage of charging stations is more important for Chinese consumers in third-tier cities than those in second-tier ones.

H2(d). Home charging capability is more important for Chinese consumers in third-tier cities than those in second-tier ones.

Consumers may also associate their preferences for EVs with different views on the vehicle's country of origin. Shankarmahesh

[3] For the sake of brevity, we discuss and propose hypotheses on the key instrumental and policy attributes that may be perceived differently across different tiers of cities.

[4] Data from Charging Bar (http://www.bjev520.com/jsp/beiqi/pcmap/do/index.jsp), retrieved on May 1, 2017.

(2006) finds that consumer ethnocentrism, the attitude of rejecting foreign-made products, is negatively associated with cultural openness, world mindedness and stage of economic development. Compared to the third-tier cities, second-tier cities are usually more developed and more open to the Western culture. Generally, Helveston et al. (2015) show that German vehicle brands are most preferred in the Chinese car market. Specifically, Schuitema et al. (2013) find that Chinese consumers in second-tier cities may have formulated their preferences for foreign and particularly European brands earlier than their third-tier counterpart, and thus may be less likely to adopt EVs of Chinese brands. Therefore, we hypothesize that:

H3(a). Chinese Consumers in general are less likely to adopt EVs of Chinese brands than of the European brands.

H3(b). Chinese Consumers in third-tier cities are more likely to adopt EVs of Chinese brands than those in second-tier ones.

3.2. *Influence of consumer psychological factors*

As discussed earlier, the south Jiangsu region also provides an interesting research context to examine the psychological effects on the preferences for EVs. In particular, previous studies suggest that the adoption intention of EVs is also affected by the psychological factors, such as symbols or symbolic meaning of cars, face consciousness and risk aversion (e.g. Qian and Yin, 2017; Rezvani et al., 2015).

Symbolic meanings of owning cars emerged in China when private vehicles ownership was exclusive to the rich class at the early stage of car market booming in China. At that time, car ownership not only instrumentally fulfilled the individual's mobility needs, but also symbolically equated to membership in a high social class. In addition, private cars in China may not only be a symbol of wealth/status (Helveston et al., 2015; Ma et al., 2009), but also be perceived as the symbols of convenience, comfort or freedom (Xue et al., 2013). As economic development leads to cultural change (Pollay et al., 1990), consumers in more developed cities in China may differ in their consumption values from those in less developed cities (Lin and Wang, 2010), and consumers from lower tier cities in China may perceive the importance of "car ownership" symbols differently. Currently, first-tier cities in China have developed the mature public-transportation networks and the utility of driving private cars in these cities is diminishing due to traffic congestion. For example, Zhu et al. (2012) shows that college students in Shanghai (a first-tier city) are not very passionate about buying cars, while college students in Zhenjiang, a lower tier city in the south Jiangsu region, would place higher psychological value on private car ownership, given its symbol as success and modern life in smaller cities. According to Helveston et al. (2015), a high level of status symbol associated with car ownership has a negative effect on EV adoption in China. From the perspective, we hypothesize that:

H4. Chinese consumers in lower tier cities who perceive the symbols of car ownership as more important are less likely to adopt EVs.

Previous scholars generally consider collectivism as one of the core values in China that governs interpersonal relationship and still receives social and cultural approval (Zhang and Gelb, 1996). While an individual in the western society is more likely to emphasize independence, an individual in Chinese context is nevertheless inherently connected to others stressing on reciprocity, sentiment, and kinship network (Joy, 2001). This interdependent self-concept leads Chinese people to focus on "face" (also as "mianzi") (Qian et al., 2007), which stands for "the prestige not only of oneself, but also of one's family, relatives, friends, and even of colleagues" in China (Bao et al., 2003, p. 737). According to Gong (2003), the importance of "face" in the Confucian culture makes Chinese more concerned with the social consequences of consumption behavior, viewing it in a social rather than private context. In the perspective of EVs, cars are extremely visible to others, which can convey status of the drivers (Johansson-Stenman and Martinsson, 2006). Previous studies have showed that normative influence plays a positive role on adoption intention for EVs (He and Zhan, 2018; Lane and Potter, 2007). In the context of China, since the pro-environmental feature of EVs is socially desirable (Helveston et al., 2015), particularly when there are more EVs publicly visible on the road (Qian and Yin, 2017), EVs would be more preferable to consumers who care about normative and "face" influence. Therefore, we hypothesize:

H5. Chinese consumers in lower tier cities who are more subject to normative and face influence are more likely to adopt EVs.

Chinese consumers are found to be not only "face conscious", but also risk averse which is exhibited in their reluctance in trying a new product or service and resistance to innovations involving complicated features (Gong, 2003; Wang and Lin, 2009). They usually minimize social risk by buying products similar to those used by their reference groups due to the group-orientation nature (Gong, 2003). In the perspective of EV adoption, EVs have been argued as a disruptive technology which pose different behavioral demands on consumers (Rezvani et al., 2015), and require users to adapt to the product's technical requirements (Lane and Potter, 2007). It is such complexity and perceived risks related to EVs that can lead to consumers' reluctance to accept them (Oliver and Rosen, 2010; Qian and Yin, 2017). In addition, consumer preference for EVs may be affected in the presence of the risk aversion value, due to the low penetration rate of EVs in China. Hence, we hypothesize:

H6. Chinese consumers in lower tier cities who are more risk averse are less likely to adopt EVs.

4. Method and data

South Jiangsu region has a fairly low penetration rate of EVs, given that none of the cities in this region appears in the top city list of EV sales (see Table 1). Therefore, we adopt SP-experiment methodology in this study to investigate the potential preferences for EVs in this region.

Table 3
Attributes and levels in SP experiment.

