Exploring the heterogeneity in drivers of energy-saving behaviours among hotel guests: Insights from the theory of planned behaviour and personality profiles

Qian-Cheng Wang [a], Yi-Tian Ren [b], Xuan Liu [c,*], Rui-Dong Chang [d], Jian Zuo [d]

[a] Department of Land Economy, University of Cambridge, Cambridge CB3 9EP, United Kingdom
[b] Department of Planning and Environmental Management, The University of Manchester, Manchester M13 9PL, United Kingdom
[c] Department of the Built Environment, Eindhoven University of Technology, Eindhoven 5600MB, the Netherlands
[d] School of Architecture & Built Environment, University of Adelaide, Adelaide, Australia

A R T I C L E   I N F O

A B S T R A C T

Guest behaviour is important in driving hotel energy consumption, operating cost and environmental issues. Promoting energy-saving behaviours of guests is a promising strategy for the sustainable development of the hospitality industry. This research aims to explore the roles of personality profiles in individual heterogeneity in drivers of energy-saving behaviours among hotel guests. The study is based on a three-step research roadmap: First, we review existing literature on hotel energy-saving behaviour and intervention and construct an extended theory of planned behaviour model to explore the relationship between personality and energy-saving behaviours. Second, the research conducts a survey to identify the critical factors in the model and sets up four personality profiles for the respondents and compares the effects of critical factors upon respondents' energy-saving behaviours among different personality profile groups. Third, the study further conducts a follow-up survey on the subjective promoters and barriers of hotel energy-saving behaviours, where a descriptive analysis is employed to validate the findings. The findings reveal that personality profiles lead to varying effects of all critical factors in influencing the energy-saving behaviours of hotel guests. The research empirically demonstrates the important roles of personality profiles and household habits in shaping the energy behaviours of hotel guests and provides a novel view of understanding the heterogeneity of energy-saving behaviours in the hospitality industry. The study contributes to environmental behavioural theory by adding normative indicators and habit factors. Also, the study classifies the respondents into groups according to personality characteristics and demonstrates the significant role of personality. The research applies a follow-up study that can provide factual evidence to support the result of previous hypothetical testing. The findings provide valuable references to the development of tailored smart energy intervention measurements and management tools for hotel buildings.

1. Introduction

The interaction between the hospitality and tourism industry and climate change has gained wide discussions in the research community. On the one hand, the hospitality sector is an important resource for consumers. The hospitality and tourism industry generated 10.4% of global GDP before the COVID-19 pandemic (World Travel and Tourism Council, 2021), while each hotel stays directly consumes 272 MJ of energy and 350 L of water and emits 13.8 kg of CO_2 emissions on average (Gössling and Peeters, 2015). On the other hand, environmental issues have posed critical challenges upon the development of

hospitality sector. In particular, global climate change can reshape the existing tourism resources: for example, the environmental decline can reduce tourist attraction (Amelung and Nicholls, 2014), the frequent occurrence of extreme weather can lead to a recession in the tourism market (Bigano et al., 2005), and the rising energy prices further push up hotel operation costs.

The research community and hospitality industry have noticed the threat of climate change and the urgent need to respond to unfolding environmental challenges (Han, 2021; Scott and Gössling, 2021). The industry has formulated various strategies to transform the current hotel operation model into more environmentally friendly and resource-

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neutral ones. For example, some policymakers have put efforts to promote passive designs and energy-efficient techniques in hotels (Ayoub et al., 2014). Besides, some researchers noted that reducing non-essential services can be another strategy to reduce resources and energy consumption (Wells et al., 2016; Schien et al., 2021; Zhao and Zhou, 2021). However, the monetary and time investment for energy efficiency retrofits and the reduced service quality could be an extra burden for practitioners, especially in developing countries where the hospitality industry is under fast-growing (López-Bernabé et al., 2021).

Several studies argued that the environmentally irresponsible behaviour of guests is the root cause of excessive consumption and pollution in the hospitality industry (Bohdanowicz, 2006; Budovska et al., 2020; Han, 2021; Wang et al., 2021b). Promoting pro-environmental behaviours (PEBs) of guests is another promising strategy for sustainable hotels (Budovska et al., 2020; Han et al., 2020; Tiefenbeck et al., 2019). Behaviour-driven conservation methods are usually low-cost and fast-acting (Wang et al., 2021b; Xu et al., 2021a, 2021b), and present feasibility in the hospitality sector (Budovska et al., 2020; Cvelbar et al., 2017; Goldstein et al., 2008; Mair and Bergin-Seers, 2010). Therefore, it is important to understand the psychological mechanisms and critical factors that drive hotel guests' energy-saving behaviour (Hevar and Aslihan, 2023). In discussions on PEB, the theory of planned behaviour (TPB) has been the most widely used theoretical framework (Budovska et al., 2020; Han et al., 2018; Han and Yoon, 2015; Paul et al., 2016). In the hospitality field, Budovska et al. (2020) adopted TPB to explain the towel reuse behaviours of hotel guests and predict the effects of different intervention strategies. Also, some studies employed extended TPB to investigate the drivers of water-saving (Gabarda-Mallorquí et al., 2021; Han et al., 2020) and food waste reducing and recycling (Salama and Abdelsalam, 2021) in hotels.

Many empirical PEB studies observe significant individual heterogeneity: For example, a PEB intervention may present significantly different effects across individuals (F. Chen et al., 2018; DellaValle and Zubaryeva, 2019; Scheibehenne et al., 2016). These heterogeneities are partly attributed to the individual differences in the perception of psychological drivers due to their differences in demographic factors (Han et al., 2011), cultural background (Choi et al., 2009) and values (Chen et al., 2018). Personality traits are the long-term stable patterns in cognition, thinking and feeling among people (Goldberg, 1993) and have been long recognised as a potential cause of the observed heterogeneity (Cao and Chen, 2021; Markowitz et al., 2012; Poškus and Žukauskienė, 2017). For instance, Wang et al. (2021a) reported the direct correlations between personality traits and all three TPB factors towards household energy-saving behaviour. Also, Cao and Chen (2021) noted a unique interaction between personality characteristics and subjective norms towards air pollution mitigation behaviour. However, these studies only focused on the effect of single personal traits but might overlook interactions between personality dimensions. Considering the complexity of personality, understanding the combined effects of intertwined personality traits is critical for PEB interventions, especially in the hospitality practice.

Given the important role hospitality industry plays in contributing to the goal of carbon neutrality and the imminent energy issues (Chen, 2021; Scott and Gössling, 2021), it is necessary to explore the combined effects of personality traits in the individual heterogeneity of energy-saving behaviours in the hotel context. This research, therefore, attempts to generate three major contributions in the area. First, identifying the critical roles of psychological and habitual driving factors in energy-saving behaviours of hotel guests. Second, setting up personality profiles for hotel guests. Third, exploring the individual behavioural heterogeneity of hotel guests with personality profiles. Understanding the inherent driving forces and personality mechanism of energy-saving behavioural heterogeneity among guests can contribute to hotel energy intervention setting and policymaking, and consequently, boosting the sustainable development of the hospitality and tourism industry.

The rest of this paper is structured as follows: Section 2 summarises the current behaviour-driven energy conservation strategies in hotels and develops the hypotheses based on literature review. Section 3 introduces the measures, data collection and analysis methods. Section 4 then illustrates the analysis results. Section 5 discusses the results and implications and then addresses the limitations, followed by the conclusion in Section 6.

2. Establishment of hypothesis and theoretical model

This section aims to establish hypotheses and a theoretical model as the building block to explore the relationship between personality profiles and pro-environmental behaviours in the hospitality industry.

