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# Behaviour-Driven Energy-Saving in Hotels: The Roles of Extraversion and Past Behaviours on Guests' Energy-Conservation Intention

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**Abstract:** The growing environmental concerns and the significant energy consumption in hotel buildings make the ability to proactively manage energy and lower carbon intensity essential in the global hospitality industry. Activating guests' energy-conservation behaviours is a potential strategy for sustainable hotel operation and maintenance. Yet, the psychological mechanism of hotel building energy-conservation intention and the roles of personality traits have not been sufficiently investigated. This study aims to examine the role of guests' extraversion levels in their hotel building energy-conservation behavioural intention using a modified theory of planned behaviour (TPB) model. The study extends the TPB model with personal norms and past behaviour as two additional factors and employs past behaviour as a moderator to bridge extraversion and other psychological factors. A field experiment was conducted consisting of 530 hotel guests in Shanghai, China. The results demonstrate the relationships between attitude, behavioural control, personal norms, past behaviour and energy-conservation intention. Specifically, extraversion negatively influences perceived behavioural control (PBC) ($\beta = -0.176$, $p < 0.001$) and positively impacts on personal norms ($\beta = 0.290$, $p < 0.001$), both of which significantly contribute to guest energy-saving intention. In addition, past behaviours positively moderate the effects of extraversion on subjective norms and personal norms. This research enriches the hospitality and tourism management literature by shedding novel light on how guests' personality characteristics influence their pro-environment intentions during their stays in hotel buildings. The findings would drive the hotel building energy management forward through actionable and effective energy-conservation interventions and enhanced guest satisfaction.

**Keywords:** energy conservation; extraversion; green hotel; past behaviour; personality traits; pro-environmental management

## 1. Introduction

The energy crisis sweeping the globe in 2022 underscores the importance of energy security and highlights the critical role of energy management in almost all industries. The hospitality and tourism industry has been an important energy consumer and carbon emitter [1–3] Given that rising energy consumption has burdened hospitality practitioners with additional operational costs, academia and industry have developed several sustainable strategies focusing on hotel operation and management. For example, many works encouraged energy retrofitting and equipped hotels with more energy-efficient building

services [4,5]. Though these engineering-based solutions can contribute to the sustainability of hotel operations, their higher initial and maintenance costs could be a significant burden on hotel managers and operators.

In addition to the hotel energy retrofits, it has been confirmed that behaviour-driven energy-conservation strategies are also effective in sustainable hotel operation and maintenance [6]. Behavioural factors have been well discussed in both building energy modelling [7] and management [8]. In the hospitality and tourism field, several studies pointed out that people consume significantly more resources at hotels than at home [9,10]. More specifically, the excessive consumption behaviours of hotel guests contribute to over 75% of the hotels' environmental impact [10], where each guest directly consumes 272 MJ energy, 350 L water, and emits 13.8 kg $CO_2$ per night [11]. Given the threat of the energy consumption issues, many empirical studies have shifted their focus on energy-conservation behaviours in the household [12,13] and workplace [14,15] contexts. In addition, sufficient evidence suggested that behavioural intervention can reduce building energy demand by 10% to 25% [16,17] Therefore, behaviour-driven strategies present potential as a low-cost energy management approach in hotel operations.

In recent years, academia has paid more attention to pro-environmental behaviours (PEBs) in the hospitality industry. In particular, there is an increasing number of studies on waste reduction and the water-conservation behaviours of hotel guests [10,18–22]. Among these studies, the theory of planned behaviour (TPB) framework has been widely employed to explain the psychological mechanism of PEBs in hotels [3,21,22]. Additionally, some studies have shown the importance of personality traits as antecedents of individual behaviour differences in hotel PEBs [23,24]. For example, Kozako et al. (2013) found that personality, especially extraversion and agreeableness, has a strong influence on hotel employees' individual work behaviour rather than their organisational behaviour [25]. In addition, extraversion plays an important role as the driver of the stable individual differences in hotel PEBs [23,26]. Although much research found that personality has the potential to influence individuals' PEB, there is still a lack of sufficient research to explore how each specific personality trait plays an important role in guests' hotel energy-saving willingness.

A thorough understanding of guests' energy-conservation behavioural process could be essential for intervention development and implementation. However, only a few studies have examined the energy-conservation behaviours of hotel guests [3]. Existing studies do not fully explain the factors that trigger customers to conserve energy during their hotel stays and the psychological mechanism of the hotel energy-conservation behaviour is still unclear. To address the aforementioned research gaps, the purpose of this study is to explore the relationship between extraversion and hotel guests' hotel energy-saving intentions, and whether the adoption of behavioural habits contributes to moderating the effects on psychological factors by employing an extended TPB model. Given the sustainable trend in the hospitality industry, this study will provide concrete and reliable measures for both managerial and theoretical implications for sustainable hotel operation and maintenance.

The remainder of the paper is constructed as follows. Section 2 provides a literature review, presents the theoretical framework and develops hypotheses based on this review. Section 3 presents the materials and methods used in this study. Section 4 shows the hypotheses results and mentions the model outcome. Section 5 discusses the findings and proposes potential further research directions. The last section presents the conclusion.