Attribute name	Vehicle 1: ICEV	Vehicle 2: PHEV	Vehicle 3: BEV
Purchase price	Specified by respondent*	(1) 30% (2) 55% (3) 80% higher than similar-class conventional ICEV	(1) 30% (2) 55% (3) 80% higher than similar-class conventional ICEV
Annual operational costs	Market average level based on purchase price and vehicle class#	(1) 20% (2) 40% (3) 60% lower than similar-class conventional ICEV	(1) 20% (2) 40% (3) 60% lower than similar-class conventional ICEV
Driving range	N/A	N/A	(1) 80 (2) 120 (3) 160 km
Product design	Similar style as same-class ICEV	(1) New style distinguished from same-class ICEV (2) Similar style to same-class ICEV	(1) New style distinguished from same-class ICEV (2) Similar style to same-class ICEV
Brand origin	(1) European (2) American (3) Japanese–South Korean (4) Chinese	(1) European (2) American (3) Japanese–South Korean (4) Chinese	(1) European (2) American (3) Japanese–South Korean (4) Chinese
Emission level	100% level as present vehicle	(1) 35% (2) 65% of present vehicle	0% of present vehicle
Availability of fuel/charging station	100% of gasoline stations	(1) 10% (2) 40% (3) 70% of gasoline stations	(1) 10% (2) 40% (3) 70% of gasoline stations
Capability of home charging	N/A	(1) Yes (2) No	(1) Yes (2) No
Purchase subsidies	No subsidy	(1) 15% (2) 30% of purchase price	(1) 15% (2) 30% of purchase price
Policy of vehicle licensing	Lottery licensing	(1) Lottery licensing (2) Unrestricted licensing	(1) Lottery licensing (2) Unrestricted licensing
Driving restriction	Restricted driving per plate number	(1) No driving restriction (2) Restricted driving per plate number	(1) No driving restriction (2) Restricted driving per plate number
Congestion charge	Yes	(1) Yes (2) No	(1) Yes (2) No
Access to bus lanes	No	(1) Yes (2) No	(1) Yes (2) No

* Currency: CNY; options for vehicle class in pre-survey question: (small class) less than 100,000, (middle class) 100,000–200,000, (upper middle class) 200,001–300,000, (large class) more than 300,000. The system generates the mid-point of the chosen price range as the purchase price for second- and third-class ICEVs, and sets 70,000 for first class ICEVs and 350,000 for fourth class ICEV.

Levels of ICEV annual operational costs according to the purchase price: for car price less than 100,000: 25%; for car price between 100,000 and 199,999: 20%; for car price between 200,000 and 299,999: 16%; for car price more than 299,999: 12.5% (Qian and Soopramanien, 2011).

4.1. Stated preference experiment design

In the SP experiment conducted for this study, every respondent was presented a series of hypothetical-choice scenarios relating to car purchasing. Each scenario consisted of a choice between purchase of conventional ICEV, a plug-in hybrid electric vehicle (PHEV), and a battery electric vehicle (BEV), given that PHEVs and BEVs are two types of EVs that are strongly advocated by the Chinese government (The State Council of the People's Republic of China, 2012).

Table 3 presents the details of key instrumental and policy attributes of each alternative and their levels included in our SP experiment. It is worth noting that in addition to the key attributes that we have developed specific research hypotheses in Section 3, we also control the potential effects of other attributes that commonly appear in the relevant literature of EV adoption. Specifically, the instrumental attributes consist of a range of product, service and policy attributes. The product attributes in our SP are vehicle purchase price, annual operational costs, driving range (Hoen and Koetse, 2014; Qian and Soopramanien, 2011), brand origin (Helveston et al., 2015), product design (Bohnsack et al., 2014), and emission level (Ewing and Sarigollu, 1998; Hackbarth and Madlener, 2016). Service attributes are the coverage of fuel/charging stations (Golob et al., 1997; Tanaka et al., 2014) and capability of home charging. Following Qian and Soopramanien (2011), we applied the pivoting design technique, which allows the values of purchase price and annual operational costs attributes to be adapted based on each respondent's intended vehicle price range obtained before the SP experiment in order to "create more realistic choice situations specific for each respondent" (Hensher et al., 2015, p. 255). For policy attributes, we included purchase subsidies as well as policy on vehicle licensing, driving restriction, congestion charge, and access to bus lanes. It is important to note that apart from purchase subsidies, other policies were not available in any city of the south Jiangsu region when we collected data but have been implemented in some Chinese cities and other countries to promote EV adoption (Hoen and Koetse, 2014; Lieven, 2015; Zhang et al., 2017). Therefore, it might also be of practical importance to examine the potential effects of these policies in this region.

For attribute level, most product and service attributes (e.g., vehicle purchase price, annual operational costs, driving range, and availability of fuel/charging station) have three levels, which is helpful for capturing the potential non-linear effect on consumer preferences (Potoglou and Kanaroglou, 2007). The product-design attribute has two levels because EVs can be either purposely built in a new style that can be easily distinguished from same-class ICEVs or same-class ICEVs can be refitted with an EV motor (Bohnsack et al., 2014). The attribute of brand origin attribute has four levels, which are based on the major countries of origin of car brands in China, these being European, American, Japanese–South Korean, and Chinese brands. The emission-level attribute has two levels for PHEVs, which are 35% or 65% of the emissions of comparable conventional ICEVs, while BEVs are assumed to have zero emissions at the time of vehicle use. For policy levels, conventional ICEVs are assumed to have more restrictive regulations imposed (e.g., no purchase subsidies, lottery process of vehicle licensing, restricted driving per plate number, congestion charge and ineligibility to use

Attributes	**Vehicle 1: Conventional ICEV**	**Vehicle 2: PHEV**	**Vehicle 3: BEV**
Purchase price	50,000 CNY	75,000 CNY	75,000 CNY
Annual operational costs	12,500 CNY	7,500 CNY	5,000 CNY
Driving range	N/A	N/A	120 km
Product design	Similar style as same-class ICEV	New style distinguished from same-class ICEV	Similar style as same-class ICEV
Brand origin	American	Chinese	Chinese
Emission level	The same level as present vehicle	35% of the presented ICEV	0% of the presented ICEV
Availability of fuel/charging station	100% of gasoline stations	70% of gasoline stations	40% of gasoline stations
Capability of home charging	N/A	Yes	No
Purchase subsidies	0% of purchase price	30% of purchase price	30% of purchase price
Policy of vehicle licensing	Lottery licensing	Unrestricted licensing	Unrestricted licensing
Driving restriction	Restricted driving per plate number	No driving restriction	Restricted driving per plate number
Congestion charge	Yes	Yes	No
Access to bus lanes	No	Yes	Yes
Which vehicle are you most likely to choose?	◯	◯	◯

Fig. 2. Sample choice scenario.

bus lanes), while policies for PHEVs and BEVs are assumed to have two levels to vary.