2.1. Behaviour-driven conservation in hotels

In the household and community context, residents have internalised several pro-environmental habits, such as turning off unnecessary lighting, eco-friendly A/C temperature settings, and responsible usage of waster heaters (Miao and Wei, 2013; Wang et al., 2021b). Yet, people often show significant differences between their PEB performance at home and in hotels (Budovska et al., 2020; Miao and Wei, 2013; Ram et al., 2014). The irresponsible energy consumption of hotel guests has created a huge environmental burden (Dolnicar et al., 2017; Nisa et al., 2017). Therefore, it is necessary for the hospitality industry to develop energy management strategies to reduce energy and resource waste driven by guest behaviour.

There are some reported practices to reduce behaviour-driven energy waste in the guest room with in-room electricity control systems (Ali et al., 2008; Chan et al., 2017; Lammi and Tesfaye, 2021). These control systems include smart key-cards and room occupancy sensors, which allow the electrical system to only power the occupied guest room (Chan et al., 2017; Nicholls and Kang, 2012). Chan et al. (2017) reported that these technologies could reduce 20–40% of guest room electricity consumption. However, it also found significant guests complained that these tools reduced the room comfort. For example, occupancy sensors usually fail to detect quiet guests and thus mistakenly cut power to their rooms. As a result, many hoteliers concerned that these technologies might reduce guest satisfaction with the hotel, and in turn damage the core business environment (Buckley, 2012; Chan et al., 2017; Nikolaou et al., 2012). Also, for hotels that are already in operation, updating electrical systems and installing compliant equipment may also result in reduced revenue (Nikolaou et al., 2012).

Another widely-used strategy is promoting PEB of hotel guests by behavioural interventions (M. K. M. Chan et al., 2022; Chang, 2016; Dolnicar et al., 2017; Goldstein et al., 2008; Huang et al., 2014; Mair and Bergin-Seers, 2010). The PEB interventions can be divided into two categories: (1) information-based interventions, and (2) benefit-driven incentives. The information-based methods present guests with specific information (usually by messages and notes) and promote PEBs by stimulating their pro-environmental intention. The typical information-based interventions include environmental appeals (Baca-Motes et al., 2013; Dolnicar et al., 2017), pro-environmental reminders and tips, normative messages (Mair and Bergin-Seers, 2010), and nudges (Chang, 2016). Saving money and personal interests are usually considered core drivers of PEBs (Juvan and Dolnicar, 2014). The benefit-driven incentives provide monetary benefits to encourage guests to conduct PEBs. Typical benefit-driven incentives include discounts, rewards and vouchers (Chan et al., 2022), donations (Shang et al., 2010; Warren et al., 2017), and energy-saving options (Xu et al., 2023). For example, commitments to donate the resultant savings can significantly boost PEBs of guests (Warren et al., 2017). However, empirical studies often observe diametrically opposite results for similar intervention strategies. For example, while Chan et al. (2022) found the monetary incentive approach is the most powerful intervention, Huang et al. (2014) reported the same intervention has no effect on PEBs of guests. Also, Dolnicar et al. (2017) employed pro-environmental appeals as an

intervention but observed an insignificant result, where Baca-Motes et al. (2013) observed an opposite effect. These observed heterogeneities have created uncertainty in the implementation of the intervention.

2.2. Theory of planned behaviour

The theory of planned behaviour (TPB) is one of the most widely used psychological models in PEB research. This model assumes that *intention* plays the role of the key predictor of behaviour (Ajzen, 1991). TPB consists of three psychological factors driving behavioural intention, namely, *attitude, subjective norms,* and *perceived behavioural control.* Specifically, *Attitude* reflects the disposition of an individual's psychological disposition to a specific behaviour. *Subjective norms* refer to the perceived external pressure exerted from the expectation of others/society. *Perceived behavioural control* (PBC) is an individual's perceived ability and confidence to perform a certain behaviour. In addition to exerting influence upon *intention*, PBC may also have direct effect on behaviour. Some empirical evidence has shown a positive correlation between these three factors and intention towards PEBs in hotels (Chen, 2016; Han et al., 2010; Han and Yoon, 2015; Shin et al., 2018). For example, Chen (2016) and Han et al. (2010) reported the significant positive contribution of these three factors to green hotel visiting intention. Also, Shin et al. (2018) reported similar findings on organic food orders in hotels. However, some other studies present opposite results: no significant correlation is found between subjective norms and green hotel consumption intention (Yeh et al., 2021).

Building upon TPB and previous studies in the field, this study proposes the following hypotheses upon the relationship between hotel guests' attitude, subjective norm, PBC, intention and their energy-saving behaviours:

H1. Attitude exerts a significant positive influence on hotel energy-saving intention.

H2. Subjective norms exert a significant positive influence on hotel energy-saving intention.

H3. PBC exerts a significant positive influence on hotel energy-saving intention.

H4. PBC exerts a significant positive influence on hotel energy-saving behaviours.

H5. Intention exerts a significant positive influence on hotel energy-saving behaviours.

2.3. Internal normative driver

Moral norms, also called "personal norms" (Han and Hyun, 2018; Liu et al., 2021), is another potential normative driver of PEBs. Different from subjective norms, moral norms reflect personal internal standards on a specific behaviour/action rather than external rules and pressure (Kallgren et al., 2000). Several studies have pointed out the direct contribution of moral norms to pro-environmental intentions, such as household greywater treatment and resource-saving (Ateş, 2020; Davis et al., 2018; Liu et al., 2021; Wang et al., 2021a). Rooted in the hospitality and tourism sectors, previous studies have also explored moral norms' role in shaping guests pro-environmental intention (Han and Hyun, 2018; Shin et al., 2018). For example, moral norm is found to be one of the determinants of hotel guests' intention to choose organic food (Shin et al., 2018) and save water (Han and Hyun, 2018; Liu et al., 2021). These previous studies provide heuristic evidence to further explore moral norms' critical roles in other PEBs of hospitality industry, such as hotel guests' energy-saving intention.

Given the above evidence, the following hypothesis is established:

H6. Moral norms exert a significant positive influence on hotel energy-saving intention.

2.4. Habitual factor

In addition to the aforementioned factors, habit is another possible impetus for PEBs (Han and Hyun, 2018; Untaru et al., 2016). Many studies indicated that people's frequent behaviours in daily life are important drivers of their pro-environmental intentions, decisions, and behaviours (Han and Hyun, 2018; Wang et al., 2021a). These research works demonstrate that PEB is not only shaped by attitude and PBC but also reflects the inertia of past and frequent behaviours.

Previous researchers have discussed the relationship between people's consumption and conservation behaviours in hotel and daily scenarios (Dharmesti et al., 2020; Miao and Wei, 2013; Untaru et al., 2016; F. Xu et al., 2020). Though significant gaps between PEBs in hotels and at home have been reported (Baker et al., 2014; Miao and Wei, 2013), empirical studies found that household sustainable decisions and behaviours are important predictors of hotel PEBs (Dharmesti et al., 2020; Dimara et al., 2017; Han and Hyun, 2018; Untaru et al., 2016). For example, Untaru et al. (2016), Han et al. (2010) and Dharmesti et al. (2020) demonstrate the direct effect of household habits on hotel water-saving behaviours, waste recycling, and towel reuse.

Given the initial evidence reported by existing literature, following hypotheses are developed to investigate the relationship between household habitual factors and PEB in hospitality:

H7. Household habits exert a positive influence on hotel energy-saving intention.

H8. Household habits exert a positive influence on hotel energy-saving behaviours.

In combining previous established hypotheses, the theoretical model of this study is summarised as shown in Fig. 1.

