JOURNAL OF TOURISM, HOSPITALITY AND ENVIRONMENT MANAGEMENT (JTHEM)

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ROLE OF PAST BEHAVIOUR IN APPLICATION OF TPB IN PREDICTING ENERGY SAVING BEHAVIOUR: A REVIEW

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Article Info:

Abstract:

The energy sector is the largest source of emissions and accounting for nearly 68% of the world's greenhouse gas emissions. Where 36% of all global final energy use is generated from buildings. Currently, the topic of energy-saving behaviour is attracting the attention of researchers, how to encourage users towards energy-saving behaviour (ESB). Theory of Planned Behaviour (TPB) is empirically recognized as a model widely used in predicting social behaviour. However, the TPB has received much debate and criticism about the narrow sufficiency of the three original determinants: Attitudes, Subjective Norms and Perceived Behaviour Control. This article discusses empirical support by several authors who acknowledged other related factor that need to be considered in developing a theoretical framework by adding Past Behaviour in predicting the energy saving behaviour of users to improve the ESB. An extensive literature search was conducted on 100 published literature in year 2011-2021, to explore the significance of past behaviour as an additional psychological factor of ESB in a building context. Content analysis conducted based on previous research published in leading journals (e.g. Scopus and Web of Science). About 30% of previous studies have found Past Behaviour as a significant contributing predictor of ESB beside the TPB original determinants. This study will help to provide a better understanding about social psychological determinants of energy saving behaviour hence serve as a guide to the building operator and relevant agencies in shaping strategy to promote energy saving behaviour among the occupants.

Keywords:

Theory of Planned Behaviour, Past Behaviour, Energy Saving Behaviour

Introduction

Buildings users are important end users of energy, which accounts for 36% of global final energy use and 28% of global energy-related CO2 emissions (IEA,2019). Despite improvements in building design and construction, and having more efficient equipment, the total energy demand for buildings continued to increase during 2016–2018 (IEA, 2019). Energy-related CO2 emissions in buildings have increased from 7.7 Gt in 2000 to 9.6 Gt in 2018 (IEA, 2019). With increasing incomes and higher comfort needs, residents have increased their expectations of building services, which has accelerated the increased energy demand from existing buildings and an insatiable demand for new buildings.

Buildings sectors has enormous energy saving potential. According to the IEA (2019), energy demand from the buildings sector falls steadily through efficiency improvements by nearly 30% by 2050 in a faster transition scenario, however smarter electricity use can significantly reduce the environmental footprint of electricity consumption. Supported by D'oca et al (2018), "technology alone does not guarantee low energy use in buildings" and the human dimension should be considered carefully when dealing with higher building performance (Qin & Pan, 2020; Zhou et al., 2016). Jareemit and Limmeechokchai (2019) have stated that annual household energy use in Bangkok, Thailand can decrease by 7% - 15% or 484-1038 kWh with favourable energy saving behaviour among the nation. Sun and Hong (2017) stated that occupant behaviour causes a difference in energy savings of up to 20%, depending on how different technologies are used. As buildings become smarter and people demand a more comfortable living environment, the impact of occupants on the building energy use will no doubt increase (IEA, 2019).

The occupants of a building play an important role in reducing energy consumption (Wang et al., 2014). Willingness to adopt behaviour change towards energy saving habits is very important in achieving desirable energy saving. Previous studies have recognized that specific desirable behaviour, such as energy saving behaviour, are influenced by a set of psychological determinants. In addition, there are a variety of psychological determinants that have been shown to contribute significantly to encouraging energy-saving behaviour, which vary in local contexts and cultures. Some psychological determinants may have a direct influence on an individual's intention to engage in pro-environmental behaviour and some may have a moderate impact. Therefore, this study aims to identify psychological determinants that influence energy-saving behaviour in the building by reviewing previous studies that presents various psychological determinants used to foster energy-saving behaviour in various contexts. The following sections provide description of the determinants in influencing energy-saving behaviour.

Methodology

This paper presents a review of literature published by leading journal. The selection criteria of the paper used for this review was primarily based on the direct relevant to the subject. Scopus and Web of Science databases, two of leading databases in the scientific literature were used. For this study the term of "psychological factors in energy conservation behaviour" was used to select the papers where it was found in title, abstract or keyword. The search has resulted a total of 100 previous studies that adopted TPB that were published between year 2011-2021. A content analysis was conducted on the 100 studies derived from the search results.

Main Results

This study adopts the Theory of Planned Behaviour (TPB) model as the basis for determining the psychological determinants of energy saving behaviour. A systematic review based on the 100 journal articles, about 30% of the past studies have identified the Past Behaviour as one of the significant determinants that contributing to improve the energy-saving behaviour across the contexts. The previous studies that have identified the Past Behaviour contribution in influencing energy saving behaviour is presented in Table 1.