Considering the attributes and levels discussed, there were a total of 4.59 billion scenarios if using full-factorial design. To reduce the scenario number to a manageable set that is feasible for data collection, we used fractional optimal design in the SAS 9.1 software (Ewing and Sarigollu, 1998) and yield a total number of 36 scenarios. To further manage the task for each respondent, we then randomly allocated six scenarios to each respondent using an internet-based survey platform. See Fig. 2 for a sample choice scenario.

4.2. Measures of psychological and demographic factors

In addition to the SP experiment, we include questions to measure respondent's psychographics. Specifically, we examine respondents' notions of *normative influence*, *face influence*, *risk aversion*, and *perceived symbols of car ownership* using corresponding measurement scales, which were all measured by a seven-point Likert scale (1 = "strongly disagree" and 7 = "strongly agree") (see Table 4 for the measurement items of all constructs). We adopted the four-item measure of *face preservation* from Bao et al. (2003), who compare consumer decision-making styles in China and the US. The measure of *normative influence* was adopted from Bearden et al. (1989). We also assessed *risk aversion* using three items derived from Bao et al. (2003). These scales were initially drafted in English, then translated into Chinese by a Chinese–English bilingual speaker, and then translated back into English by another Chinese–English bilingual speaker. Inconsistency in the back translation was inspected and corrected to ensure translation accuracy. The items of the constructs were mixed and presented in a random order to the respondents.

For the multi-item constructs (i.e., *normative influence*, *face* and *risk aversion*), we performed exploratory factor analysis to examine whether the measurement items of these constructs could be reduced to latent factors (Qian et al., 2007). With the collected data, a two-factor solution was converged, where *face preservation* and *normative influence* were found to load together, and *risk aversion* was a separate factor. As presented in Table 4, all items were accepted with a minimum cut-off point of 0.5, as suggested by Zaichkowsky (1985). We used this two-factor solution suggested by the exploratory factor analysis to reconstruct two variables with standardized values. We name them "*normative-face influence*" and "*risk aversion*".

Regarding the symbolic effect, Xue et al. (2013) suggest four perceived symbols attached to vehicle ownership, namely *wealth status*, *convenience*, *comfort*, and *freedom*. Thus we have four Likert-scale questions to examine each symbolic effect using single-item indicator as suggested by Zhu et al. (2012).

Table 4
Psychological measures and factor loadings.

Constructs and reference	Items	Factor loading	Component
Normative influence (Bearden et al., 1989)	(1) When buying products, I generally purchase those brands that I think others will approve of	0.814	Component 1
	(2) If other people can see me using a product, I often purchase the brand they expect me to buy	0.560	
	(3) I cannot achieve a sense of belonging by purchasing the same products and brands that others purchase*	0.709	
	(4) If I want to be like someone, I often try to buy the same brands that they buy	0.842	
Face preservation (Bao et al., 2003)	(1) It is not important that others like the products and brands I buy*	0.760	
	(2) Sometimes I buy a product because my friends do so	0.610	
	(3) Name-brand purchase is a good way to distinguish some people from others	0.649	
	(4) Name products and brand purchases can bring me a sense of prestige	0.668	
Risk aversion (Bao et al., 2003)	(1) I am cautious in trying new/different products	0.903	Component 2
	(2) I would rather stick with a brand I usually buy than try something I am not very sure of	0.879	
	(3) I always buy something I don't know about at the risk of making a mistake*	0.913	
Perceived symbolic meanings of car ownership † (Xue et al., 2013)	o Car-ownership is a symbol of wealth status	Not Applicable	
	o Car-ownership is a symbol of convenience		
	o Car-ownership is a symbol of comfort		
	o Car-ownership is a symbol of freedom		

Note:
* Reversed-coded items.
† The single item measures on four symbolic meanings of car ownership are not involved in the exploratory factor analysis.

Demographic and household characteristics may also influence consumers' attitudes and preferences for EVs (Roche et al., 2010). To control the effects of those demographics, we also asked questions relating to the respondents' gender, age, education level, and car-use experience, as well as household size, car ownership, and number of children in the household.

4.3. Data collection

We established the SP experiment and other questions in an online questionnaire hosted by an internet-based survey platform. We collected the survey data in each city of the south Jiangsu region, using quota sampling based on the urban population size in every city included in the study in 2015 (Jiangsu Statistical Bureau, 2017). Before data collection, we provided five undergraduate students employed as research assistants with thorough training on basic EV knowledge and participant recruitment procedure. We then visited each city on the weekends from June to July 2016. In each city, our research assistants visited large shopping malls and invited local adult shoppers to participate in our survey. Our research assistants provided their own mobile device to facilitate participants to complete the online survey, and senior participants who had difficulty using the devices were provided additional support. We emphasized to the local shoppers that they could participate in our survey regardless of whether they owned a car. A local shopping mall was a suitable place to conduct our survey because this context captures the mainstream consumers in each city.