2.5. Personality traits

The term *personality traits* refers to long-term stable sets of psychological characteristics that uniquely influence people's patterns in cognition, feelings and decision-making (Goldberg, 1993). The Big Five Personality Model is well-accepted in academia and underlies contemporary personality-based theories (Lynn, 2021). The model identifies five traits: openness, conscientiousness, extraversion, agreeable, neuroticism (Goldberg, 1993). Over the past decade, by employing Big Five Personality Model, academia has investigated the roles of personality traits in several typical PEBs (Liu et al., 2021; Poškus and Žukauskienė, 2017; Wang et al., 2021b).

Particularly, rooted in the context of hospitality industry, previous studies have carried out several empirical explorations with the construct-centred approach (Kvasova, 2015; Tang and Lam, 2017). The approach treats different personality dimensions as separate constructs and focuses on how personality traits work separately (Lan et al., 2021; Poškus and Žukauskienė, 2017). Tang and Lam (2017), for example, reported the critical roles of agreeableness and extraversion in green hotel visiting intention of Gen-Y customers. Kvasova (2015) found positive correlations between four personality traits and sustainable tourism behaviours in Cyprus. These studies have advanced the frontier of the PEB research, while their method presented inherent limitations: these methods overwhelmingly only focus on the separate correlation between each trait and behaviour but oversimplify the interactions and synergies between different dimensions of personality traits (Lan et al., 2021; McLarnon et al., 2015). Given the complex synergies of multiple personality dimensions, solely understanding the role of each single dimension can hardly contribute to behaviour prediction and intervention development in an accurate way (Poškus and Žukauskienė, 2017).

Following this line of research, some studies have turned to the people-centred approach to examine the personality profile composition of people and discuss how these personality profiles affect people's behavioural/decision-making patterns (Lan et al., 2021; Liu et al., 2021;
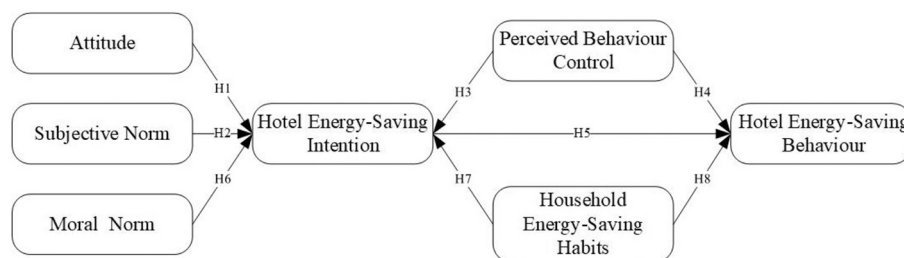
Fig. 1. The theoretical framework.

Poškus and Žukauskienė, 2017). This method attempts to cluster people into typical personality profiles covering the five dimensions and explores the effects of the unobserved heterogeneity between different personality profile groups. For instance, Liu et al. (2021) reported different energy-saving behavioural patterns among residents with different personality characteristics. Also, Poškus and Žukauskienė (2017) found that one psychological factor might generate different effects on the recycling intention and behaviours of adolescents with different personality profiles. These findings provide novel views of the PEB heterogeneity among individuals and contribute to accurate PEB promotion in practice. However, the research community has yet widely adopted the person-centred approach in hospitality-related PEB studies.

3. Materials and methods

3.1. Measures

This study conducts a two-round questionnaire survey, which has the advantage of being more focused and tailored to reveal the characteristics of target population. The empirical evidence will be drawn from Chinese hotel guests to explore the roles of personality profiles in energy-saving behavioural heterogeneity in China, a typical fast-growing context of hospitality industry.

The first-round data survey consists of four sections. The first section records the respondent's self-reported energy-saving behaviours when staying at home and in hotels respectively. Following the advice from industry practitioners, the questionnaire covers four typical made-ups of household energy-saving habits and hotel energy-saving behaviours: (1) sustainable lighting use, (2) sustainable air conditioning setting, (3) sustainable appliance use, and (4) persuading others to save energy. The second section focuses on the seven psychological variables in the research model adapted from previous studies (Han et al., 2019; Han and Yoon, 2015; Wang et al., 2021a). Both the first and the second sections employ a five-point Likert scale, ranging from 1 (fully disagree) to 5 (fully agree) (questionnaire details are shown in Appendix A(a)). The third and fourth sections collect demographic information and the personality of respondents. The third section employs a 20-item Chinese version Mini-International Personality Item Pool (IPIP) Scale with a seven-point Likert scale. The level of agreement with the description is ranked from 1 (absolutely disagree) to 7 (absolutely agree). Sufficient empirical research has evidenced the acceptability, convergent and discriminant validity, as well as cross-cultural applicability of the IPIP Scales in delineating people's personalities (Donnellan et al., 2006; Laverdière et al., 2020). Lastly, the socio-demographic section invites the respondents to fill in their purposes, budgets, and frequency of the last hotel visits.

The second-round survey focuses on the effects of critical drivers upon hotel energy-saving behaviour. The design of this questionnaire is based on the analysis results of the first-round survey. In this survey, respondents are invited to self-evaluate (1) whether the listed factors influence their hotel energy-saving behaviours, and (2) if so, how strongly these factors influence, the strength of influence is measured via five-point Likert scale, ranging from 1 "very slight" to 5 "very strong".

The second-round questionnaire is detailed in Appendix A(b).

In addition, the two-round pilot study is conducted before finalising the questionnaire design and sending out for wider distribution. The first-round pilot study invited 15 selected expert participants, and the second invited 55 hotel guests as pilot respondents. In line with the feedback from these two-round pilot studies, the authors further revised the wording and order of some constructs to improve the language suitability for Chinese respondents.

3.2. Data collection

By using the designed questionnaires, this study conducted a two-round internet-based survey in mainland China. The internet-based survey has been found an effective data collection approach and has been widely used in behaviour studies (Han et al., 2010). In the first-round survey, the study employs a local online market research platform to send survey invitations to randomly selected hotel customers in China. It is reported that customers of service products can well-recall their service experience in six months (Keaveney, 1995). Therefore, the survey only accepted respondents who have visited hotels no less than once within the six months before the dates that they took the survey. The qualified and consented participants were sent a link to the questionnaire. In the first-round data collection, the study received 1535 responses. The researchers checked the received data and according to the answer to trapping questions, unreasonable consecutive replies, and thus recognised 1193 responses as valid. The second-round data collection is a follow-up survey and all valid respondents in the first-round data collection were invited. The researchers consequently received 879 responses and reviewed the feedback. After checking the completion of the survey and excluding some missing data, the study confirmed a total of 848 valid data.

Table 1 presents the demographic characteristics of both the final pool of 1193 respondents in the round-one survey and 848 respondents in the follow-up survey. It can be seen from the table that in the first-round survey, gender is almost equally distributed with females (55.66%) slightly outnumbering males (44.17%). Meanwhile, most respondents hold a bachelor's degree or above, and 31.27% of participants reported a 50 K to 100 K CNY annual income. More than half (55.57%) of respondents reported that their frequency of staying in a hotel is every few months, which is consistent with some previous research (Yadav and Roychoudhury, 2019). The majority of the respondents (28.67%) lived in a comfortable hotel, and the budget hotel (26.82%) was the next largest. To sum up, the respondents' demographic information generally matches statistical data and previous research. The demographic characteristics in the second-round survey are overall consistent with the first round.

3.3. Data analysis

The data analysis process of this study is divided into three steps. The first step is to analyse the collected data in the first-round survey to determine the validity of the theoretical framework and the variables contained in the framework, and the relationship between the variables.

Table 1
Respondent profiles.