## 2. Literature Review

### 2.1. Theory of Planned Behaviour

The theory of planned behaviour (TPB) is an extension of the theory of reasoned action (TRA) with an enhanced predictive power [27]. The TPB model also pays more attention to the hedonistic side of human behaviours. Specifically, this model assumes that an individual's behaviour (or decision making) is driven by her/his intention to carry out the specific behaviours (or decisions). The term of intention refers to an individual's

readiness to perform a specific behaviour or to make a specific decision. The TPB model develops three psychological factors to determine the behavioural intention: (1) attitude, which refers to one's subjective evaluation of the nature and the outcome of a specific behaviour; (2) subjective norms, which refers to one's perceived expectations from other people and society in general; and (3) perceived behavioural control (PBC), referring to the perceived ability to perform a specific behaviour or the self-evaluation of the convenience of the specific behaviour, which is rooted under Bandura's social cognitive theory [27,28]. The TPB model has been employed in predicting a wide range of pro-environmental intentions and behaviours such as recycling [29], green product consumption [30] and household and office energy conservation [12,13,31].

Recently, many existing studies have attempted to incorporate the TPB model into hotel PEBs research. Several studies examined the role of three TPB factors in green hotel visiting intention. For example, Verma and Chandra (2018) [24] and Chen and Tung (2014) [32] report that all three factors in the TPB model are positively correlated with guests' green hotel visiting intention in the India and China context, respectively. In addition to green visiting behaviour, some researchers also adopted the TPB model to explain guests' PEBs during their hotel stays. For example, Budovska et al. (2020) [21] observed significant relationships between three TPB factors and hotel towel use intention. In addition, Fatoki (2020) [22] also noted similar findings in his research on hotel water conservation behaviours. Based on the aforementioned discussions, this research posits the following hypotheses:

**Hypotheses 1 (H1).** *Attitude positively influences the hotel energy-conservation intention of guests.*

**Hypotheses 2 (H2).** *Subjective norms positively influence the hotel energy-conservation intention of guests.*

**Hypotheses 3 (H3).** *PBC positively influences the hotel energy-conservation intention of guests.*

### 2.2. Personal Norms

The TPB can be modified and extended in different situations. Personal norms is a widely used determinant to extend the TPB (also called the morally extended TPB). The term "personal norms" refers to the perceived responsibility or moral obligation of an individual for a certain action or a decision [33]. Several studies have identified that there is a direct correlation between personal norms and PEBs in hotels. For example, Han et al. (2020) [18] found that personal norms have a significant and positive relationship with both hotel water-conservation intention and waste-reduction intention. Another study noted that personal norms have a direct impact on towel reuse behaviours [34]. Although the morally extended TPB gained prevalence in PEBs research, some researchers also reported different views and results [32,35]. For instance, Chen and Tung (2014) [32] reported a less significant statistical relationship between personal norms and green hotel visiting intention (i.e., $p < 0.10$). Hence, the following hypothesis is developed:

**Hypotheses 4 (H4).** *Personal norms positively influence the hotel energy-conservation intention of guests.*

### 2.3. Extraversion

Personality traits reflect the individual's stable perception and behaviour patterns. In 1949, Fiske summarised the previous personality research and proposed the Big Five personality model [36]. In decades of development, the Big Five personality traits have become the most widely used personality model [37]. Previous research has confirmed the cross-cultural reliability of the Big Five personality model [38]. In particular, an increasing number of studies employ the Big Five personality traits to explain individual stable differences in pro-environmental behaviours and decision making [14,23,39–41].

Extraversion is a particular personality trait that shows the individual's group participation and sociality [42,43]. Extraverts are more willing to participate in group activities and pursue mainstream ideas [41]. Thus, extraversion might have a stronger impact on pro-environmental behaviour in public places. For example, studies found that extraversion can significantly promote energy-conservation behaviour in offices [14] rather than at home [13]. Moreover, the extraversion personality trait also presented positive roles in the donation to the WWF charity [44] and in waste management [45]. Additionally, in the tourism and hospitality industry, Kvasova (2015) [23] found that extraversion shows a direct impact on sustainable tourism in Cyprus. Tang and Lam (2017) [26] also reported that extraversion is positively associated with the individual's willingness to pay for green hotels. In recent years, several empirical studies have also evidenced that personality factors can have an indirect effect on PEBs through the TPB factors [29,31,46,47]. This study hypothesises that extraversion also plays a positive role in hotel energy-conservation intention and develops the following hypotheses:

**Hypotheses 5 (H5).** *Extraversion positively influences the hotel energy-conservation intention of guests.*

**Hypotheses 6 (H6).** *Extraversion significantly influences attitude (6a), subjective norms (6b), PBC (6c) and personal norms (6d) towards hotel energy-conservation intention.*

*2.4. Past Behaviour*

Relevant existing studies have also discussed the role of past behaviour in predicting future actions and decision making [31,48–51]. However, this contract has been a controversial predictor in the PEBs research. On the one hand, Ajzen (1991) [27] argued that past behaviour only indirectly contributes to the intention. Norman et al. (2000) [49] noticed that past behaviour only plays a mediating role. Han et al. (2018) [52] also reported that household behaviour is a moderator in predicting hotel towel reuse behaviour. On the other hand, more studies have observed contrasting results in recent years [3,31,53,54]. More empirical evidence has been reported in the tourism and hospitality management field; for example, Budovska et al. (2020) [21] highlighted the significant effect of past behaviours on the towel reusing intention of hotel guests. Similarly, Yadegaridehkordi et al. (2021) [54] also found a strong influence of past behaviours on green hotel visiting. It is believed that past behaviour is related to the development of habits and can be a direct predictor of some pro-environmental intentions. Based on the abovementioned discussion, this study develops the following hypotheses:

**Hypotheses 7 (H7).** *Past behaviour positively influences the hotel energy-conservation intention of guests.*

**Hypotheses 8 (H8).** *Past behaviour moderates the relationships between extraversion and attitude (8a), subjective norms (8b), PBC (8c) and personal norms (8d) towards hotel energy-conservation.*

In general, Figure 1 illustrates the developed theoretical framework that summarises all of the aforementioned proposed hypotheses.
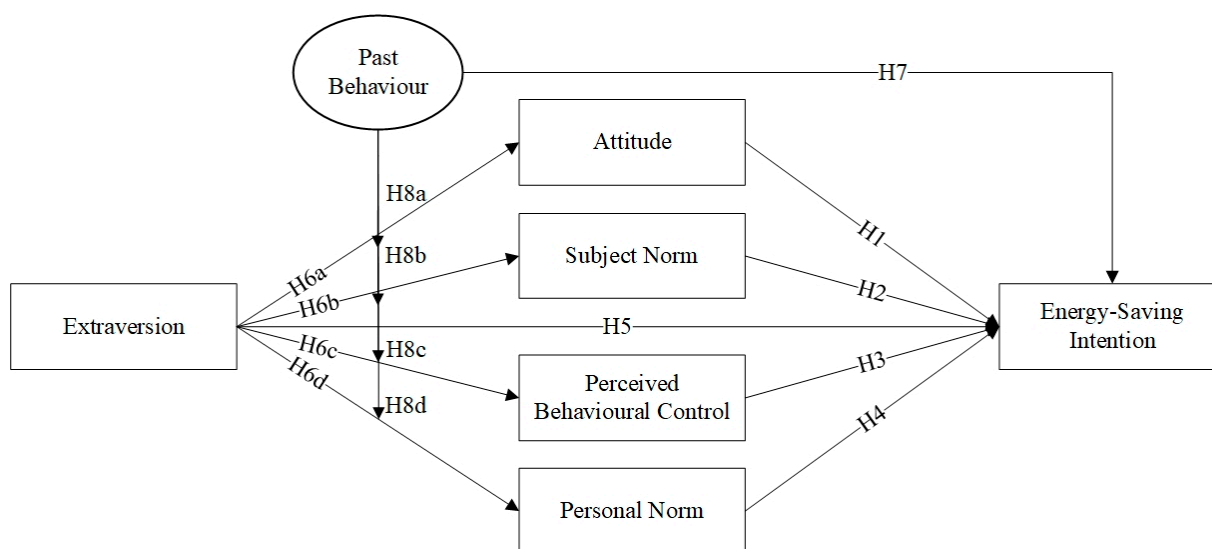
**Figure 1.** Theoretical framework.

## 3. Methodology

### 3.1. Questionnaire Design

The study employed a questionnaire survey method and collected data from hotel guests, which is a widely used method in pro-environmental behaviour studies. The constructs of the questionnaire were developed from the literature review. The questionnaire contained three sections: personality traits, psychological characteristics, and sociodemographic information. Referring to the literature review, the items in the questionnaire included the psychological characteristics of extraversion, attitude, subjective norms, perceived behavioural control, personal norms and energy-conservation intention. In addition, the personal characteristics (e.g., gender, age, education, income) of the respondents are indicated as the potential factors in expounding energy conservation [55], and the information was thus gleaned from the questionnaire survey.

The Likert scale is an effective method to capture the respondents' viewpoints [29]. The study employed a five-point Likert scale measurement for psychological variables (ranging from 1: totally disagree to 5: totally agree). Based on the suggestions and feedback from respondents in the pilot study, the study employed a seven-point Likert scale for personality characteristics (1: totally disagree; 2: disagree; 3: slightly disagree; 4: neutral; 5: slightly agree; 6: agree; 7: strongly agree). There are several PEB studies that use a seven-point Likert scale to measure the personality traits of the respondents, such as Kvasova (2015) [23] and Milfont and Sibley (2012) [40]. The questionnaire started with an introduction session on the research purposes, and privacy protection commitments. The survey presented the explanation of "There is no right or wrong answer and just consider what your thoughts are" to the respondents on each page.

### 3.2. Data Sampling

Before the formal survey, the researchers organised three rounds of the pilot study to validate the design rationality, readability and items of the questionnaire. The attendant of the first-round pilot study provided some suggestions on the sequence of a few items and the clarity of the statements. The researchers accordingly improved the quality of the questionnaire based on the discussion. Some hotel customers were invited to participate in the second- and third-round pilot studies. Their feedback contributed to further slight improvements to the questionnaire.

After the pilot study, the formal questionnaire survey was conducted in Shanghai, one of the representative cities in China. The study received 827 responses from hotel guests and 530 final responses were utilised for analysis after checking the quality of the collected

questionnaire results and eliminating invalid feedback. Table 1 shows the demographic information of the efficient responses from 530 respondents.