Following Hair et al. (2014) who suggest a sample size of at least 50 respondents for a small scale conjoint analysis (p. 373), we collected 406 responses in the five cities, with 233 respondents from second-tier cities and 115 respondents from third-tier cities, and average response time of 8.70 min to complete the survey. Because the overly short response time in online survey can negatively affect data quality (Revilla and Ochoa, 2015), we decided to focus on cases that completed the survey 5 min or longer. As a result, 348 responses were used in the data analysis, yielding a valid response rate of 85.71%.

5. Results

5.1. Sample description

Table 5 summarizes the basic demographic information of our sample. Similar to the regional sample collected by the Jiangsu Statistical Bureau (2017), we have more respondents in the second-tier cities (Nanjing and Suzhou) than in the third-tier cities. Most respondents of our sample are aged 40 years and younger, and have achieved a university degree. The age distribution in our sample is consistent with the age range of consumers in the Chinese car market, as DaaS-Auto Research Center (2017) shows that 89.6% of car buyers in China are aged between 20 and 59. Our sample has a balance of male (49.5%) and female (50.5%) respondents. More than 80% of participants own at least one car in their household. On average, households in south Jiangsu region have three members, including 1.5 children per household. In comparing the second-tier and third-tier cities, the demographic characteristics do not differ a great deal apart from in age distribution ($F = 15.325$, $p < 0.001$). The second-tier cities have a higher proportion of young respondents aged 25 and below than do the third-tier cities. The demographic characteristics of our sample are similar to those reported in regional statistics in relation to gender distribution and household size; however, we had more well-educated consumers and car owners, which is also found in similar studies (e.g. Hackbarth and Madlener, 2016; Qian and Yin, 2017). The high level of household car ownership and lengthy car-use experience mean our respondents have greater practical car-related knowledge, which allows them to state more rational and informed preferences in the hypothetical-choice scenarios provided in our SP experiment.

Table 5
Demographic characteristics of survey sample.

Sample characteristics		Full sample	Second-tier cities	Third-tier cities	Regional sample[1]
Sample size		348	233	115	
Subsample size in each city	Suzhou	106	106		1,149
	Nanjing	127	127		1,460
	Wuxi	60		60	670
	Changzhou	39		39	633
	Zhenjiang	16		16	487
Age	18–25	26.4%	30.9%	17.4%	n/a
	26–30	31.0%	33.1%	27.0%	
	31–40	31.0%	28.3%	36.5%	
	41–50	9.8%	6.0%	17.4%	
	51–60	1.7%	1.7%	1.7%	
Gender	Male	49.1%	50.7%	46.1%	49.5%
	Female	50.9%	49.4%	53.9%	50.5%
Education level	Below senior high school	0.6%	0.4%	0.9%	63.7%
	Senior high school	6.0%	8.2%	1.7%	19.1%
	Junior college	17.8%	16.7%	20.0%	17.2%[2]
	Undergraduate	61.5%	57.5%	69.6%	
	Postgraduate	14.1%	17.2%	7.8%	
Car use experience (year)	< 1 (including 0)	17.8%	21.9%	9.6%	n/a
	1–3	15.8%	13.7%	20.0%	
	3–5	16.1%	15.5%	17.4%	
	5–8	24.7%	24.9%	24.4%	
	8–10	12.6%	13.3%	11.3%	
	> 10	12.9%	10.7%	17.4%	
No. of private vehicles per household	0	16.7%	18.9%	12.2%	0.76
	1	56.3%	54.1%	60.9%	
	2	25.0%	24.6%	26.1%	
	> 2	2.0%	2.6%	0.9%	
Average household size (person)		2.99	2.98	3.02	2.91
Average no. of children in household		1.54	1.52	1.57	n/a

[1] Retrieved and calculated from the 2015 Jiangsu Statistical Yearbook and the Sixth National Population Census of China (city populations: http://www.jssb.gov.cn/2016nj/nj05/nj0516.htm; gender, no. of private vehicles per household, and average household size: http://www.jssb.gov.cn/2016nj/nj19/nj1902.htm; education level: Sixth National Population Census of China).
[2] This figure combines junior college, undergraduate, and postgraduate levels.

5.2. Nested logit modelling results

To examine consumers' reported preferences for EVs, we applied discrete-choice models underpinned by utility-maximization assumption (Train, 2009). We formulated the individual utility for each alternative as a linear function of the SP-experiment attributes (as summarized in Table 3), as well as the individual characteristics (i.e., consumer psychological and demographic characteristics) interacted with alternative specific constants (ASCs) of PHEV and BEV.

As Qian and Soopramanien (2011) suggest, we did not "impose any a priori assumption about how consumers perceive the different types of car" (p. 607). Instead, we allow for potential correlations between some alternatives by estimating a nested logit (NL) model and thus capture heterogeneous preferences (Qian and Soopramanien, 2015, p. 34). We construct three tree structures (see Fig. 3) to illustrate all possible correlations among the three alternatives included in our SP experiment, where each tree structure (i.e., Tree 1, Tree 2 and Tree 3) has two alternatives within a branch that implies the correlation between branch elements. We then estimated three different NL models, corresponding to each tree structure. As a key criterion of the validity of the NL model, the estimated inclusive value (IV) coefficient must be between 0 and 1 to ensure the model's consistency with utility maximization (Train, 2009, pp. 83–84). Among all three NL models, we found that only the model corresponding to Tree 3 that assumes the strong correlation between the BEV with the ICEV can achieve a valid IV coefficient for the sample, since the Wald test shows that this estimated IV parameter differs from both 0 and 1 at 5% significance level.

This counter intuitive finding on the correlation between the BEV and the ICEV can be explained by the market fact that BEVs have gradually become the second popular choice in the Chinese car market, in addition to the conventional ICEVs, while PHEVs are much less popular than those two types of cars[5]. To be specific, the sale ratio of PHEVs to BEVs in China declined from 0.56 in 2015, to the 0.16 in 2016, and notably the figure decreased quarter by quarter throughout the year (Du, 2017). The less popularity of

[5] We thank one of the anonymous reviewers to highlight this market fact.