Item		First Round		Second Round	
		Frequency	Percentage	Frequency	Percentage
Gender	Male	527	44.17	366	43.16
	Female	664	55.66	480	56.60
	Uncertain	2	0.17	32	3.77
Age	≤ 25	439	36.8	284	33.49
	26 to 30	363	30.43	260	30.66
	31 to 40	291	24.39	204	24.06
	41 to 50	82	6.87	56	6.60
	51 to 60	15	1.26	11	1.30
	> 60	3	0.25	3	0.35
Education	Secondary or Below	19	1.59	15	1.77
	High School or Equivalent	78	6.54	57	6.72
	College Diploma or Equivalent	265	22.21	184	21.70
	Bachelor's Degree or Equivalent	743	62.28	526	62.03
	Master's Degree or Equivalent	78	6.54	58	6.84
	Doctoral or Equivalent	10	0.84	8	0.94
Marital Status	Unmarried	565	47.36	402	47.41
	Married without Children	172	14.42	127	14.98
	Married with Children	456	38.22	319	37.62
Income Per Year	50 K to 100 K	373	31.27	261	30.78
	100 K to 150 K	335	28.08	245	28.89
	150 K to 200 K	214	17.94	153	18.04
	200 K to 250 K	115	9.64	79	9.32
	250 K and Above	69	5.78	47	5.54
	Not Applicable	87	7.29	63	7.43
Visiting Frequency	At least once a week	46	3.86	27	3.18
	1–4 times per month	367	30.76	273	32.19
	Once every few months	663	55.57	466	54.95
	At most once a year	117	9.81	82	9.67
Hotel Level (CNY)	Budget (‹200)	320	26.82	227	26.77
	Economy (200–250)	211	17.69	147	17.33
	Comfort (250–350)	342	28.67	252	29.72
	Higher standard (350–500)	238	19.95	167	19.69
	Superior (500–850)	68	5.7	46	5.42
	Luxury (> 850)	14	1.17	9	1.06
Aim	Business and Conference Trip	499	41.82	196	23.11
	Tourism Trip	450	37.72	319	37.62
	Staycation/Family or couple gathering (local)	224	18.78	320	37.74
	Other	20	1.68	13	1.53

Note: 1 Chinese Yuan (CNY) approximately equals 0.1430 US Dollars (USD).

This step uses the measurement modelling method to test reliability and validity, and Structural Equation Modelling (SEM) to measure the statistical relationship between variables.

The second step applies a cluster analysis based on the respondents' personality assessments. This study first determines the appropriate number of clusters for data samples and employs K-means clustering approach with Euclidean distance and Ward's linkage to classify and specify the respondents, and one-way ANOVA to test the differences of variables between different clusters. The clustering process follows previous studies (Poškus, 2020; Poškus and Žukauskienè, 2017; Sircova et al., 2015). The research then applies SEM for each cluster, so that the standardized path coefficients and significance of the model for each group can be obtained. SmartPLS 3.0 and SPSS 27 are employed for SEM analysis and cluster analysis respectively.

The third step employs a follow-up survey to validate the effects of critical factors found in step one by using descriptive statistical analysis, which has been widely used in behaviour, psychology, environmental and public health research. The examination of indicators and effects should suppose based on relevant measurements to ensure an accurate understanding of concepts (Boiral and Paillé, 2012). Also, the intervention effectiveness in household energy-saving and the explanation of mental health assessment mechanism will be validated by using the method (Bakken et al., 2017; Xu et al., 2021a, 2021b).

4. Empirical results

4.1. Identifying the critical factor

This section aims to identify critical psychological drivers of hotel energy-saving behaviours in two stages: (1) measurement modelling and (2) structural modelling. The first is to evaluate the reliability and validity of the construct, and the second is to assess the model fit and test the hypothesis's result.

4.1.1. Measurement modelling

This study employs the Partial least squares (PLS) algorithm to perform measurement modelling to evaluate the convergent validity (CV) and discriminant validity (DV) of the model. CV aims to assess the correlation between different items in the same category. Four indexes are employed for CV assessment: *Cronbach's Alpha, Composite Reliability (CR), Average Variance Extracted* (AVE), and *Factor Loading*. Cronbach's Alpha and CR test the internal consistency reliability of the index, which with a larger value reflects a higher reliability level. Cronbach's Alpha over 0.5 and CR over 0.7 are considered acceptable standards (Hair et al., 2011). Factor Loading reflects the relationship between the items and the corresponding construct, and the threshold value should be greater than 0.5 (Hair et al., 2011). AVE represents the interpretation of the latent variables by the observed variables and should be greater than 0.5. DV aims to evaluate whether items from different constructs can be distinguished. *Fornell-Larcker Criteria* is a widely accepted method to test DV efficiency. According to Fornell-Larcker (1981), a DV can be

confirmed if the average extraction variation is greater than the correlation coefficient between other constructs.

Table 2 illustrates the results of the CV assessment, which shows all Cronbach's Alpha values of constructs above 0.642 and CR greater than 0.7. The AVE values are shown between 0.525 and 0.638. The factor loading of each item ranges from 0.681 to 0.828. Therefore, the measurement model has sufficient convergent validity. The Fornell-Larcker Criteria result in Table 3 further demonstrates that the model has sufficient DV.

4.1.2. Structural modelling

Different to covariance-based SEM (CBSEM), PLS does not provide various statistical measures for the model validation, such as χ^2 and other model fit measurements (Henseler and Sarstedt, 2013; Wan et al., 2017). Referring to Tenenhaus et al. (2005), "The GoF represents an operational solution to this problem as it may be meant as an index for validating". Thus, the study adopts a goodness of fit index (GoF) to measure the performance of the proposed model. The cutoff value of 0.1, 0.25, 0.36 is considered as small, medium, and large goodness of fit, respectively (Mital et al., 2018). The GoF calculation method (Mital et al., 2018; Tenenhaus et al., 2005) is provided as follow:

$$\text{Goodness of Fit} = \sqrt{AVE_{avg} \times R^2_{avg}}$$

In addition, the study measures the model fit by employing the Standardized Root Mean Square Residual (SRMR) to determine the difference between observed correlations. SRMR <0.08 signifies a sufficient model fit (Hu and Bentler, 1998). The GoF value of the proposed model is 0.540, which means that the proposed model has a large GoF index. The SRMR value of the proposed model is 0.077, suggesting an acceptable model fit.

The research also evaluated the multicollinearity issue and coefficient of determination of the proposed model. The study adopts the variance inflation factor (VIF) to measure the degree of multicollinearity, whose cut-off line is 5 (Hair et al., 2011). R-squared value (R^2) has usually been used to measure the variance of the dependent

Table 2
Convergent-validity results, overall analysis.

Variables	Item	Factor Loading	Alpha	CR	AVE
Attitude	ATT-1	0.777	0.642	0.807	0.582
	ATT-2	0.756			
	ATT-3	0.757			
Subjective Norms	SN-1	0.821	0.722	0.841	0.639
	SN-2	0.828			
	SN-3	0.746			
Perceived Behaviour Control	PBC-1	0.764	0.673	0.820	0.603
	PBC-2	0.790			
	PBC-3	0.776			
Moral Norms	MN-1	0.785	0.702	0.833	0.625
	MN-2	0.822			
	MN-3	0.764			
Hotel Energy-Saving Intention	HI-1	0.765	0.715	0.841	0.638
	HI-2	0.841			
	HI-3	0.788			
Hotel Energy-Saving Behaviour	HB-1	0.744	0.710	0.821	0.534
	HB-2	0.792			
	HB-3	0.702			
	HB-4	0.681			
Household Energy-Saving habits	FB-1	0.772	0.698	0.815	0.525
	FB-2	0.713			
	FB-3	0.712			
	FB-4	0.698			

Table 3
Fornell-Larcker criteria.