**Table 1.** Demographic information of respondents.

| Demographic | | Frequency | Percentage |
|---|---|---|---|
| Gender | Female | 224 | 42.26% |
| | Male | 306 | 57.74% |
| Age | Under 25 | 123 | 23.21% |
| | 26 to 30 | 123 | 23.21% |
| | 31 to 40 | 197 | 37.17% |
| | 41 to 50 | 74 | 13.96% |
| | 51 to 60 | 10 | 1.89% |
| | above 60 | 3 | 0.57% |
| Education Level | Secondary Degree or Below | 4 | 0.75% |
| | High School or Equivalent | 22 | 4.15% |
| | Diploma Degree or Continuing | 71 | 13.40% |
| | Bachelor's Degree or Equivalent | 376 | 70.94% |
| | Master's Degree or Equivalent | 51 | 9.62% |
| | Doctoral Degree or Equivalent | 6 | 1.13% |
| Yearly Income (CNY) | 100,000 and Below | 133 | 25.09% |
| | 100,000 to 150,000 | 167 | 31.51% |
| | 150,000 to 200,000 | 91 | 17.17% |
| | 200,000 to 250,000 | 53 | 10.00% |
| | 250,000 and Above | 40 | 7.55% |
| | Not Applicable | 46 | 8.68% |

Note: CNY is Chinese Yuan (1 US Dollar is approximately equivalent to 6.37 Chinese Yuan).

The demographic result reveals that female respondents account for 42.26% and the proportion of males is 57.74%, thus, the gender ratio basically consists of the local situation. It is worth noting that 31 to 40 years is the largest age group, which occupied 70.94%. The age groups of both under 25 and 26 to 30 are the second largest groups, accounting for 23.21%. The other groups represent a smaller percentage. In addition, most of the respondents obtained a bachelor's degree or had equivalent experience (70.94%). The percentage rate of respondents who received a diploma degree (13.40%) is similar to the group with a master's degree or equivalent (9.62%). Moreover, among the 530 respondents, the majority of people (31.51%) earned 100,000 to 150,000 CNY (equivalent to 15,699 to 23,575 USD) in a year, followed by those who made 100,000 CNY (equivalent to 15,699 USD) and below (25.09%), and 150,000 to 200,000 CNY (equivalent to 23,575 to 31,397 USD) (10.00%). The sociodemographic information characteristics of the respondents in this study are similar to the local characteristics, which proves that the sample is representative to a certain extent.

## 4. Data Analysis

Structural equation modelling (SEM) is a method of establishing, estimating and examining the causality of a model [56]. The method combines the statistical methods of factor analysis and path analysis, which explore the relationship between observed variables and latent variables [56]. Specifically, SEM includes two aspects: the measurement model and the structural model. The study aims to investigate the relationship between variables and explore the interaction effect of extraversion and psychological variables. SmartPLS 3.0 was employed for the SEM analysis in this study. SmartPLS 3.0 is a widely-used Java-based software for variance-based SEM with the partial least squares path method. Several studies use SmartPLS 3.0 in PEB research, such as Liu et al. (2021) [31], Wang, Chang et al. (2021) [13] and Wang et al. (2020) [14].

### 4.1. Model Fit and Variance Inflation Factor

Before assessing the path coefficient, the researchers tested the model fit and variance inflation factor (VIF) in advance. The Standardized Root Mean Square Residual (SRMR) is the absolute goodness-of-fit index, which assesses the model explanation ability [57]. An SRMR value below 0.10 or 0.08 is considered a sufficient model fit [58]. VIF quantifies the severity of multicollinearity in ordinary least squares regression analysis, which is an important criterion to measure the multicollinearity issue between independent variables [56]. The VIF value is suggested to be less than 5 [56]. Table 2 presents the VIF values of the variables.

**Table 2.** Variance inflation factor value.

| Item | VIF | Item | VIF | Item | VIF |
|------|-----|------|-----|------|-----|
| E-1 | 1.717 | ATT-1 | 1.332 | INT-1 | 1.543 |
| E-2 | 1.495 | ATT-2 | 1.349 | INT-2 | 1.593 |
| E-3 | 1.728 | ATT-3 | 1.372 | INT-3 | 1.321 |
| E-4 | 1.430 | PBC-1 | 1.236 | PB-1 | 1.122 |
| | | PBC-2 | 1.086 | PB-2 | 1.097 |
| | | PBC-3 | 1.309 | PB-3 | 1.132 |
| | | SN-1 | 1.420 | PB-4 | 1.090 |
| | | SN-2 | 1.610 | | |
| | | SN-3 | 1.220 | | |
| | | PN-1 | 1.159 | | |
| | | PN-2 | 1.370 | | |
| | | PN-3 | 1.290 | | |

Note: VIF is variance inflation factor value; E is extraversion; ATT is attitude; PBC is perceived behavioural control; SN is subjective norms; PN is personal norms; INT is energy-conservation intention; PB is past behaviour.

The analysis reports that the SRMR of the proposed model is 0.079, which meets the goodness-of-fit requirement. The VIF values of the variables range between 1.086 and 1.717, confirming that there is no significant multicollinearity issue between the variables.

### 4.2. Measurement Model

Table 3 represents the results of the convergent validity tests. The analysis results reveal that the Cronbach's alpha ranges between 0.627 and 0.780, the composite reliability ranges between 0.801 and 0.859, and the AVE ranges between 0.535 and 0.671. All constructs satisfy the criteria of convergent validity.