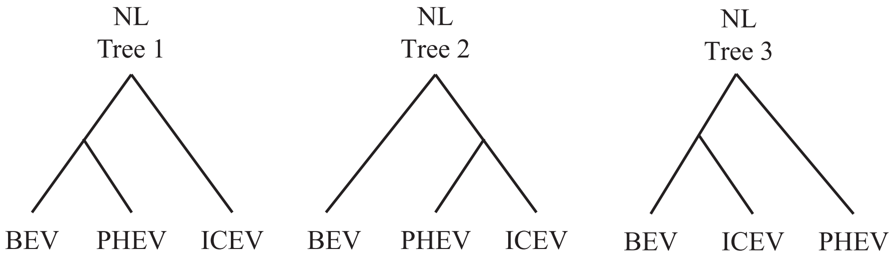

Fig. 3. Three tree structures for NL models.

PHEVs compared to BEVs may result from the signaling effect of government policies. For instance, Beijing is the city with the largest EV sales in China and in Beijing, buyers of PHEVs are not eligible to benefit any municipal level purchase subsidy or free vehicle license that are only available to BEVs buyers (Association of Beijing New Energy Automotives, 2016). In addition, local policies in some other cities have prioritized the support to BEVs rather than PHEVs because many PHEV users were found to fuel their cars with petrol without charging the battery (Li et al., 2018). We note that Qian and Soopramanien (2011) find that Chinese consumers perceived the strong correlation between hybrid and petrol cars in 2010. Our finding contributes to the literature by complementing their study to demonstrate a changing conception of EVs along with the market development in the past years.

The estimation result of this basic NL model is presented in Table 6. The basic NL Model has the converged log-likelihood function of $-1,963.08$, and a likelihood ratio test shows that it is significantly better than the Multinomial Logit (MNL) model ($\chi^2 = 4.2$, df $= 1, p < 0.05$). Based on this basic NL model, we also estimate an extended NL model by further taking account of the interactions between city tiers and every attribute to examine the systematic taste variation between second and third tiers of cities (see Table 6 for its estimation results as well). We first discuss the main effects based on the basic NL model in this subsection and the interaction results of the extended model (i.e. systematic taste variations) will be discussed in Section 5.4.

For the key attributes discussed earlier, all estimated parameters have the expected signs. More specifically, consistent with the literature (e.g. Dagsvik and Liu, 2009; Potoglou and Kanaroglou, 2007), the coefficients of two monetary attributes, vehicle purchase price and annual operational costs, are significant at 0.1% level with negative signs, which suggests that consumers prefer alternatives with a lower price and lower operational costs. Similarly, the NL model shows that the coefficient of purchase subsidies is significant at 0.1% level with positive sign. Thus H1(a) is supported. We also find that the coefficients of driving range, coverage of fuel/charging stations, and capability of home charging are significant with positive signs, which are in line with Helveston et al. (2015), Bunch et al. (1993), and Hoen and Koetse (2014), respectively, and thus H2(a) is supported. For preferences for different origins of car brands, by using the European brands as the reference category, we find that the Chinese brands are significantly less preferred, which is partially in line with Helveston et al. (2015) who find that Chinese consumers have the strongest preferences for German brands and against South Korean and Japanese brands. Thus H3(a) is supported.

Regarding other attributes we controlled in the SP experiment, the new style in product design is found to have a negative but insignificant influence on consumers' preference, possibly because some consumers may feel embarrassed to drive an EV as it is not as appealing as conventional ICEVs in appearance (Graham-Rowe et al., 2012). In addition, our NL model shows that emission level has an expected negative but insignificant effect on consumers' choice of vehicles. Such insignificance might be explained by the immature car culture in China, where consumers tend to focus more on the instrumentality and symbolic effects of car ownership (Helveston et al., 2015), while environmental effect is not among the primary factors considered by Chinese consumers when purchasing a car (Zhang et al., 2011b). For government policies, except important purchase subsidies discussed earlier, other policies are perceived unimportant by the respondents for their choice of vehicles, which is largely in line with the literature (Hackbarth and Madlener, 2016; Hoen and Koetse, 2014).

With regard to the effects of psychological factors, we first find that consumers who more strongly perceive cars as the symbol of convenience are less likely to adopt PHEVs, possibly because users of PHEVs need to be familiar with both petrol stations and electric charging facilities. We don't find significant effects on the symbols of "wealth", "comfort" and "freedom" associated with the choice of EVs. Therefore, H4 is partially supported. Further, we find that consumers who are subject to normative-face influence are more likely to choose both types of EVs, and thus H5 is supported. This finding is in line with the literature on the strong association between consumer's moral norm and their perceived utility of EVs (He and Zhan, 2018; Jansson et al., 2017a), as well as the positive influence of face-consciousness on the attitude and adoption intention for EVs in China (Qian and Yin, 2017). Finally, the interactions of risk averse with the PHEV and BEV have the negative sign but is only significant at 10% level, which suggests that consumers in lower tier cities have some cautiousness or skepticism towards EVs that is typically found in the literature (Oliver and Rosen, 2010; Petschnig et al., 2014; Qian and Yin, 2017). Therefore, H6 is marginally supported in our study.

Regarding the effects of demographic characteristics, we find following significant results for the choice of EVs. First, we find respondents living in the second-tier cities are much more likely to adopt BEVs and PHEVs than those in third-tier cities. Second, female consumers are more likely to adopt EVs and particularly PHEVs than the male. Third, respondents who are better educated, live in the larger households, and have fewer children in the household are also more likely to adopt both types of EVs, which corroborates findings in previous literature (Potoglou and Kanaroglou, 2007; Qian and Soopramanien, 2011; Zhang et al., 2011b). Fourth, by following Hackbarth and Madlener (2013) to use respondents' intended price for next purchase as a proxy for their income, we find that consumers who plan to pay more for next vehicle purchase are more likely to adopt EVs and particularly PHEVs. Finally, consumers with more car-use experience are more likely to adopt EVs and particularly BEVs.