Variables	ATT	SN	PBC	MN	HI	HB	FB
ATT	0.763						
SN	0.482	0.799					
PBC	0.499	0.413	0.777				
MN	0.430	0.545	0.331	0.791			
HI	0.593	0.462	0.600	0.372	0.799		
HB	0.560	0.409	0.558	0.261	0.630	0.724	
FB	0.557	0.499	0.477	0.400	0.564	0.620	0.731

Note: 1. ATT: Attitude; 2. SN: Subjective Norms; 3. PBC: Perceived Behaviour Control; 4. MN: Moral Norms; 5. HI: Hotel Energy-Saving Intention; 6. HB: Hotel Energy-Saving Behaviour; 7. FB: Household Energy-Saving habits.

variable that can be explained by independent variables. In the research domain of consumer behaviour studies, a value of 0.20 and above is regarded as a good explanation ability (Hair et al., 2011). Table 4 reflects the result of the VIF and R^2 in this study. It can be seen that the VIF value of the hypothesises are between 1.519 and 1.946, and the $R^2_{Behaviour}$ and $R^2_{intention}$ are 0.440 and 0.545 respectively. All values satisfied the requirement.

A subsequent step is the evaluation of the structural model to test the hypotheses result of the established model. The study runs 5000 bootstrapping of 1193 samples to evaluate the model. Table 4 and Fig. 2 present the result of the hypothesis and the result of the overall model. Note: (1) ATT: attitude, SN: subjective norms, PBC: perceived behavioural control, MN: moral norms, HI: hotel energy-saving intention, HB: hotel energy-saving behaviour, FB: household energy-saving habits. (2) ***: p < 0.001, ***: p < 0.01, *: p < 0.05.

The overall structural modelling results present that all psychological factors are closely related to energy-saving intentions of hotel guests. Household energy-saving habits show the strongest driving force of hotel energy-saving intention ($\beta = 0.308$, $p < 0.001$) and behaviour ($\beta = 0.409$, $p < 0.001$). Subjective norms ($\beta = 0.087$, $p < 0.01$) and moral norms ($\beta = 0.063$, $p < 0.05$) perform a small but positive effect on the intention of hotel energy conservation intention. At the same time, household energy-saving habits, hotel energy-saving intention and PBC all help to better predict respondents' hotel energy-saving behaviour. In sum, the eight hypotheses of the proposed model are tenable.

4.2. Personality profile development and analysis

4.2.1. Cluster analysis

To further explore the heterogeneity in energy-saving behaviours among hotel guests, this study clusters the respondents into different groups according to their personality profiles delineated by the big five personality model. K-means clustering approach is adopted and the squared Euclidean distance and Ward's linkage analysis suggest that the respondents should be clustered into four groups. Then, the research uses one-way ANOVA to validate for differences in variables between

Table 4
Overall structural modelling analysis results.

Hypothesis	Relationship	Beta	P-value	Support?	VIF	R^2
H1	ATT -> HI	0.221	***	√	1.793	HI:
H2	SN- > HI	0.087	0.005**	√	1.683	0.440
H3	PBC -> HI	0.261	***	√	1.627	
H4	PBC- > HB	0.101	0.001*	√	1.519	
H5	HI -> HB	0.246	***	√	1.754	
H6	MN -> HI	0.063	0.015*	√	1.946	HB:
H7	FB -> HI	0.308	***	√	1.706	0.545
H8	FB -> HB	0.409	***	√	1.810	

Note: (1) ATT: attitude, SN: subjective norms, PBC: perceived behavioural control, MN: moral norms, HI: hotel energy-saving intention, HB: hotel energy-saving behaviour, FB: household energy-saving habits. (2) ***: p < 0.001, ***: p < 0.01, *: p < 0.05.
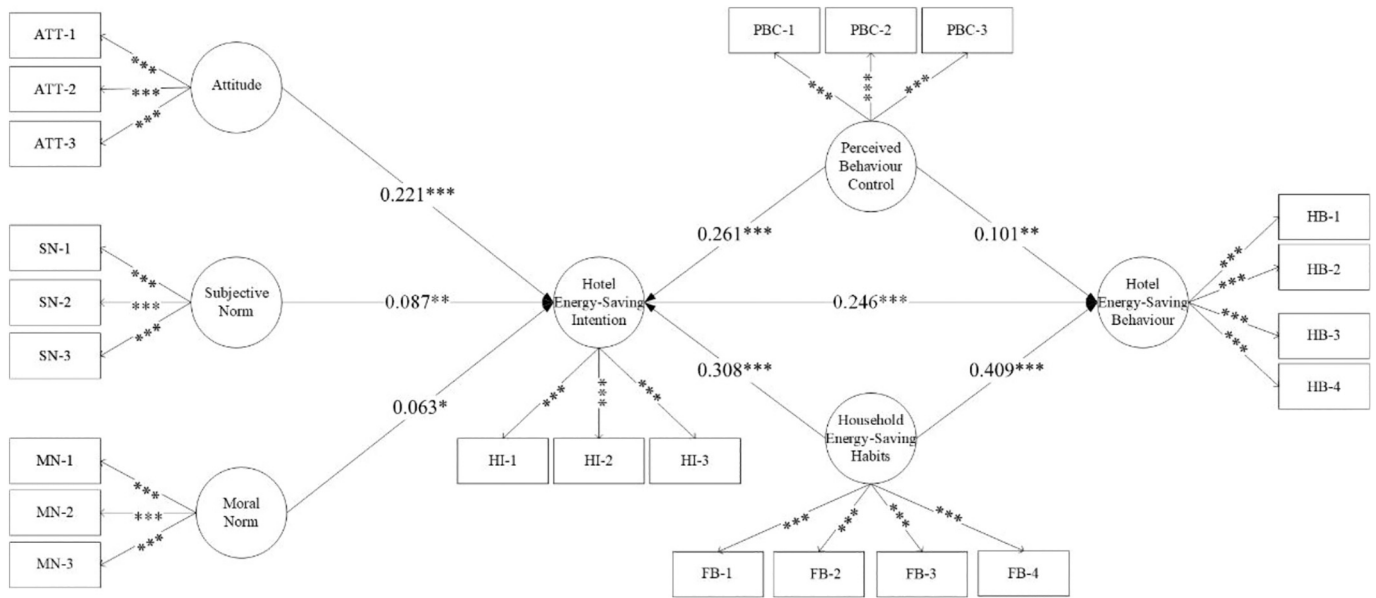
Fig. 2. The overall structural modelling result.

the four groups, where the results show significant differences ($p < 0.001$) among all variables of the four clusters. Fig. 3 illustrates the personality characteristics of the four groups. The data of personality represent the average value of respondents who were categorised into a group.

Group I (Positive) perform the highest scores on most personality items but the lowest score on Neuroticism (2.29) among all respondents. Group II (Introverted) manifests below-average scores in Extraversion (3.56), Agreeableness (4.02), and Conscientiousness (4.44). The introverted guests present above-average levels of Neuroticism (4.06) and Openness (4.32). Group III (Sensitive) is above average in all items. Among them, the score of Neuroticism (4.64) is significantly higher than the average (3.86), which is also the highest among the four groups. Group IV (Conservative) has lower scores than others in most items, while their scores on Neuroticism (4.06) are higher than the average. It is worth noting that the conservative group presents the lowest score on

Openness (3.13) among all the groups.

4.2.2. Structural modelling analysis by group

Following the clustering of respondents' personality profiles, this section conducts structural modelling to explore the distinguishing feature of interrelationship between personality characteristics and energy-saving behavioural patterns among the four groups. Table 5 summarises the SEM and hypothesis test results of each group.

