Energy Policy 115 (2018) 171–180

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Exploring the effects of non-cognitive and emotional factors on household electricity saving behavior

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ARTICLE INFO

Keywords:
Theory of planned behavior
Electricity saving behavior
Personal moral norm
Habit
Positive anticipated emotion

ABSTRACT

Understanding and promoting household electricity saving behavior is vital to reduce electricity consumption and carbon emissions. The main purpose of this research is to analyze the effects of non-cognitive (personal moral norm and habit) and emotional factors (positive anticipated emotion) on household electricity saving behavior using a comprehensive model integrating the theory of planned behavior and the theory of interpersonal behavior. The model is empirically tested using questionnaire survey data collected from 320 households. The results indicate that personal moral norm, habit and positive anticipated emotion are important determinants of residents' intention to save electricity. Furthermore, it is find that habit is also positively associated with electricity saving behavior. However, positive anticipated emotion is negatively associated with electricity saving behavior, which means that residents who present more positive anticipated emotion about electricity conservation intend to save electricity in their daily lives but actually end up consuming more electricity. In addition, the results also suggest that residents with positive attitude towards saving electricity and greater senses of control have stronger intention to save electricity, while the role of subjective norm is not significant. Based on these results, policy implications for research and practice and suggestions for further research are discussed.

1. Introduction

With the rapid development of economy and the improvement of living standards in the past decades, the electricity consumption in Chinese household sector is increasing in an incredible speed (Du et al., 2017; Ding et al., 2017). According to a report issued by National Energy Administration of China,[1] the average household electricity consumption in 2000 is only 232.8 kWh, but by 2015 it increased to 698.3 kWh in China. The annual growth rate is nearly about 7.60%. There is no doubt that the household electricity consumption in China will continue increase in the next few years because the electricity consumption and economic development exhibit a significant positive causal nexus (Yuan et al., 2007). The increased household electricity consumption intensifies the energy crisis in China and brings huge number of carbon emissions and other toxic gases, which may damage the environment and individuals' health (Pothitou et al., 2016; Zhang et al., 2013). Meanwhile, it is worth noting that household electricity consumption has a large saving potential (Ouyang and Hokao, 2009). Murata et al. (2008) indicated that 28% reduction in household electricity consumption in China could be achieved through changing electricity consumption pattern and promoting electricity saving behavior by the year of 2020. Thus, considering the negative consequences and the large saving potential, several measures and relevant researches should be taken to reduce household electricity consumption and promote electricity saving behavior.

Currently, the measures and research efforts focus on household electricity consumption behavior can be divided into three major categories, namely economic oriented perspective, technological oriented perspective and psychological behavior oriented perspective (Zhou and Yang, 2016; Arawomo, 2017; da Silva and Cerqueira, 2017). Economic oriented perspective mainly focuses on price-based measures and financial incentive-based measures (Zhou and Yang, 2016). Theoretically, it seems that price-based measures such as multi-part tariffs and peak-load pricing can reduce household electricity consumption dramatically and promote electricity saving behavior. However, in practice, most studies have found that the effects of these measures is relatively limited (Reiss and White, 2005; Zhou and Teng, 2013). This is because that compared with other household consumption expenditures, the expenditure on electricity consumption is rather small and electricity consumption usually exhibits low price elasticity (Zhou

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[1] See detail at http://data.stats.gov.cn/easyquery.htm?cn=C01.

https://doi.org/10.1016/j.enpol.2018.01.012
Received 22 August 2017; Received in revised form 26 December 2017; Accepted 6 January 2018

and Teng, 2013; Yu and Guo, 2016). Most households are insensitive to electricity price change and unwilling to save electricity to sacrifice their comfortable living style and welfare in their daily lives (Cheung et al., 2017). Financial incentive-based measures aim to provide subsidies to households to compensate for their sacrifices (Handgraaf et al., 2013). Previous studies have suggested that financial incentive-based measures can only be effective in a short period of time unless the measures are long lasting (Handgraaf et al., 2013; Frederiks et al., 2015). Hence, financial incentive-based measures may not encourage electricity saving behavior effectively in the long run. Technological oriented perspective aims to improve electricity consumption efficiency and promote energy-efficient technology and appliance to reduce and save electricity consumption (Zhou and Yang, 2016). However, relying on energy-efficient technology and appliance are not sufficient to reduce electricity consumption due to the 'rebound effect[2]' (Sorrell and Dimitropoulos, 2008; Georges et al., 2017). For example, Nilsson et al. (2014a) noted that the energy-efficient technology has improved greatly and technical energy efficiency of appliance has improved substantially over the past decades, while in the same period the household electricity consumption has also increased.