Table 6
Estimation results for the basic and extended NL models.

Variables	Basic NL model			Extended NL model [f]	
	Coefficient	*t*-ratio	WTP	Coefficient	*t*-ratio
Instrumental and policy attributes					
Vehicle purchase price (10 k CNY)	−0.144***	−12.591		−0.117***	−9.093
Vehicle purchase price × Third-tier cities				*−0.088****	*−3.969*
Annual operational costs (10 k CNY)	−0.364***	−5.243	−2.533	−0.374***	−4.529
Annual operational costs × Third-tier cities				*−0.027*	*−0.180*
Driving range	0.007***	4.348	0.050	0.007***	3.539
Driving range × Third-tier cities				*0.002*	*0.480*
New style in product design [a]	−0.037	−0.463		−0.029	−0.311
New style in product design × Third-tier cities				*−0.016*	*−0.088*
American brand [b]	−0.151	−1.751		−0.189	−1.801
American brand × Third-tier cities				*0.082*	*0.435*
Japanese-South Korean brand [b]	−0.135	−1.548		−0.221*	−2.074
Japanese-South Korean brand × Third-tier cities				*0.258*	*1.346*
Chinese brand [b]	−0.230*	−2.516	−1.601	−0.303**	−2.741
Chinese brand × Third-tier cities				*0.163*	*0.813*
Emission level	−0.007	−1.913		−0.007	−1.593
Emission level × Third-tier cities				*< 0.001*	*−0.012*
Coverage of fuel/charging station	0.019***	13.000	0.134	0.017***	9.792
Coverage of fuel/charging station × Third-tier cities				*0.008**	*2.520*
Home charging capability	0.246**	3.045	1.711	0.235*	2.443
Home charging capability × Third-tier cities				*0.049*	*0.276*
Purchase subsidies (10 k CNY)	0.133***	7.226	0.925	0.111***	5.120
Purchase subsidies × Third-tier cities				*0.076**	*2.020*
Unrestricted vehicle licensing [c]	0.003	0.034		0.085	0.900
Unrestricted vehicle licensing × Third-tier cities				*−0.234*	*−1.337*
No driving restriction [d]	−0.062	−0.741		−0.157	−1.575
No driving restriction × Third-tier cities				*0.286*	*1.557*
No congestion charge	−0.010	−0.128		0.026	0.281
No congestion charge × Third-tier cities				*−0.141*	*−0.790*
Access to bus lanes	−0.125	−1.530		−0.085	−0.877
Access to bus lanes × Third-tier cities				*−0.123*	*−0.680*
Alternative Specific Constant (ASC)					
ASC of PHEV	−1.046	−1.884		−0.907	−1.662
ASC of PHEV × Third-tier cities				0.521	1.379
ASC of BEV	−2.686***	−3.758		−2.117**	−2.817
ASC of BEV × Third-tier cities				−0.159	−0.157
Psychological characteristics interacted with ASCs					
Car symbol of wealth × PHEV	−0.060	−1.577		−0.054	−1.419
Car symbol of wealth × BEV	−0.061	−1.479		−0.063	−1.521
Car symbol of convenience × PHEV	−0.116*	−2.263		−0.116*	−2.260
Car symbol of convenience × BEV	−0.045	−0.796		−0.048	−0.835
Car symbol of comfort × PHEV	0.084	1.825		0.087	1.890
Car symbol of comfort × BEV	0.056	1.108		0.054	1.060
Car symbol of freedom × PHEV	−0.055	−1.134		−0.056	−1.154
Car symbol of freedom × BEV	−0.036	−0.686		−0.036	−0.680
Normative-face influence × PHEV	0.156*	2.448		0.159*	2.513
Normative-face influence × BEV	0.214**	3.100		0.222**	3.212
Risk averse × PHEV	−0.116	−1.877		−0.115	−1.846
Risk averse × BEV	−0.061	−0.912		−0.065	−0.964
Demographic characteristics interacted with ASCs					
Second-tier city [e] × PHEV	0.595***	4.661			
Second-tier city [e] × BEV	0.742***	5.455			
Female × PHEV	0.342**	2.954		0.337**	2.908
Female × BEV	0.245	1.925		0.248	1.931
Age × PHEV	−0.129	−1.885		−0.116	−1.694
Age × BEV	−0.060	−0.807		−0.050	−0.659
Education level × PHEV	0.173*	2.296		0.165*	2.199
Education level × BEV	0.174*	2.128		0.168*	2.046
Household size × PHEV	0.310***	4.344		0.319***	4.500
Household size × BEV	0.418***	5.374		0.426***	5.437
No. of children in household × PHEV	−0.319**	−2.681		−0.305*	−2.565
No. of children in household × BEV	−0.467***	−3.626		−0.475***	−3.654
Intended vehicle price × PHEV	0.786**	3.057		0.842	3.722
Intended vehicle price × BEV	0.112	1.026		0.097***	0.879
Car use experience × PHEV	0.028	0.676		0.019	0.463
Car use experience × BEV	0.121**	2.675		0.122**	2.692

(*continued on next page*)

Table 6 (*continued*)

Variables	Basic NL model			Extended NL model [f]	
	Coefficient	*t*-ratio	WTP	Coefficient	*t*-ratio
Inclusive Value (IV)					
IV for the nest with BEV and ICEV [#]	0.703***	5.084		0.661***	5.683
No. of observations	2,088			2,088	
LL function of constant-only model	−2,262.35			−2,262.35	
LL function of the MNL model	−1,965.18			−1,952.78	
LL function of the NL model	−1,963.08			−1,948.31	
McFadden pseudo R-squared	0.199			0.205	

Note:
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.
[a] Similar style as same class ICEV as the reference.
[b] European brands as the reference.
[c] Lottery process for vehicle licensing as the reference.
[d] Driving restriction per plate number as the reference.
[e] Third-tier cities as the reference.
[f] Every second row (in italic) in the extended model is the interaction term between the corresponding variable and the third-tier-city dummy (second-tier cities as the reference).
[#] The standard error of IV parameter is 0.138 in basic NL model, and thus Wald test of IV parameter against one = $(0.703 - 1)/0.138 = -2.152 < -1.96$, and thus p-value < 0.05.