The structural modelling results of the positive group (Group 1) show that attitude, PBCs, moral norms, and household habits are statistically associated with hotel energy-saving behaviours. The habitual factor presents the strongest influence ($\beta = 0.412$, $p < 0.001$) on hotel energy-saving intention among other factors. Besides, the habitual factor and moral norms ($\beta = 0.219$, $p < 0.01$) present the strongest effect on intention in the positive group among all guests, while the contribution of subjective norms seems insignificant. Additionally, household habit is
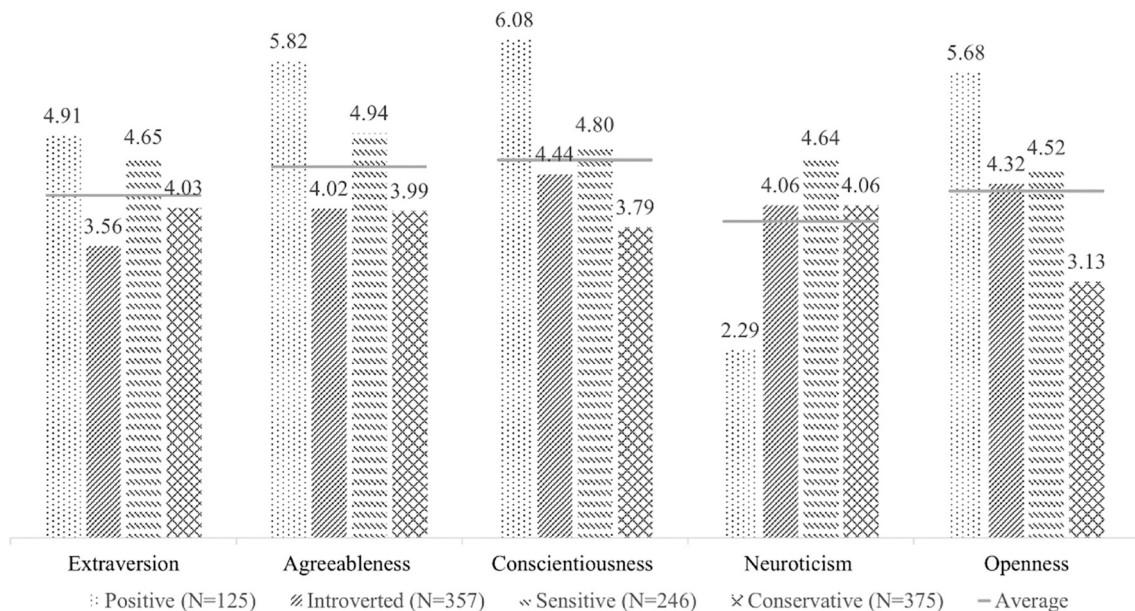

Fig. 3. Big five personality characteristics of four groups.

Table 5
The hypothesis test result of four groups.

Cluster		Hypothesis							
		H1	H2	H3	H4	H5	H6	H7	H8
Group 1 (Positive)	Beta	0.212	−0.065	0.214	0.072	0.037	0.219	0.412	0.476
	P-value	0.001**	0.398	***	0.423	0.677	0.004**	***	***
Group 2 (Introverted)	Beta	0.190	0.057	0.303	−0.008	0.251	0.018	0.334	0.512
	P-value	0.001**	0.290	***	0.862	***	0.670	***	***
Group 3 (Sensitive)	Beta	0.385	0.016	0.183	0.163	0.225	0.159	0.245	0.327
	P-value	***	0.824	0.003**	0.036*	0.004**	0.012*	***	***
Group 4 (Conservative)	Beta	0.182	0.133	0.293	0.229	0.248	0.075	0.271	0.310
	P-value	0.002**	0.007**	***	***	***	0.104	***	***

Note: ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.005$.

the only factor ($\beta = 0.476$, $p < 0.001$) that was observed strong significant positive correlation to hotel energy-saving behaviour of guests.

The Group II (Introverted) result shows that household habit ($\beta = 0.334$, $p < 0.001$) is the most reliable in predicting the intention of introverted customers to save energy in hotels. Besides, introverted respondents display the greatest degree of influence of PBC ($\beta = 0.303$, $p < 0.001$) on their hotel energy-saving intention among the four groups, followed by the conservative group (Group IV). However, there is no significant observed correlation between normative factors (subjective and moral norms) and hotel energy-saving intention in this group. Furthermore, the influence of household energy-saving habits ($\beta = 0.512$, $p < 0.001$) presents the strongest effect on hotel energy-saving behaviour among all four groups, the effect of household habit is even stronger than that of behavioural intention ($\beta = 0.251$, $p < 0.001$). Besides, the results show that the direct correlation between PBC and energy-saving behaviour is not significant in Group II.

Results from Group III (Sensitive) reveal that the attitude of sensitive people played the most crucial role ($\beta = 0.385$, $p < 0.001$) in influencing hotel energy-efficient intention across all respondents. Their household energy-saving habits ($\beta = 0.245$, $p < 0.001$) had the second-greatest positive effect on hotel energy-saving intention. Although moral norms ($\beta = 0.159$, $p < 0.05$) have a slightly positive effect, subjective norms are not a significant cause affecting hotel energy-economize intention. For the effect on hotel energy-saving behaviour, household energy-saving habits ($\beta = 0.327$, $p < 0.001$) has the strongest predictive capacity, followed by hotel energy-saving intention ($\beta = 0.225$, $p < 0.01$) and PBC ($\beta = 0.163$, $p < 0.05$)

The Conservative group turns out that the influence of PBC ($\beta = 0.293$, $p < 0.001$) and household energy-saving habits ($\beta = 0.271$, $p < 0.001$) on the hotel energy-saving intention are greater than other factors. In addition, this group is the only group whose relationship between subjective norms ($\beta = 0.133$, $p < 0.01$) and hotel energy-saving intention are significantly positive whereas the moral norm presents no significant effect. Moreover, the effects of household energy-saving habits on hotel energy-saving behaviour ($\beta = 0.310$, $p < 0.001$) is the highest. And hotel energy-preserving intention ($\beta = 0.248$, $p < 0.001$) and PBC ($\beta = 0.229$, $p < 0.001$) are the second and third important factors influencing energy-conservative behaviour in hotels.

4.3. Follow-up survey and validation

Based on the influencing factors identified among the four groups, this study conducts a follow-up survey to validate the findings in the first and second steps of the analysis. In this round of research, the study employs SPSS 27 to test the reliability of the recovered questionnaire data. The Cronbach's alpha value is 0.803, implying high confidence in internal consistency and reliability. Adopting The researchers listed seven factors: (1) personal interests and comforts (attitude), (2) environmental impacts (attitude), (3) pressure from others/society (subjective norms), (4) convenience of the behaviours (PBC), (5) required skills/knowledge (PBC), (6) moral obligations (moral norms), and (7) at-home behavioural habit (habitual factor). Table 6 presents the

descriptive statistical analysis results of the follow-up survey.

The follow-up survey collected 848 valid responses, covering 149 positive, 258 introverted, 180 sensitive and 261 conservative in terms of personality profile. The distribution of people in each group is close the step two. The descriptive analysis result roughly matches the findings in the first two steps. Generally, factors related to attitude, PBC and habitual factor shows a stronger influence than the normative factors. Besides, the results also well-reflect the heterogeneity observed in step two. For example, conservative guests grade the highest subjective norms (3.10), and the positive group scores the highest moral norms (4.07) among all respondents. Noteworthily, when it comes to attitude, similar results are observed in all four clusters that respondents pay more attention to the environmental impact of their energy-saving behaviour (79.95%, 3.37) rather than their personal benefits and comfort (63.68%, 3.12). However, the four groups present different feedback to two items related to PBC: the positive (95.89%, 3.43) and the sensitive groups (86.11%, 3.35) tend to be influenced by the perceived knowledge/ability, while the other two groups pay more attention to the convenience of the energy-saving behaviours.