**Table 3.** Convergent validity testing.

| Construct | Item Number | Factor Loading | Cronbach's Alpha | Composite Reliability | AVE |
|-----------|-------------|----------------|------------------|----------------------|-----|
| Extraversion | 4 | 0.649–0.862 | 0.780 | 0.848 | 0.587 |
| Attitude | 3 | 0.776–0.806 | 0.694 | 0.830 | 0.620 |
| Subjective Norms | 3 | 0.761–0.865 | 0.763 | 0.859 | 0.671 |
| Perceived Behavioural Control | 3 | 0.738–0.835 | 0.739 | 0.840 | 0.637 |
| Personal Norms | 3 | 0.678–0.821 | 0.627 | 0.801 | 0.575 |
| Energy-Conservation Intention | 3 | 0.745–0.848 | 0.733 | 0.849 | 0.652 |
| Past Behaviour | 4 | 0.681–0.778 | 0.639 | 0.821 | 0.535 |

Discriminant validity requires that the observed values should be able to distinguish constructs. The Heterotrait–Monotrait (HTMT) is a ratio to evaluate discriminant validity, whose values should be below 0.9 [59]. Table 4 shows the result of the HTMT of the analysis fulfilling the statistical requirements.

**Table 4.** Heterotrait–Monotrait ratio.

| | Extraversion | Attitude | Subjective Norm | PBC | Personal Norm | Intention | Past Behaviour |
|---|---|---|---|---|---|---|---|
| Extraversion | | | | | | | |
| Attitude | 0.191 | | | | | | |
| Subjective Norms | 0.486 | 0.649 | | | | | |
| PBC | 0.196 | 0.519 | 0.230 | | | | |
| Personal Norms | 0.444 | 0.609 | 0.826 | 0.118 | | | |
| Intention | 0.162 | 0.752 | 0.472 | 0.646 | 0.701 | | |
| Past Behaviour | 0.291 | 0.599 | 0.527 | 0.645 | 0.533 | 0.663 | |

Note: PBC is perceived behavioural control; Intention is energy-conservation intention.

### 4.3. Structural Modelling

Structural modelling is used to examine the significance of the hypotheses by using a bootstrapping technique. The study ran a 5000-bootstrap resampling to test the proposed model to find out the significance of the path coefficients, and Table 5 reveals the analysis result.

**Table 5.** Path coefficient results.

| Hypotheses | Relationship | Path Coefficient | Standard Deviation | T Statistics | *p* Values |
|---|---|---|---|---|---|
| H1 | Attitude → Energy-Conservation Intention | 0.267 | 0.046 | 5.825 | *** |
| H2 | Subjective Norms → Energy-Conservation Intention | 0.028 | 0.053 | 0.528 | 0.598 |
| H3 | PBC → Energy-Conservation Intention | 0.290 | 0.042 | 6.891 | *** |
| H4 | Personal Norms → Energy-Conservation Intention | 0.310 | 0.043 | 7.258 | *** |
| H5 | Extraversion → Energy-Conservation Intention | −0.022 | 0.036 | 0.621 | 0.535 |
| H6a | Extraversion → Attitude | 0.075 | 0.041 | 1.842 | 0.066 |
| H6b | Extraversion → Subjective Norms | 0.322 | 0.038 | 8.559 | *** |
| H6c | Extraversion → PBC | −0.176 | 0.042 | 4.205 | *** |
| H6d | Extraversion → Personal Norms | 0.290 | 0.038 | 7.715 | *** |
| H7 | Past Behaviour → Energy-Conservation Intention | 0.109 | 0.039 | 2.814 | 0.005 ** |

Note: PBC is perceived behavioural control; *** is $p < 0.001$; ** is $p < 0.01$.

Regarding the psychological factors that affect hotel energy-conservation intention, the results show that personal norms ($\beta = 0.310$, $p < 0.001$) are the most important predictor of hotel energy-saving intention. The finding indicates that perceived behavioural control ($\beta = 0.290$, $p < 0.001$) has the second-greatest effect on guests' energy-conservation intention among these variables. Moreover, attitude ($\beta = 0.267$, $p < 0.001$) and past behaviour ($\beta = 0.109$, $p = 0.005$) significantly contribute to the energy-saving intention of hotel customers. Therefore, hypotheses 1, 3, 4 and 7 are supported. However, hypotheses 2 and 5, which proposed the positive influences from extraversion and subjective norms on hotel energy-conservation intention, are not identified. Figure 2 displays the SEM result of the proposed model.