5.3. *Willingness to pay*

Based on the estimation results of the basic NL Model, we further calculate willingness to pay (WTP) for the instrumental and policy attributes, which is the negative of the ratio of the attribute's coefficient to the coefficient of the vehicle purchase price (Tanaka et al., 2014; Train and Weeks, 2005). For the sake of brevity, we only discuss the WTPs for key attributes that are significant in the basic NL model. As presented in the column of "*WTP*" in Table 6, the respondents in our survey are willing to pay approximately 25,300 CNY more at the time of vehicle purchase to save 10,000 CNY on annual operational costs, which falls into the WTP range of CAN$2,200–5,300 per CAN$1,000 savings on annual fuel costs found by Potoglou and Kanaroglou (2007). For WTP of driving range, we find that consumers in the south Jiangsu region are willing to pay 500 CNY (approximately US$75 in 2016) for an extra kilometer of driving range, which is largely in line with the recent literature findings on WTP for driving range of €12–125 (approximately US$14.5–151) for an additional kilometer in Germany (Hackbarth and Madlener, 2016) and €46–134 (approximately US$55–162) in Denmark (Jensen et al., 2013). For WTP for different brands, we find that consumers are willing to pay 16,000 CNY more (approximately US$ 2,400) to buy a vehicle of a European brand than a Chinese brand. In addition, we find that WTP for 1% more fuel/charging stations is 1,340 CNY (approximately US$200), which is broadly in line with Hackbarth and Madlener (2016), who found WTP of €60–296 (approximately US$66–327) for 1% increase of fuel/charging-station availability, but is higher than the WTP figures found by Tanaka et al. (2014) and Hackbarth and Madlener (2013). Importantly, the study finds that there is a very high WTP of 17,110 CNY (approximately US$2,570) for having home-charging capability. Compared with consumers in developed markets where home charging can be assumed to be available for all households (Jensen et al., 2014), most Chinese consumers live in apartments without dedicated parking space or have greater difficulty installing home-charging facilities due to the limited support or even objection from residential management firms (Yang, 2016), and thus home-charging capability is highly valued in China. Finally, the study also finds that WTP for 10,000 CNY vehicle purchase subsidies is 9,250 CNY, which implies that the consumers in the study value the subsidy approximately 7.5% less than currency amount.

5.4. *Preference heterogeneity between second- and third-tier cities*

In order to further investigate the preference heterogeneity between the second- and third-tier cities in south Jiangsu region, we extend the basic NL model by taking account of the potential systematic taste variations by the tiers of cities. Specifically, following Ortúzar and Willumsen (2011), we introduce additional terms in the utility function by interacting the dummy variable for the third-tier city with every attribute, which is suggested as an economical way to capture taste heterogeneity (p. 279). Consistent with the basic NL model, the extended NL with systematic taste variations also fits the choice structure of Tree 3 best. Its estimation results are presented in Table 6 under the columns of "*Extended NL Model*". In this model, an interaction term with a coefficient significantly different from zero effectively means the significant taste heterogeneity on the corresponding attribute between second and third-tier cities.

As shown in the interaction terms (in *italic*) in Table 6, we find several significant differences on the preferences for instrumental and policy attributes between the second-tier and third- tier cities. First, the coefficients of the interaction terms for purchase price and purchase subsidies are significant at 1% and 5% level respectively, with negative sign for the former and positive sign for the latter. This effectively implies that consumers in the third-tier cities, compared to those in the second-tier ones, are more looking for lower vehicle purchase price and higher purchase subsidies, which supports H1(b) and H1(d). Meanwhile, we do not find the significant difference on the annual operational cost between the two tiers of cities, and thus H1(c) is not supported. Second, consumers in third-tier cities are more concerned about the coverage of fuel/charging stations, given the negative and significant coefficient for the corresponding interaction term ($p < 0.05$), so H2(c) is supported. However, the cross-tier differences for the driving range and home charging capability are insignificant, and thus we reject H2(b) and H2(d). In addition, we do not find any significant cross-tier difference on the preference for country-of-origins of vehicle brand, and thus H3(b) is not supported.

6. Conclusion and discussion

6.1. Summary of contributions and key findings

Our contributions in this paper are threefold. First, we explore heterogeneous consumer preferences for EVs in the lower tier cities of China by conducting a SP experiment in five cities of south Jiangsu region. The market segment of lower tier cities of China has received little attention in the literature but presents stronger growth potential, so our study contributes to the literature by providing new insights about consumer preferences towards EVs in China as well as complementing the prior studies that are usually conducted in the context of first tier cities in China (e.g. Dagsvik and Liu, 2009; Helveston et al., 2015; She et al., 2017; Wang et al., 2018). Specifically, we identify the key influential attributes for EV adoption in lower-tier cities of China. As we discuss, Chinese consumers in lower-tier cities are sensitive to monetary attributes (such as vehicle purchase price, operational costs, and purchase subsidies), service attributes (such as coverage of fuel/charging stations and home charging capability) as well as driving range. In addition, Chinese vehicle brands are generally perceived to be disadvantaged compared with European brands. Meanwhile, the design of EVs, whether they are purpose-built or refitted (Bohnsack et al., 2014), is perceived unimportant. Also, non-monetary policies, no matter whether they are supporting the adoption and use of EVs or restricting the adoption and use of ICEVs, tend to have no effect on the choice of EVs.