Table 1: Previous Studies using Past Behaviour as a factor on Energy Saving Behaviour

No	Source	Context / Behaviour	Other determinants except TPB
1	Xu et al., 2021	Energy saving behaviour in workplace	User comfort and past behaviour
2	Zhang et al., 2021	Behaviour in residential energy use	Past behaviour and thermal insulation building
3	Lee et al., 2020	Energy consumption in South Korea	Past behaviour and energy information
4	William et al., 2020	Electricity Use Behaviour in Johannesburg, South Africa	Past behaviour
5	Gkargkavouzi et al., 2019	Environmental behaviour	Self-identity and past behaviour
6	Hafner et al., 2019	Reduction energy consumption	Past behaviour
7	Karlijn et al., 2019	Energy saving behaviour	Past behaviour
8	Lalot et al., 2019	Pro-environmental behaviour	Self-identity and past behaviour
9	Satish and Brennan, 2019	Energy use behaviour of British Indian households	Past behaviour
10	Shi et al., 2019	Energy conservation behaviour among college students	Past behaviour and value
11	Wang et al., 2019	Electricity conservation behaviour in workplace	Personal norm and past behaviour
12	Zhao et al., 2019	Household energy saving behaviour	Past behaviour
13	Jiang et al., 2018	Individual environmental behaviour building low carbon communities in china	Knowledge and past behaviour
14	Carfora et al., 2017	Pro-environmental behaviour	Self-identity and past behaviour
15	Ding et al., 2017	Energy conservation behaviour among resident in China	Past behaviour and social norm
16	Ohnmacht et al., 2017	Energy saving behaviour	Self efficacy and past behaviour
17	Oztekin et al., 2017	Pro-environmental behaviour on household recycling	Past behaviour
18	Varotto and Spagnolli, 2017	Household recycling	Knowledge, past behaviour and demoghraphic factor
19	Pothitou et al., 2016	Household energy conservation behaviour	Knowledge and past behaviour
20	Maleetipwan mattson et al., 2016	Energy conservation behaviour in hospital environment	Past behaviour
21	Simanaviciene et al., 2015	Energy saving behaviour	Past behaviour
22	Tetlow et al., 2015	Electricity consumption	Past behaviour
23	Wan et al., 2015	Determinants of recycling	Past behaviour and social influences
24	Parkpour et al., 2014	Household waste behaviour	Past behaviour, moral obligation, demographic factor

No	Source	Context / Behaviour	Other determinants except TPB
25	Wang et al., 2014	Energy conservation behaviour among Beijing resident	Knowledge, past behaviour and demographic factor
26	Wu et al., 2013	Pro environmental behaviour	Past behaviour
27	Yue et al., 2013	Energy saving behaviour	Past behaviour
28	Lo et al., 2012	Energy related behaviour in office buildings	Self-efficacy and past behaviour
39	Sommer et al., 2011	Pro-environmental behaviour	Past behaviour
30	Wang et al., 2011	Household electricity-saving behaviour	Social norm, past behaviour and policy

Theory of Planned Behaviour (TPB)

TPB is one of classic theoretical model develop specifically for individual behaviour studies (Ajzen, 1991). In detailed, TPB is the extension version from Theory of Reasoned Action (TRA) (which has been widely used as a model for identifying strategies for behavioural changes (Ajzen and Fishbein, 1980). As shown in Figure 1, TPB consists of three determinants which are Attitude, Subjective Norm and Perceived Behavioural Control (PBC). Attitudes are formed by a series of beliefs and result in a value being placed on the outcome of the behaviour. If the outcome or result of a behaviour is seen as being positive, valuable, beneficial, desirable, advantageous, or a good thing, then a person's attitude will be favourable with a greater likelihood of the person engaging in the behaviour (Ajzen, 2002). While subjective norm refers to the relevant expectations of community which individual search to comply (Lülfs and Hahn,2014). It is agreed by Han et al (2010), subjective norm as a determinant of energy behaviour could play a role in understanding the social pressure from reference group that influenced an individual perform certain behaviour. On the other hand according to Thøgersen and Grønhøj (2010), PBC is the level of difficulty for a person to sustain in performing certain behaviour based on the rationality. Furthermore, PBC has been included into TPB model with an assumption that this additional determinant will have direct effect on behaviour and indirect effect which involve intention before performing certain behaviour (Madden et al., 1992).
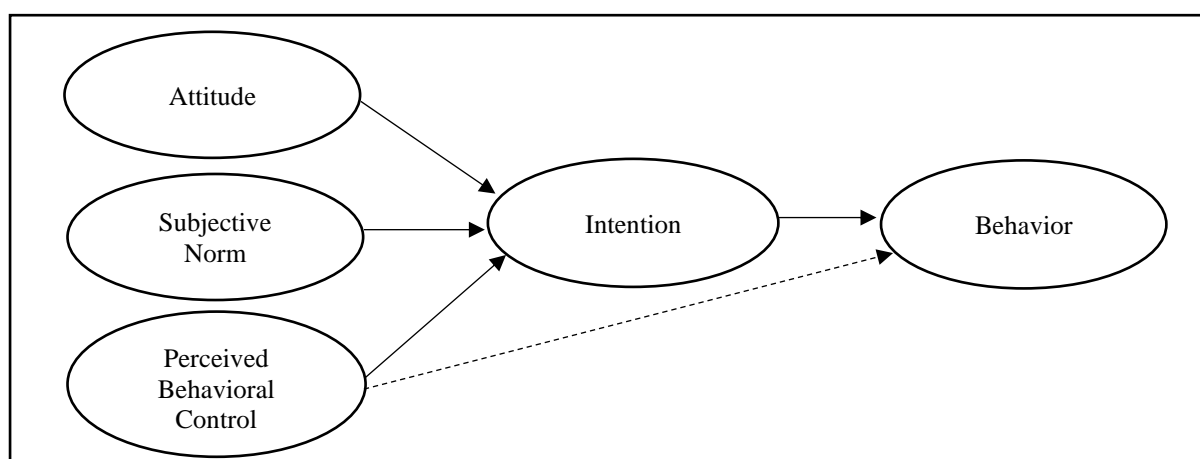

