How to activate moral norm to adopt electric vehicles in China? An empirical study based on extended norm activation theory

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A B S T R A C T

Mass adoption of electric vehicles (EVs), environmentally friendly and sustainable innovations, is critical to reducing the consumption of fossil fuels and the emission of greenhouse gases. However, research investigating the effect of altruism on EV adoption from a pro-environmental behavior perspective is limited. To fill this gap, we propose an extended norm activation model to study the relationship between personal norms and consumers’ intention to adopt EVs, and to explore how such relationship is influenced by external costs and the antecedents of personal norms. The model is empirically tested with data collected from 396 participants in China. Results show that personal norms have a positive influence on EV adoption intention, and such influence is moderated by external costs, including perceived price and perceived complexity. The former negatively moderates it, while the latter has a nonlinear moderation effect on it. Moreover, awareness of consequences, ascription of responsibility, and perceived consumer effectiveness are positive predictors to personal norms. The findings help to understand consumers’ adoption behavior of EV better, and contribute to promoting EV development.

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1. Introduction

China’s automobile industry has experienced rapid development during the past decade, but its sustainable development is facing the severe challenges of energy security and air pollution. In 2016, China’s automobile production and sales totaled more than 28 million, and have ranked first in the world for eight consecutive years (Xinhuanet, 2017). Among them, over 98% of on-road vehicles are powered by fossil fuels, which consumes about one-third of total oil every year, and this percentage is expected to rise to 57% by 2020 (ChinaIRN, 2015). But China relies heavily on oil imports. Its net oil import was up to 381 million tons with the dependence degree on oil import rising to 65.4% in 2016 (Zhang, 2017), and this percentage is projected to exceed 80% in 2040 (Lin and Tan, 2017). Meanwhile, vehicle emissions have become one of the key factors affecting urban air quality and climate change in China (Liu et al., 2017; Ke et al., 2017). China’s Ministry of Environmental Protection (MEP) reported that vehicle use was the main contributor to the total emission of pollutants (MEP, 2016).

Electric vehicles (EVs) have become the promising sustainable solution to alleviate energy crisis and environmental pressure because of their advantages of energy efficiency and tailpipe emission reduction. Thus, the Chinese government has regarded EVs as one of national strategies (SCPRC, 2012), and taken many measures to promote the widespread adoption of EVs during recent years, e.g. incentive policy, funding for R&D and EV market demonstrations, etc. (Ou et al., 2010; Du and Ouyang, 2017). Nevertheless, the adoption rate of EVs is still low in China. The China Association of Automobile Manufacturers (CAAM) reported that the sale of EVs was about 507,000 in 2016, which accounted for only 1.8% of the total number of vehicles sold (CAAM, 2017). Worse still, consumers have little interest in EVs, and a large proportion of them are in a state of wait-and-see (She et al., 2017). It is therefore crucial to understand what factors influence consumers’ adoption of EVs to ensure the continuing success of EVs.

There are two streams that researchers examine antecedents of consumers’ EV adoption. The mainstream focuses on the role that consumers’ perception of EVs’ instrumental attributes plays in EV adoption. For example, previous research has indicated that purchase price, driving range, performance, and recharging time all have a significant impact on EV adoption (Graham-Rowe et al., 2012; Skippon and Garwood, 2011). The other stream examines EV adoption integrating a pro-environmental perspective. For example, environmental attributes and environmental concerns

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have an effect on consumers' acceptance of EVs (Ziegler, 2012; Axsen et al., 2013; Sang and Bekhet, 2015). Since the nature of EVs are instrumental and environmental, consumers' adoption of EVs would involve both self-interest and altruism. However, existing research pays more attention to the self-interested factors within the rational theory framework (e.g. theory of planned behavior and rational choice theory), and the effect of altruism on EV adoption was not completely investigated.

To fill this gap, we study EV adoption from a pro-environmental perspective based on the norm activation model (NAM). The NAM is a social-psychological model of altruistic behavior, and has been frequently used to explain pro-environmental behavior, such as recycling (Schultz, 1999), reducing car use (Eriksen et al., 2006) and energy saving behavior (Werff and Steg, 2015). However, NAM concerns only internal moral variables without considering external factors. Research has found that consumers may fail to act pro-environmentally because of the costs of pro-environmental behavior, including monetary cost and behavioral cost — efforts required by the behavior (Hunecke et al., 2001). Although consumers approve of the environment benefit of the EV and feel a moral obligation to adopt it, they are reluctant to act because of concerns around the high purchase price, the limited range, and the lack of charging infrastructure (Egbue and Long, 2012). So, it is necessary to study the influence of external costs on the relationship between moral norms and EV adoption.