Second, we examine the preference differences in second-tier versus third-tier cities, by taking into account the systematic taste variation (Ortúzar and Willumsen, 2011, p. 279) across these two tiers of cities. We find that consumers in third-tier cities are more sensitive to vehicle price, purchase subsidies, and the coverage of fuel/charging station than their counterparts in second-tier cities. Consumers in third-tier cities are more responsive to monetary attributes (such as vehicle price and subsidies), possibly due to their lower income levels than those in larger cities (Sun et al., 2013). Therefore, the adoption for EVs in third-tier cities would be more price or subsidy driven than in the second-tier cities. In addition, the differences in perceived importance of availability of charging stations in the different tiers of cities can be explained by two possible reasons. On one way, the second-tier cities (i.e., Nanjing and Suzhou in our sample) are better served by urban subway networks (see Table 2) and intercity high-speed trains. The subway network and high-speed trains in large cities may substitute the use of cars, so that they don't need to be concern about the charging convenience if using EVs. On the other way, there are more EV charging stations in second-tier cities than in third-tier cities (see Table 2), which can not only alleviate concerns about EV driving range, but can also account for the difference in the perceived importance of charging-station availability between the second-tier and third-tier cities.

Third, we contribute to the literature by considering the potential influence of several psychological factors on consumer preferences for EVs, while the prior literature on EV adoption tends to concentrate more on the effects of instrumental and policy factors (Rezvani et al., 2015). For example, we find the negative effect of perceiving owning cars as a symbol of convenience on the adoption of PHEVs, possibly caused by the requirements of being familiar with both petrol refilling and electricity recharging systems. Although we do not find significant effects of other symbols, we note that new symbolic meanings would emerge when EVs become more popular in the market (Heffner et al., 2007; Helveston et al., 2015). Furthermore, we identify the positive effect of normative and face influence for the choice of both types of EVs. This suggests the importance of moral norm (He and Zhan, 2018; Jansson et al., 2017a) and word-of-mouth (Zhang et al., 2011a) in EV adoption, in that consumers who are subject to normative and face influence may usually pay attention to opinions from the peers, neighbors and family members (Jansson et al., 2017b) and mass media communication. In addition, risk aversion is another important psychological factor that may negatively affect consumer's preference for EVs. This implies consumers might be concerned about uncertainties related to EVs, such as the immaturity of technology and scarcity of the service facilities. It reflects the status quo of the market where the early adopters of EVs are more risk taking than the mainstream consumers.

6.2. Practical implications

This study provides important practical implications for government policy and business strategy. For governments and regulators, first, our finding of the stronger influence of purchase price and subsidies in third-tier cities than in the second-tier cities suggests that policy makers should localize purchase subsidies by considering the characteristics of the cities. It will be more effective to differentiate the subsidies at the city level to facilitate the EV adoption, rather than at the national and provincial levels only. Second, our results show that the EV charging network is crucial for EV adoption, particularly in smaller cities where there are fewer charging stations. This implies that the government of smaller cities should provide strong financial and policy support for the development of EV charging networks. Lieven (2015) highlights that a well-established EV charging network is far more important than various policies (such as using bus lanes) that grant high priority to EVs. Third, we fail to find sufficient evidence on the effectiveness of various transport-related policies that aim to prioritize the use of EVs and/or regulate the use of ICEVs. For example, the policy efficiency of access to bus lanes for EVs decreases when there are more EVs on the road, so that the bus lanes "could become congested over time and the advantage for drivers disappear" (Lieven, 2015, p. 80). Therefore, we recommend that government should be cautious when implementing such transport-related policies. Fourth, the significant effect of normative-face influence suggests that government can play a role in enhancing the social norm and face-consciousness of adopting and using EVs. For example, China started to issue special license plates for EVs in selected cities in December 2016, and the plates were designed to have green background color to differentiate from the blue plate for ICEVs. Such initiative can effectively enhance the visibility of EVs on the road, and is expected to promote the adoption of EVs (Zhou, 2016).

For the business implications, we generally highlight the importance of contextualizing marketing strategies in relation to the different sizes and characteristics of cities, given that every city may have its unique characteristics in relation to economic, subcultural, and institutional factors (Budeva and Mullen, 2014). For example, manufacturers of EVs may consider differentiating product offerings and their value propositions to target different types of cities. Given that consumers in third-tier cities are more sensitive to vehicle purchase price than their second-tier counterpart, car makers are therefore encouraged to put more emphasis on cost-effectiveness when targeting consumers in the third tiers of cities. Similarly, car makers and especially domestic Chinese ones could adopt the penetration pricing strategy with affordable prices, when entering third-tier or even smaller cities, so that they gain market share quickly in a context in which EV adoption is currently quite low (Ferrell et al., 2011).

6.3. Suggested future research directions

There are several limitations in this study that suggest potential directions for future research. First, our exploratory study only provide some empirical evidences based on the data collected in south Jiangsu region, which may not fully represent the lower-tier cities of China. Further research can extend our study by collecting more data in other regions of China, to verify whether our results can be generalized into other lower-tier cities in China. Second, we have not considered emerging cultural values in the new Chinese youth and middle-class segment, such as materialism, fashion awareness, and seeking uniqueness (Simmel, 2010). Future research could examine the influence of these emerging cultural values on EV adoption in China and particularly in lower-tier cites. Third, we examine only the effects of symbolic meanings of car ownership on EV adoption in this study, but the symbols of EVs might differ and thus future research could examine perceived symbolic meanings of EVs in China by using an exploratory, in-depth qualitative approach. Fourth, this study collected cross-sectional data that cannot capture preference evolution over time (Qian and Soopramanien, 2015). We recommend future research collect longitudinal data to examine any changing patterns of Chinese consumers' preferences for EVs.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.trd.2018.06.017.

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