5. Discussion

5.1. Theoretical implications

This research tested the original TPB and the proposed model in explaining hotel customers' energy-saving behaviours. The analysis suggests that both the original TPB model and the proposed model can well predict energy-saving intentions and behaviours of hotel guests. However, the proposed model presents a better explanatory power than that of the original TPB model. In the proposed model, all eight hypotheses are supported, and the predictive constructs are validated as determinants of hotel energy-saving intention and behaviours. Especially, attitude, PBC, and household habitual factors presented stronger effects among all drivers. The novel model could offer psychological explanation for hotel energy-saving behaviours and contribute to the development of psychological theory in future.

Besides, this research empirically evidences the important effects of personality characteristics on the roles of influencing factors of hotel guests' energy consumption. Specifically, this study develops four personality profiles to better delineate the respondents and understand their energy consumption behaviours. Based on the proposed framework, the research reveals and compares the critical drivers of hotel energy-saving behaviours for each group in the second and third analysis step, where significant variances of driving effects are found among the groups. These findings provide a personality view of the long-debated heterogeneity of behavioural interventions in different cases: psychological factors might have different effects among people with different personality profiles. For example, the energy-saving intentions of introverted guests tend to be more sensitive to their PBCs rather than moral obligations and external pressure. While the observed heterogeneity is similar to previous research on household energy-saving behaviours (Liu et al., 2021) and recycling behaviours of adolescents

Table 6
Descriptive analysis result of second-round survey.

Critical Factors	Items	Positive (N = 149)		Introverted (N = 258)		Sensitive (N = 180)		Conservative (N = 261)		Overall (N = 848)	
		Percentage	Influence Value	Percentage	Influence Value	Percentage	Influence Value	Percentage	Influence Value	Percentage	Influence Value
Attitude	Personal Interests and Comforts	77.40%	3.27	57.85%	2.90	65.00%	3.20	61.69%	3.15	63.68%	3.12
	Environmental Impacts	97.26%	3.88	74.71%	3.25	86.11%	3.17	70.50%	3.27	79.95%	3.37
Subjective Norms	Pressure from Others/Society	64.38%	3.00	51.72%	2.73	52.22%	2.67	69.73%	3.10	52.36%	2.73
Perceived Behavioural Control	Convenience	89.04%	3.72	77.78%	3.05	77.22%	3.43	69.73%	3.48	76.89%	3.38
	Required Skills/Knowledge	95.89%	3.43	72.03%	2.92	86.11%	3.35	64.75%	3.47	77.24%	3.25
Moral Norms	Moral Obligations	84.93%	4.07	67.82%	3.40	78.89%	3.13	67.43%	3.35	73.23%	3.47
Habitual Factor	At-home Behavioural Habit	95.21%	3.75	72.80%	3.15	82.22%	3.13	68.97%	3.05	77.95%	3.25

(Poškus and Žukauskienė, 2017), the follow-up survey goes one step further to explore the views of different guest groups. For instance, although PBC plays critical roles in all four groups, the positive and the sensitive guests tend to consider personal ability/knowledge more, while the other two groups are more likely to be influenced by the perceived convenience. The findings shed new lights on the individual heterogeneity in energy-saving behaviours and energy intervention effectiveness in hospitality industry from the personality perspective.

Both the two normative factors (subjective norms and moral norms) only present small but still important effects on hotel energy-saving intentions. The facts suggest that social and moral pressure is not the most important psychological driver of hotel energy-saving behaviours. The findings are in line with a few previous studies (Miao and Wei, 2013; Yeh et al., 2021). Previous works often attribute the results to general cultural environment and limited public environmental awareness (Yeh et al., 2021), which suggests that norm-based interventions (e.g., social norms feedback) might be less effective in hotel energy-saving behavioural promotion in general. This study, however, provides another view from the perspective of personality profile: moral norm has stronger effect on the positive guests than others, while subjective norms are only critical for the conservative guests. Especially, moral norms only have significant correlation in the positive group and the sensitive group. The guests in these two groups present above-average agreeableness, consciousness, and openness, which directly contribute to empathy and lead to consideration for social and environmental benefits (Markowitz et al., 2012). Thus, more customized normative interventions for positive and sensitive customers can be an effective energy-saving solution.

The analysis results emphasize the important role of household habits in predicting hotel energy-saving intentions and behaviours. Several studies have observed the significant behavioural inconsistency between hotel and household PEBs and discussed their different psychological mechanisms (e.g., Baker et al., 2014; Miao and Wei, 2013). This study, however, evidences that household habits are still important predictors of energy-saving behaviours in hotel settings. Especially, the habitual factors show a significantly stronger effect on the introverted group (Group II) that holds a lower extraversion level than others. The introverted guests tend to present higher self-centredness levels (Romero et al., 2003), and thus, be less influenced by external factors than their original lifestyles. From the habitual perspective, the finding also offers a plausible explanation for the attitude-behaviour gap in hotel PEBs: only a few guests take pro-environmental actions, even most of them are well aware of the importance (Baker et al., 2014; Miao and Wei, 2013). The findings suggest that habitual factors have an equally important contribution to hotel energy-saving behaviour as other psychological factors. Therefore, in addition to well-designed energy interventions, it is also important to encourage sustainable lifestyles and develop pro-environmental habits among the people to promote the cross-contextual PEB spillover.

5.2. Managerial and practical implications

Some managerial implications can also be drawn from the research findings of this study. First, the finding can provide hospitality practitioners with some novel views on energy-saving interventions for hotel guests. A few interventions, such as energy-saving tips and brochures, are emerging recently in the hospitality sector to promote guests' energy-saving behaviours (Tiefenbeck et al., 2019). Yet, observations often found significant differences in the effectiveness of these behavioural interventions. This study argues that guests with different personality profiles have both similarities and differences in their psychological mechanisms driving hotel energy-saving behaviours. Thus, interventions would have different effects on different guests. While it is difficult to obtain the individual personality data of each guest, employing tailored intervention according to the guest personality profile structure can be a potential solution to reduce the cost of hotel operations and improve the sustainability performance of the

hospitality industry. For example, the analysis suggests that moral feedbacks are more effective for positive and sensitive guests, and interventions that lower the behavioural controls (e.g., energy-saving tips) are more likely to promote the energy-saving behaviours of both positive and introverted guests. Besides, as the positive hotel guests present stronger concerns about environmental interests, the hotel would consider employing the donation to environmentally friendly charity as an incentive for them. In particular, large hotel chains can obtain guest personality profiles through big data or quick personality tests, while small-scale hotels might benefit from adopting more widely-accepted interventions. However, when applying tailored intervention strategies, hoteliers must obtain the consent of the guests and strictly adhere to privacy regulations.

Given the observed cross-context behavioural spillovers between household and hotel settings, this research highlights the critical role that habitual factors play in energy-saving behaviours. Therefore, in addition to monetary incentives and normative tips, cultivating energy-efficient behavioural habits can be another effective promotion of guests' energy-saving behaviours. It is suggested that hospitality practitioners should engage with their target customers and promote this beneficial spillover. For example, they can involve environmental protection schemes and energy-saving campaigns partnering with local communities and schools. This investment can not only promote the hotel brand and improve the corporate image but also help develop long-term energy-saving habits of potential customers.