Additionally, perceived consumer effectiveness (PCE), an estimate of the contribution of an individual action on solving a problem, plays a major role in pro-environmental behaviors (Lee and Holden, 1999; Zhao et al., 2014). Consumers, who believe they can contribute to the environment, would operate their consciences to guide their behaviors. Although the NAM states that awareness of consequences and ascription of responsibility are crucial antecedents of personal norms, it may ignore the importance of PCE in the activation of personal norms. As many studies extended the NAM by adding antecedents of personal norms (Klöckner and Ohms, 2009; Peters et al., 2011), we also explore the importance of perceived consumer effectiveness on personal norms.

This study makes the following contributions. Firstly, an extended NAM is proposed to examine the effect of altruism on EV adoption from a pro-environmental perspective. Secondly, external costs, such as the perceived price and the perceived complexity, are introduced in our research model to study how external factors influence the relationship between personal norms and EV adoption. Finally, perceived consumer effectiveness is added as an antecedent to explore its effects on personal norms and the intention to adopt EVs.

The remainder of this paper is organized as follows. A review of EV adoption and the NAM is presented in Section 2. In Section 3, we propose the research model and hypotheses of the study. The research methodology and data analysis are presented in Section 4 and Section 5 respectively. In Section 6, we discuss the interpretation of results, theoretical and practical implications, limitations and future research. The conclusion is presented in Section 7.

2. Literature review

2.1. EV adoption

EV adoption is a behavioral response (e.g. purchase or usage behavior) to the availability of this eco-innovation (Schuitema et al., 2013). As intention to adopt an innovation can well predict adoption behavior, it is considered as the proxy variable for adoption behavior in an abundance of research (Arts et al., 2011).

Recently, considerable studies have focused on EV adoption. Most of them are concerned with the influences of three sets of factors: technological factors, consumer characteristics and contextual factors (Bjerkan et al., 2016; Sierzchula et al., 2014). Technological factors mainly involve the battery, EV driving range, and EV charging time (Brownstone et al., 2000; Hackbarth and Madlener, 2013; Lieven, 2015). Consumer characteristics include age, gender, income, education levels, and environmentalist status (Coffman et al., 2017; Hidrue et al., 2011; Ozaki and Sevastyanova, 2011). Contextual factors refer to incentive policy, fuel price, and charging infrastructure (Diamond, 2009; Gallagher and Muehlegger, 2011; Struben and Sterman, 2008).

Most of the existing studies have explained consumer adoption of EVs with the theory of planned behavior (TPB) (Lane and Potter, 2007; Kaplan et al., 2016; Wang et al., 2016) and rational choice theory (Carley et al., 2013; Jensen et al., 2013; Krupa et al., 2014). TPB has often been used for predicting a variety of intentions and behaviors. It assumes that consumers rely on their rational evaluation of behavior to make decisions, and three dimensions (attitude, subjective norm and perceived behavioral control) explain the intention of behavior (Ajzen, 1991). Rational choice theory asserts that consumers make decisions based on maximization of their benefits and utilities. Related literature has considered consumers’ EV adoption behavior as a rational behavior, and has measured consumer attitude towards EV attributes such as driving range, purchase price, and operation costs.

EVs as eco-innovations can lessen adverse effects on the environment by reducing energy use and tailpipe emission, so EV adoption behavior is considered as a pro-environmental behavior (Rezvani et al., 2015). Pro-environmental behavior is a conscious action performed by an individual for relieving the adverse impacts of human behaviors on the environment, or enhancing the quality of the environment (Jensen, 2002; Kollmuss and Agyeman, 2002). Consumers perform pro-environmental behavior motivated not only by their self-interests but also by concerns about other people and the whole ecosystem. However, TPB and rational choice theory only take consumers’ self-interests into account to explain their EV adoption behavior, so it is necessary to study consumers’ adoption of EVs from a pro-environmental behavior perspective. Since previous researchers were inclined to use the norm activation model (NAM) to study pro-environmental behaviors (Steg and de Groot, 2010), we study consumers’ adoption of EVs based on the NAM in this paper.

2.2. Norm activation model

The norm activation model (NAM) developed by Schwartz (1970s), proposes a mechanism for the transfer of a moral norm into environmental actions. The model has been widely used in the context of pro-social behavior including pro-environmental behavior (De Groot and Steg, 2009; Schwartz, 1977). The NAM contains three cardinal variables, namely personal norms, awareness of consequences, and ascription of responsibility. Personal norms, defined as a “moral obligation to perform or refrain from specific actions” (Schwartz and Howard, 1981), plays a critical role in the NAM and is used to predict pro-social behavior immediately. Awareness of consequences is described as “whether someone is aware of the negative consequences for others or for other things one values when not acting pro-socially” (De Groot and Steg, 2009). Ascription of responsibility is defined as “feelings of responsibility for the negative consequences of not acting pro-socially” (De Groot and Steg, 2009).

The relationship between these variables is controversial among researchers (De Ruyter and Wetzel, 2000). Some researchers assume that NAM is a mediator model, which states that awareness of consequences and ascription of responsibility indirectly influence
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