Considering the limitations of economic oriented perspective and technological oriented perspective, scholars have been more and more recognized that psychological behavior oriented perspective is of great significance in achieving electricity saving goals (Martinsson et al., 2011; Hori et al., 2013; De Leeuw et al., 2015; Bertoldo and Castro, 2016; Shi et al., 2017). Psychological behavior oriented perspective aims to achieve household electricity conservation by underscoring some psychological factors, such as attitude, social norms and environmental awareness to promote electricity saving behavior (Martinsson et al., 2011; Fornara et al., 2016; Zhou and Yang, 2016; Ding et al., 2017). In previous studies, scholars have paid attention to psychological factors and many psychological behavior models and theories have been developed to understand household electricity consumption behavior and explore the influencing factors (Barr et al., 2005; De and Steg, 2009; Hori et al., 2013; Nilsson et al., 2014b; Fornara et al., 2016; Yu and Guo, 2016; Ding et al., 2017). Among these models and theories, theory of planned behavior (TPB) is widely used. Rivis et al. (2009) indicated that TPB is probably the most influential theory in explaining environmentally relevant behavior. In this research, we also try to adopt TPB to understand household electricity behavior from the psychological behavior oriented perspective.

In fact, in the pro-environmental behavior domain, theory of reasoned action (TRA) and norm activation model (NAM) have also often been used to study pro-environmental behavior, such as recycling behavior, green buying behavior and energy conservation behavior (Davies et al., 2002; Wahid et al., 2011). However, they have often been questioned due to their own limitations (Shi et al., 2017). TRA has been questioned since this theory only focuses on volitional control factors and ignores the non-volitional factors, such as time, opportunities and resources (Lam and Hsu, 2004). NAM has been criticized since that it only focuses on internal factors and ignores the external factors, such as social environment, time and resources (Shi et al., 2017). Compared with TRA and NAM, TPB not only considers the non-volitional factors (e.g., perceived behavioral control) but also external factors (e.g., subjective norm). Hence, it is appropriate to select TPB as the basic theoretical framework in this research to understand household electricity saving behavior. In addition, several scholars have noted that additional psychological factors and variables can also be added to TPB to improve the model explanatory power (Kaiser and Scheuthle, 2003; Shi et al., 2017; Gao et al., 2017). In this research, two additional factors, namely non-cognitive factors (e.g., personal moral norm and habit) and emotional factors (e.g., positive anticipated emotion) are incorporated into TPB model to better understand household electricity saving behavior (Hassin et al., 2009; Webb et al., 2013; Fornara et al., 2016). The main goals of this research are to explore whether these factors and variables significantly affect household electricity saving behavior and what measures can be taken to promote household electricity saving behavior.

There are several theoretical and applied contributions of this research. Theoretically, to the best of our knowledge, this is the first time to incorporate non-cognitive factors and emotional factors together into TPB to understand household electricity saving behavior, which enriches the existing understanding of household electricity saving behavior. Meanwhile, this research provides a paradigm for understanding household electricity saving behavior in pro-environmental research filed. This paradigm can help refine and strengthen future research on electricity saving behavior. In addition, this research highlights the importance of non-cognitive and emotional factors in promoting household electricity saving behavior and provides new directions for future research in pro-environmental behavior field. In practice, based on the research findings, measures and intervention strategies can be taken to promote household electricity saving behavior.

The remainder of this research is organized as follows. Section 2 focuses on literature review. Section 3 proposes the conceptual framework and hypotheses. Section 4 focuses on data and the research method. Data analysis and results are presented in Section 5. In Section 6, we discuss the results and implications. In Section 7, we conclude the research and address the research limitations.

2. Literature review

TPB is first proposed by Ajzen in 1991 and now it is the most popular theory to predict and explain individual's behavior in a wide range of fields, especially in pro-environmental domain (Ajzen, 1991). Klöckner (2013) noted that approximately 40% of all papers published in environmental psychology domain have employed TPB as their basic theoretical framework. In fact, TPB has been successfully applied to explore household environmentally friendly behavior, such as energy conservation behavior, green purchasing behavior and other sustainable consumption behavior (Kaiser and Scheuthle, 2003; Chen and Tung, 2014; Wang et al., 2014; De Leeuw et al., 2015; Yadav and Pathak, 2016).

Though TPB has received strong support in explaining environmentally friendly behavior and own several advantages compared with TRA and NAM, it also has several shortcomings and these shortcomings can be solved by adding additional factors and variables (Bamberg, 2003; Gao et al., 2017). One of the shortcomings of TPB is that as for the social norm, TPB overestimates the effect of it and under represents the contribution of internal moral norm, particularly personal moral norm (Webb et al., 2013; Cheung et al., 2017). Abrahamse and Steg (2009) and Bertoldo and Castro (2016) argued that most pro-environmental behaviors are motivated by personal moral norm rather than social norm. Meanwhile, unlike other pro-environmental behavior (e.g., green buying behavior or green travel behavior), household electricity saving behavior has less visibility to other people (e.g., friends, relatives or neighbors). Intuitively, it can be predicted that the effect of social norm on household electricity saving behavior is likely to be of less importance.

Another shortcoming is that the variables in TPB are cognitive and rational predictors and TPB largely relies on the assumption that individuals make rational choices (Abrahamse and Steg, 2009; Demarque et al., 2015). As we know, to some degree, environmentally friendly behavior cannot be just considered as a result of rational choice (Kals et al., 1999). Many behaviors are guided more by automatic, repeated and positive affective processes, which means that some non-cognitive and emotional factors, such as personal moral norm, habit and emotion

[2] Rebound effect refers to an increase in energy use efficiency by 1% will cause a reduction in energy consumption that is far below 1% or, sometimes, it can even cause an increase in energy consumption.