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Promoting sustainable hospitality: examining the impact of voice assistant recommendations on customer engagement in pre-travel decision-making: moderating effects of use purpose and cultural orientation

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ABSTRACT

Voice assistants (VAs) are increasingly used to offer hospitality recommendations to guests, but few studies have examined their role in promoting sustainable hospitality practices. This study examines the impact of environmental sustainability-related content on user engagement with VAs and the adoption of their recommendations during the “pre-travel” stage. An online scenario-based experiment and a lab-based experiment revealed that incorporating sustainability content into VA recommendations boosts engagement and increases the likelihood of adopting sustainable VA recommendations. The findings also demonstrate the interaction effects of cultural orientations on engagement, depending on whether the purpose of VA use is transactional or non-transactional. This study advances the hospitality marketing and technology management literature by incorporating self-affirmation theory into VA adoption and illustrating how sustainability-focused content from VAs can enhance engagement and shape decision-making. It also provides marketers with insights for promoting sustainable hotel practices and positioning sustainability as a compelling value proposition.

摘要


语音助手(VA)越来越多地用于向客人提供酒店推荐,但很少有研究考察它们在促进可持续酒店实践中的作用。本研究考察了环境可持续性相关内容对用户参与VAs的影响,以及在“旅行前”阶段采纳VAs建议的情况。一项基于在线场景的实验和一项基于实验室的实验表明,将可持续性内容纳入VA建议可以提高参与度,并增加采用可持续VA建议的可能性。研究结果还表明,文化取向对参与度的交互作用取决于VA使用的目的是交易性的还是非交易性的。本研究通过将自我肯定理论纳入VA采用中,并说明VA中以可持续发展为重点的内容如何提高参与度和塑造决策,从而推进了酒店营销和技术管理文献。它还为营销人员提供了促进可持续酒店实践和将可持续性定位为引人注目的价值主张的见解。

KEYWORDS

Voice assistants; hospitality and tourism; environmental sustainability; cultural orientation; purpose of use; engagement

Introduction

As the frequency of global travel continues to increase, the hospitality industry is experiencing both a revival and rapid new growth (Lee et al., 2024). Standing out in the highly

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competitive lodging sector has become a substantial marketing challenge (Hwang et al., 2024). Technological advancements have also significantly impacted hospitality-related businesses, particularly with the growing application of interactive voice-based artificial-intelligence (AI)-embedded devices, commonly known as voice assistants (VAs). The global market for VAs has seen remarkable growth, with a compound annual growth rate of 32% between 2022 and 2023 (Shewale, 2024), highlighting their immense potential in the hospitality industry (Rechberg, 2023).

VAs play a crucial role in assisting travelers and hotel guests with tasks such as hotel searches and providing personalized recommendations based on factors including location, amenities, and price. They enhance convenience for users by facilitating hands-free interactions and enabling quick access to information. Studies have shown that approximately 30% of voice search users in the United States rely on VAs to find relevant information on hotels, reflecting the growing dependence on this technology in travel planning (Murphy, 2022). Additionally, VAs simplify the decision-making process by allowing users to book hotels directly or compare options across multiple platforms, increasing operational efficiency for both guests looking for hotel accommodations and hospitality businesses (Buhalis & Moldavska, 2021). This not only boosts customer satisfaction but also provides hotels with a competitive edge (Loureiro et al., 2021).

Although the application of VAs in the hospitality industry is becoming increasingly widespread, from a marketing perspective, existing research lacks insight into how businesses can leverage VAs to endorse their hospitality services or products (e.g., Li et al., 2023). Previous research on VAs in the hospitality context has predominantly focused on guest experiences with VA during travel, including concerns related to data privacy and security (e.g., Cai et al., 2022; Cao et al., 2022), the perceived value of VA in delivering hospitality services (e.g., Loureiro et al., 2021), the social interactions between VAs and hotel guests (e.g., Fan et al., 2022; Tussyadiah & Miller, 2019), and VA characteristics (e.g., Cai et al., 2022). There thus remains a gap in examining the effectiveness of VA recommendations and promotions in the “pre-travel” stage of the travel journey, especially as it relates to persuading customers to adopt a particular hospitality and tourism product or service (Tussyadiah & Miller, 2019). There is also limited exploration of how VA content should be designed to further encourage potential guests and travelers to accept VA recommendations (e.g., Fan et al., 2022).

At the same time, various AI applications have begun facilitating the growing emphasis on environmentally sustainable practices in the hospitality sector (Liu et al., 2024; Pulido-Fernández et al., 2019). For instance, Goodwings uses AI to help travelers offset their carbon emissions by calculating the environmental impact of their trips, including showing the approximate carbon emissions generated by hotel stays and recommending eco-friendly options. While hotels and other hospitality service providers have adopted environmentally sustainable practices through the support of AI, and guests are becoming increasingly environmentally conscious (Del Gaudio et al., 2024; Liu et al., 2022), there remains a lack of research on how technologies can effectively promote environmentally sustainable practices and use sustainability as a marketing strategy to attract guests (He & Harris, 2020). Drawing on self-affirmation theory, which posits that individuals seek to enhance their self-worth by engaging in activities aligned with societal values, this study proposes that hospitality companies can potentially increase guests’ intentions to adopt VA-

recommended products or services by designing VA recommendations to highlight and promote the environmental sustainability of their offerings.