This study also contributes to smart building energy management in the hospitality industry. Previous studies have developed activity-based building energy models to capture the impacts of occupants' behavioural changes (e.g., flexible working patterns) and personality compositions rather than only considering building service efficiency (Stoppel and Leite, 2014; Zhang et al., 2018). These models have been applied in residential and official sectors, while the investigation in hospitality sector is still insufficient. The findings of this study provide a valuable reference for activity-based energy modelling and research in hotel buildings. These activity-based models would help hospitality practitioners predict more precisely the hotel energy demands under different scenarios, such as energy effects of declining occupancy rates during COVID-19 lockdowns and different energy interventions. These would further drive the decision-making efficiency in hotel management and the sustainability of hotel operations.

5.3. Limitations and future research agenda

There are four limitations to this research. First, this research employs self-reported data on energy-saving behaviours in household and hotel settings. Therefore, the data might be influenced by the social desirability bias: the perceived social desirability of respondents may produce a statistical gap between their self-reported information and real-world situations (Krumpal, 2013). The survey emphasized that there were no correct or incorrect answers on any page of the questionnaire to reduce the adverse effects of social desirability. Future studies may benefit from the employment of smart meters or sensors to collect real-time energy-consumption data.

Second, during the data collection process, several surveyed Chinese cities experienced COVID-19 pandemic lockdowns. The pandemic and local lockdowns not only influence hotel operation strategies but also change guest composition and behavioural patterns. For example, some respondents might visit hotels for quarantine purposes and their behavioural patterns might be rather different from the normal hotel visiting. Thus, more investigations would be required amid the post-pandemic era and further studies would benefit from identifying the impacts of pandemic on the hospitality sector.

Third, there is a gap between the sample distribution of guests for different visiting aims in the first and second-round data collection. The reason is that in the second-round survey, some respondents, especially those for business and conference, were unsuccessfully contacted.

In addition, the survey in this study was conducted in mainland China and all respondents were ethnic Chinese. Personality profile characteristics can be different in different locations and cultures (McCrae and Terracciano, 2005), and thus the applicability of the findings in other regions and countries require more investigation.

6. Conclusion

The research proposes an extended TPB model with normative factors and habitual factors to investigate hotel energy-saving behaviours of guests. The study then employs a clustering method to categorise the respondents into four groups to evaluate the proposed model. In addition, the result has been verified in accordance with second-round research. The extended model shows a stronger explanatory power than the conventional one and the analysis suggests that moral obligation and home energy-saving habits have strong contribution to hotel energy-saving behaviours of guests. By clustering the respondents into four groups according to their personality characteristics, the study observes significant variances in the effects of psychological drivers among the groups. The analysis of the follow-up survey validates the findings, which provide empirical evidence in terms of the important role of personality in behavioural heterogeneity among guests. Based on the analysis and discussion, the research suggests the hospitality partitioners to adopt targeted and tailored interventions to encourage energy-saving behaviours of guests and positively engage in community/school energy conservation campaigns to promote cross-contextual spillover of energy-saving behaviour. The researchers call for boarder application of person-centred approach to link personality profiles with PEB research in different cultural contexts.

CRediT authorship contribution statement

Qian-Cheng Wang: Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Yi-Tian Ren:** Methodology, Investigation, Resources, Funding acquisition, Writing – review & editing. **Xuan Liu:** Conceptualization, Methodology, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing. **Rui-Dong Chang:** Resources, Writing – review & editing. **Jian Zuo:** Resources, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. (a) The core questionnaire items

Section	Construct	Code	Item	Reference
I	Household Energy-Saving Habits	HB-1	Often turn off unnecessary lighting and electrical appliances at home	N/A
		HB-2	Often set the temperature of the air conditioner to 26 degrees in summer at home.	
		HB-3	Often turn on the ventilation (appliances) only when needed at home.	
		HB-4	Often persuade or advise others to conserve energy at home.	
I	Hotel Energy-Saving Behaviour	FB-1	Turn off unnecessary lighting and electrical appliances in the hotel.	N/A
		FB-2	Set the air conditioning temperature to 26 degrees when staying in a hotel. in summer.	
		FB-3	Turn on the ventilation (appliances) only when needed in the hotel.	
		FB-4	Persuade or advise others to conserve energy at hotel.	
II	Attitude	ATT-1	I think saving energy during the living period in a hotel is valuable to protect the environment.	(Dharmesti et al., 2020; Han and Yoon, 2015; Palani and Karatas, 2021; Untaru et al., 2016; Wang et al., 2021a)
		ATT-2	I think it is advisable to employ energy-saving behaviours in hotels	
		ATT-3	I think energy-conservation behaviours in hotels contribute to alleviating energy shortages.	
	Subjective Norms	SN-1	I think my family support me to conserving energy in the hotel.	(Han and Hyun, 2018; Han and Yoon, 2015; Palani and Karatas, 2021; Untaru et al., 2016; Wang et al., 2021a)
		SN-2	I think my boss and colleagues support me to conserving energy in the hotel.	
		SN-3	I think that people who are important to me support me to conserving energy in the hotel.	
	Perceived Behaviour Control	PBC-1	It is hard for me to apply energy-saving behaviours in hotels.	(Han and Yoon, 2015; Palani and Karatas, 2021; Wang et al., 2021a; Yeh et al., 2021)
		PBC-2	It is completely decided by me whether to do energy-saving behaviour in the hotel.	
		PBC-3	I am fully capable of engaging in energy-saving behaviour in hotels.	
	Moral Norms	MN-1	What saving energy in hotels means to me is a moral obligation.	(Han and Hwang, 2015; Han and Hyun, 2018; Palani and Karatas, 2021; Wang et al., 2021a)
		MN-2	I would have a guilty conscience if I dallied over the energy-saving implementation in hotels.	
		MN-3	My criterion of morals do not enable me to squander energy when in hotels.	
	Intention	HI-1	I am pleasure to less consume energy in hotels.	(Han et al., 2015; Han and Yoon, 2015; Lan et al., 2021; Untaru et al., 2016; Wang et al., 2021a)
		HI-2	I would like to exert myself to conserve energy in hotels.	
		HI-3	I care to do to follow the energy-saving instruction of the hotels I stay in.	

Appendix B. (b) Validation survey questionnaire items

Factor	Code	Item
Section I: Do you agree that the following items influence your hotel energy-saving behaviours? (Yes/No)		
Attitude	BEN-1	Personal interests and comforts
	ENV-1	Environmental impacts
Subjective Norms	SOP-1	Pressure from others/society
Perceived Behaviour Control	ABL-1	Required skills/knowledge
	COV-1	Convenience of the behaviours
Moral Norms	MOR-1	Moral obligations
Habitual Factors	HAB-1	At-home behavioural habit
Section II: Please self-assess how strongly the factors listed below affect your hotel energy-saving intentions		
Attitude	BEN-1	Personal interests and comforts
	ENV-1	Environmental impacts
Subjective Norms	SOP-1	Pressure from others/society
Perceived Behaviour Control	ABL-1	Required skills/knowledge
	COV-1	Convenience of the behaviours
Moral Norms	MOR-1	Moral obligations
Habitual Factors	HAB-1	At-home behavioural habit

Appendix C. HTMT result

	ATT	SN	PBC	HI	MN	FB	HB
ATT							
SN	0.702						
PBC	0.756	0.575					
HI	0.876	0.603	0.857				
MN	0.636	0.780	0.471	0.520			
FB	0.838	0.579	0.807	0.885	0.378		
HB	0.818	0.685	0.677	0.783	0.579	0.873	

Note: ATT refers to attitude, SN refers to subjective norms, PBC refers to perceived behavioural control, MN refers to moral norms, HI refers to hotel energy-saving intention, HB refers to hotel energy-saving behaviour, FB refers to household energy-saving habits.

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