The results show that extraversion plays the most principal key role in hotel guests' subjective norms ($\beta = 0.322$, $p < 0.001$). Extraversion is also significantly positively associated with their personal norms ($\beta = 0.290$, $p < 0.001$). Hence, the result supports hypotheses 6b and 6d. By contrast, the result implies a negative effect of extraversion on perceived behavioural control ($\beta = -0.176$, $p < 0.001$). In addition, the path from extraversion to energy-conservation intention and attitude are nonsignificant, thus failing to provide support for hypotheses 5 and 6a.
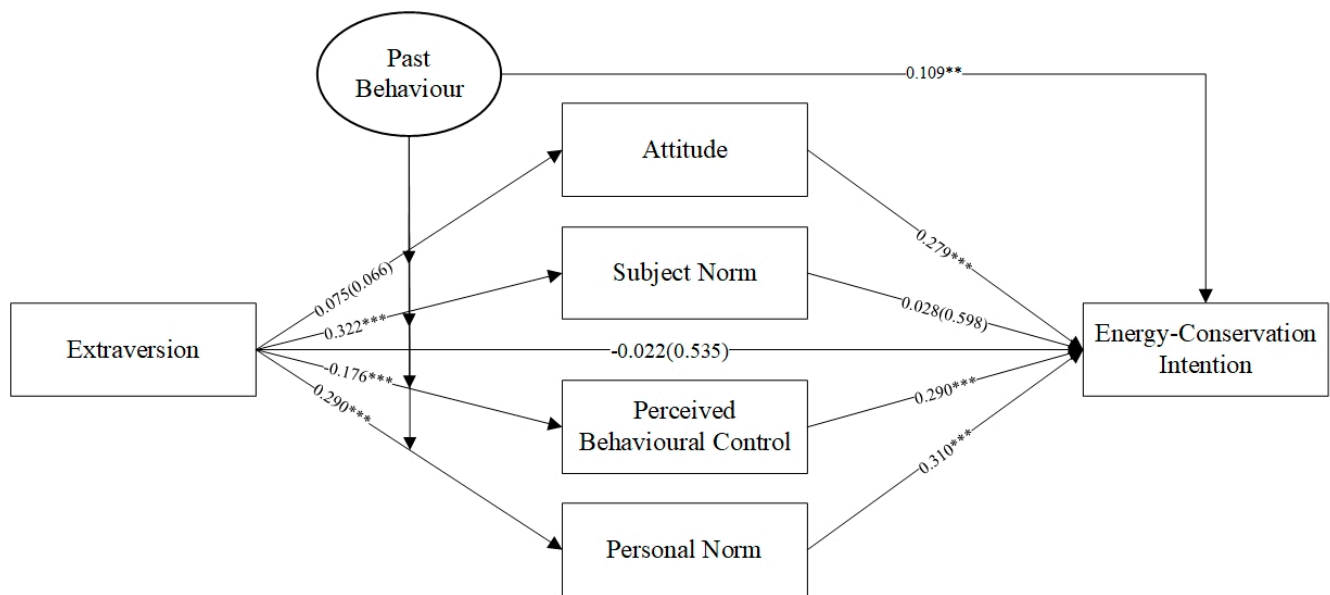
**Figure 2.** Testing result of structural equation model. *** is $p < 0.001$; ** is $p < 0.01$.

*4.4. Moderating Effect of Past Behaviour*

According to hypotheses 8a, 8b, 8c and 8d, past behaviour moderates the effect of extraversion on attitude, perceived behavioural control, subjective norms and personal norms. In order to investigate the moderating effect of past behaviour, the study further tested the simple slopes analysis in SEM. The SEM-estimated result of the moderation effect is listed in Table 6, and the slope analysis result is presented in Figure 3.

**Table 6.** Result of the moderation effect of past behaviour.

| Hypotheses | Relationship | Path Coefficient | Standard Deviation | T Statistics | *p* Values |
|---|---|---|---|---|---|
| H8a | Extraversion × Past Behaviour→Attitude | 0.090 | 0.050 | 1.794 | 0.073 |
| H8b | Extraversion × Past Behaviour→Subjective Norms | 0.090 | 0.010 | 2.173 | 0.030 * |
| H8c | Extraversion × Past Behaviour→PBC | 0.119 | 0.039 | 3.065 | 0.002 ** |
| H8d | Extraversion × Past Behaviour→Personal Norms | 0.087 | 0.044 | 1.981 | 0.048 * |

Note: PBC is perceived behavioural control; ** is $p < 0.01$; * is $p < 0.05$.
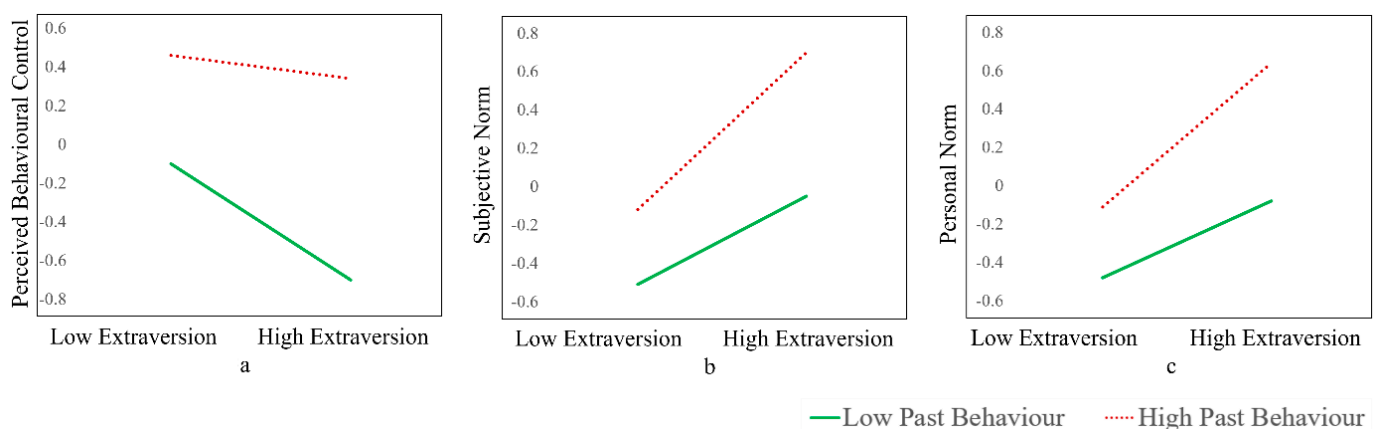


**Figure 3.** Moderating effect of past behaviour. (**a**) Perceived Behavioural Control. (**b**) Subjective Norm. (**c**) Personal Norm.