Figure 1: Model for Theory of Planned Behaviour (TPB)
Source: Azjen (1991)

Psychological Determinant: Past Behaviour

In present context, Past Behaviour refers to a previous involvement in certain behaviour and situation (Wan et al.,2015). Past green behaviour has first been found to positively predict future performance of the same behaviour, for example in household recycling (Carfora et al., 2017). A study conducted by Wang et al. (2011) has confirmed the residual effect of the basic model of TPB because past behaviour or experience may contribute to perform certain behavioural intention. Additionally, a study by Ding et al. (2017) has evidenced that the past behaviour and lifestyle factor both have a strong correlation with the resident's daily energy use behaviour.

Previous study has acknowledged that past behaviour could be a good predictor of individual intention towards pro-environmental behaviour. Xu et al (2021) also identified past behaviour has effect on energy saving. Moreover, past behaviour can influence individual intention in two ways which are through habit formation or semi-automatic responses in complex behaviour (Ouellette and Wood, 1998). While William et al (2020), past behavior or daily actions that often carried out in the context of electricity use will have an effect on sustainable electricity and can be understood as good or bad environmental behavior. According to Barr (2007), individual who has past behaviour in a certain specific pro-environmental behaviour will be more willing to perform pro-environmental behaviour in the future.

For example, study by Lee et al (2020) investigated the effects past behaviour and feedback on energy consumption and found habits as a part of past behaviour have been considered as one of the primary causes of inefficient energy consumption. While Gkargkauouzi et al (2019) explored the determinants of environmental behaviour in private spaces and the results showed past behaviour and subjective norm is the main supporter of the intention to environmental behaviour. Lalot et al (2019) also found that positive past behaviour will strengthen the positive relationship between self-identity and intentions at high levels of past behaviour. Pothitou et al (2016) found a significant correlation indicating that residents with positive environmental knowledge are more likely to exhibit energy behaviours, attitudes and past behaviour that lead to energy-saving activities in the household. Study by Wang et al (2019) analysed how normative past behaviour factors affect employee's electricity conservation behaviour in the workplace and found it has positively and significantly affected the employee's intention to conserve electricity. Another study by Zhao et al (2019) in understanding the energy saving characteristic could provide foresight in predicting energy saving behaviour, has acknowledged the past behaviour as one of possible influencing factors of ESB.

While study by Carrus et al. (2008) indicated that past behaviour is necessary in determining individual intention towards certain behaviour and study by White and Hyde (2012) found that past behaviour was positively correlated with household behaviour to perform recycling. Agreed by Oztekin et al (2017), their study assessed of some socio-psychological attributes in explaining recycling behaviour of Turkish university community in the context of the theory of planned behaviour with an additional variable which is past behaviour and it found intention to recycle is shaped by their past behaviour for male group, while female group was shaped by their perceived behaviour control (PBC). Hafner et al (2019) stated that past behaviour was found to be one of the biggest barriers to change, and also has a direct impact on energy use. In particular, subjects who stated that they were 'accustomed to behaving in a certain way' were found to use more energy and were less likely to engage in energy-saving measures that were known to have an impact on thermal energy consumption.

Furthermore, a study conducted by Tetlow et al (2015) to assess the contribution of various behavioural constructs towards energy consumption in the office based on TPB and past behaviour, investigated that past behaviour is an influential factor of electricity consumption to the occupants.

Conclusion

TPB has been accepted as a model with strong proprietary utility for predicting social behaviours. Despite its valid predictions, some researchers proposed relevant additional predictor to enhance predictive ability of specific behavioural intention. Based on the review of 100 pieces of published literatures that adopted TPB as based model, Past Behaviour has been identified as an additional determinant that potentially contribute in influencing the energy-saving behaviour. More work will need to be done to explore further determinants that predicting the energy-saving behaviour based on the well-established TPB model.

Acknowledgement

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