The results illustrate that the interaction of extraversion × past behaviour is positively correlated to three psychological factors. In the impact path of extraversion on perceived

behavioural control, the coefficient value is the highest ($\beta = 0.290$, $p < 0.001$), revealing that past behaviour is correlated to extraversion on perceived behavioural control positively. The path of extraversion on hotel guests' subjective norms and personal norms are slightly similar. The interaction of extraversion $\times$ past behaviour has the second strongest effect on subjective norms ($\beta = 0.090$, $p = 0.030$). The path coefficient of extraversion $\times$ past behaviour on personal norms is 0.087, with a *p*-value of 0.048. The above results supported hypotheses 8b, 8c and 8d. On the contrary, the result shows there is no significant effect on the path of extraversion on customers' attitude, meaning that past behaviour plays no moderating effect on the path.

Figure 3 displays the plots of the significant interaction between past behaviour and extraversion on perceived behavioural control, subjective norms and personal norms. For instance, Figure 3a illustrates that a high degree of past behaviour improves the impact of extraversion on perceived behavioural control obviously. Similarly, the high level of past behaviour improves the influence of extraversion on both subjective norms and personal norms.

### 4.5. Results Summary

According to the abovementioned measurement modelling, structural equation modelling and moderating analysis, the test results show that H1, H3, H4, H6 (b, c, d), H7 and H8 (b, c, d) are supported, while H2, H5, H6a and H8a are rejected. The results indicate that most of the psychological characteristics (i.e., attitude, subjective norms and PBC) and past behaviour have a significant positive influence on hotel energy-conservation intention. At the same time, hotel guests' extravert personalities positively affect subjective norms, PBC and personal norms. In addition, guests' past behaviour plays an important role in moderating extraversion's effect on energy-saving intention. Table 7 summarises the test results.

**Table 7.** Reflection of the test results.

| Hypotheses | Relationship | Hypotheses Result |
|:---:|:---:|:---:|
| H1 | Attitude → Energy-Conservation Intention | Support |
| H2 | Subjective Norms → Energy-Conservation Intention | Reject |
| H3 | PBC → Energy- Conservation Intention | Support |
| H4 | Personal Norms → Energy-Conservation Intention | Support |
| H5 | Extraversion → Energy-Conservation Intention | Reject |
| H6a | Extraversion → Attitude | Reject |
| H6b | Extraversion → Subjective Norms | Support |
| H6c | Extraversion → PBC | Support |
| H6d | Extraversion → Personal Norms | Support |
| H7 | Past Behaviour → Energy-Conservation Intention | Support |
| H8a | Extraversion × Past Behaviour→Attitude | Reject |
| H8b | Extraversion × Past Behaviour→Subjective Norms | Support |
| H8c | Extraversion × Past Behaviour→PBC | Support |
| H8d | Extraversion × Past Behaviour→Personal Norms | Support |

Note: PBC is perceived behavioural control.

## 5. Discussion

Based on the proposed theoretical framework, we examine the statistical relationship between the psychological factors in the extended TPB and hotel energy-conservation intention. Specifically, the study observes that the direct correlation between subjective norms is insignificant, but highlights the criticality of personal norms in in-hotel energy conservation (i.e., $\beta = 0.310$, $p < 0.001$). This result is in line with previous work on in-hotel PEBs [18,34,60]. Existing hotel practitioners often employ social normative messages as an intervention to encourage the PEBs of hotel guests [52]. However, the finding suggests that internal normative factors (i.e., sense of moral obligation) play more important roles than external pressure in hotel energy conservation. Therefore, personal norm-based interventions would be more effective in promoting hotel energy-conservation behaviours.

For example, persuasive moral norm messages, such as "saving energy is our responsibility" and "energy conservation is important to save the environment", might be a potential intervention in practice.

The research also suggests that hotel guests' intention to save energy increases with stronger attitude toward hotel energy conservation. Therefore, it is important to enhance the guests' subjective evaluation as well as perceived outcomes of the hotel's energy-saving behaviours. For the guests, the perceived outcomes of their energy-saving behaviours are usually in terms of resource or environmental benefits. Therefore, hotel practitioners may consider informing guests of the more figurative or even quantified environmental impacts of hotel energy-saving behaviours. For example, hotel practitioners may inform guests that "saving 10% of energy during the stay is equivalent to protecting a plant" rather than "saving energy is good" in the welcome letters. In addition, hotel practitioners can share the economic benefits of energy-saving behaviours with their guests. For example, the hotel can use the reduced energy budget for public welfare and acknowledge the contribution of their guests. In addition, some studies mention that guests' perception of energy-saving behaviour outcomes can be changed by means of cash incentives [32] or energy-saving options [61].

In addition, this study sheds new light on the psychological process of in-hotel energy-conservation behaviours from the view of extraversion. Some researchers have considered personality traits in hotel PEB studies [24,26] However, there is an apparent lack of research focusing on the role of personality factors in hotel energy-conservation. We find that extraversion exerts a direct and positive influence on subjective norms and moral norms, while it also has a significant, but negative, effect on PBC. Thus, extraverted traits prompt hotel guests to tend to consider the expectations of others and moral factors, while they are more likely to be held back by the convenience of energy-saving behaviours. This finding is different from a previous study on household energy-saving behaviours [13], which reported an insignificant link between extraversion and normative factors. A potential explanation is that the household provides a more private context, and extraversion presents a stronger influence on PEBs in public contexts rather than in private environments [14]. The findings can contribute to more customised energy interventions in hotel operations.

The study also discusses the role of past behaviour in hotel energy-conservation behaviour. We observe a direct and significant correlation between past behaviour and energy-saving intention, which is consistent with the findings of Budovska et al. (2020) [21] and Han and Hyun (2018) [34] on other in-hotel PEBs of guests. In addition, our analysis results reveal the moderating mechanism of extraversion and the psychological drivers of hotel energy-saving intention and demonstrate that past behaviours moderate the linkages between extraversion and subjective norms, personal norms and PBC. The findings suggest that at a similar level of extraversion, guests who perform more energy-saving behaviours at home or in the workplace gain stronger levels of subjective norms, personal norms and PBC. The critical effects of past behaviours emphasise the habitual influence and imply that it is important to boost residents' daily energy-saving actions to promote their hotel energy conservation. In practice, hotel practitioners can employ message interventions to strengthen the link between energy-saving behaviours in the hotel and the household.

In terms of the limitations, first, the survey in this study only focuses on hotel guests in China and, therefore, more future investigations are necessary to generalise the findings to other racial populations, countries and areas. Second, although the widely used five-factor personality scale or the HEXACO scale can explain the personality differences among guests well, they are difficult to apply in the practice of hotel operations. Additionally, in practice, hotel operators and practitioners need to consider the comprehensive impact of different personality traits on hotel PEB, not just extraversion. Therefore, further work would benefit the hospitality industry by revealing the integrated effect of personality traits on hotel PEBs and further simplifying the personality scales (e.g., setting up personality profiles) to develop feasible differential interventions. Third, this study only focuses on the energy-conservation behaviours of hotel guests. Other PEBs for hotel guests, such as water

conservation, food conservation and waste recycling, are also critical to the sustainability of the hospitality industry. Future studies could consider these PEBs more comprehensively and establish more effective interventions.

## 6. Conclusions

This study employs an extended TPB model to reveal the role of extraversion in hotel guests' energy-saving behaviours. The result shows that among all of the hypotheses, 10 are supported while 4 are rejected. According to the analysis results, the study firstly found that attitude, PBC, personal norms and past behaviour have direct positive effects on hotel energy-conservation intention. Second, although extraversion cannot directly affect energy-conservation intention, it can significantly influence two normative factors and PBC. Third, past behaviour moderates extraversion's statistical relationship to normal factors and PBC. Overall, this study found that most of the psychological factors had a positive effect on the guests' energy-saving intention in hotel scenarios, and individuals' extraversion trait had a positive effect on most of the psychological factors. In addition, past behavioural habits positively moderate the relationship between extraversion and some of the psychological factors. Therefore, based on the results of this study, guests' moral sense and trust in their abilities are important factors that affect their willingness to save energy in hotels. Thus, this study advocates that hotels can consider adopting appropriate prompts, such as reminding guests that everyone is responsible for maintaining the living environment to make guests acknowledge the importance of their responsibility. Similarly, in the actual operation process, hotels should consider taking advantage of the characteristics of the extraversion of the guests and adopt specific measures. For instance, it is suggested that hotels express that the participation of the guests will help achieve the goal of sustainable development, thus actively reminding the guests to use the characteristics of friendliness, gregariousness, self-confidence and cheerfulness to participate in the hotel's energy-saving actions. In addition, since past behaviours have a moderating effect on extraversion and psychological factors, communities or other environmental protections, organisations should also actively encourage people to develop energy-saving habits, and integrate energy-saving behaviours into people's daily activities. Thus, people are able to similarly and habitually adopt energy-saving behaviours while staying at the hotel as a customer.

In conclusion, the findings of this study reveal the critical impact of personality traits on in-hotel PEBs. We empirically explain the generation of hotel energy-saving behavioural intentions and the unique roles of psychological factors in this process from the perspective of extraversion. The study provides a psychological explanation for the long-term stable heterogeneity of hotel guests' PEB. Hospitality managers might consider differential interventions to hotel guests with different personality characteristics and provide additional incentives for those who present strong energy-saving potential. However, the behavioural interventions for hotel guests should strictly adhere to ethical requirements. In addition, this study enriches the PEB research literature in hotel and tourism management, providing a theoretical basis for hotel practitioners to develop more effective energy-saving behavioural interventions. The findings of this study contribute to more efficient hotel energy management and operation.

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