Additionally, previous research on marketing and advertisements emphasizing environmental protection practices has primarily focused on consumer attitudes or purchase intentions (e.g., Liu et al., 2019). The present study acknowledges that user engagement with technology plays a crucial role in the adoption and consumption of products or services promoted through such technology (Zhu et al., 2023) and therefore requires further evaluation. User engagement involves fostering interaction and participation with an object and reflects the psychological connection and interactive behavioral involvement experienced by individuals (So et al., 2014). This study expands on how increasing user engagement with VAs may enhance guests' intentions to follow their environmentally sustainable recommendations.

Furthermore, existing studies suggest that individuals' interactions with technology are influenced not only by their relationship with the engagement object (the technology) but also by their individual characteristics (Acikgoz et al., 2023). In the context of VA environmental sustainability messages, the level of engagement can be further enhanced if these messages are tailored to align with guests' personal characteristics and specific usage contexts. Existing research has overlooked the joint influence of VA users' backgrounds and consumption motivations on their engagement with VAs (e.g., Jiménez-Barreto et al. 2023), refer to the literature review in Table 1. This study posits that cultural orientation and use purpose could significantly shape how potential guests engage with environmental sustainability information of hospitality providers conveyed by VAs. Guests with an independent cultural orientation tend to prioritize personal goals, while those with an interdependent orientation emphasize group affiliation and collective values (Lalwani & Shavitt, 2009). The use purpose of the potential guests regarding VAs also affects their interaction and engagement. When VA recommendations align with user needs and values, engagement should increase. This study examines how transactional uses focused on specific goals and non-transactional uses assessing recommendation alignment may impact user engagement with VAs.

It is worth noting that different information search platforms have distinct features and functionalities, and users use them on different occasions depending on their preferences and needs. A single hospitality company also rarely relies on only one platform to promote its product information. Therefore, the purpose of this study is not to compare the differences or pros and cons between VAs and other information search platforms or approaches. Instead, it focuses on the premise that an increasing number of VA users are turning to VAs to assist with their searches. As a result, VAs that emphasize environmentally sustainable recommendations may enhance user engagement with considerations of a user's cultural orientation and search purpose, and, in turn, increase the effectiveness of VA recommendations. By addressing the research gap and within the scope of VA-recommended search results, this study aims to examine (1) whether potential guests who use VA for hospitality service searches will be more engaged with VAs and more willing to adopt VA recommendations when they communicate the environmental sustainability of a hospitality and tourism product or service and (2) how the cultural orientation and VA-facilitated use purpose may jointly affect VA engagement of potential guests.

Understanding these dynamics offers valuable insights for leveraging VA technology to promote environmentally sustainable practices in the hospitality sector. The findings contribute to the hospitality and marketing literature by extending self-affirmation theory to

Table 1. Summary of the previous VA literature in the context of hospitality and tourism.

Authors	Stage of the travel journey	Theoretical foundation	Main findings	Effects on VA engagement	Individual differences
Tussyadiah and Miller (2019)	During-travel	Watching-eyes effect	A VA with social feedback can more effectively enhance pro-environmental behavior intentions among guests than a VA without social feedback.	✓	
Loureiro et al. (2021)	During-travel	Social exchange theory	Perceived values of VA strongly affect tourists' relationship quality with a VA. Tourists' self-esteem and technology expertise can strengthen the effect.		✓
Buhalis and Moldavska (2021)	During-travel	N/A	The use of VAs is becoming more important for both hotels and guests. VAs help hotels improve their customer services from the operational perspective and reduce costs.	✓	
Lv et al. (2022)	Post-travel	N/A	The cuteness of VAs can enhance tourists' tolerance level toward service failure. This effect is mediated by both tenderness and performance expectancy. However, cuteness would not help in the case of a severe service failure or when the perceived time pressure is high.	✓	
Cao et al. (2022)	During-travel	Social cognitive theory	Self-efficacy, perceived functional value, perceived emotional value, and perceived privacy risk can significantly affect guests' adoption of a VA in an Airbnb. Perceived values also mediate the relationship between self-efficacy and VA adoption.		✓
Cai et al. (2022)	During-travel	Technology Acceptance Model	When the VA is branded, hotel guests experience a higher level of perceived usefulness, perceived ease of use, and anthropomorphism. The construal level of guests positively moderates the relationship between a branded VA and perceived ease of use and anthropomorphism. Anthropomorphism leads to positive word-of-mouth. The grade of the hotel positively affects the relationship between a branded VA and perceived usefulness. However, anxiety and privacy concerns negatively affect guests' VA adoption.		✓
Fan et al. (2022)	During-travel	Automated social presence theory	The use of a VA results in lower satisfaction and behavioral intentions than the use of a touch panel due to a lower level of perceived control. This effect is strengthened when guests have a higher independent self-construal tendency.		✓
Jiménez-Barreto et al. (2023)	Pre-travel	Assemblage theory	Based on the interaction-centric approach, the use of VAs tends to be different in the planning stage for tourists. In this stage, tourists focus more on informational goals and "how-to" information, while they also consider social consensus and "what-to" enjoy when not using a VA. Tourists also tend to adopt an analytical thinking style when using a VA for travel planning.		✓
This Research	Pre-travel	User engagement theory explained by self-affirmation theory	(1) Examine whether consumers (potential hotel guests) will be more engaged with a VA when it communicates the environmental sustainability of a product or service. (2) Investigate how the cultural orientation and VA use purpose of consumers (guests) may jointly affect how consumers engage with the VA.	✓	

the design of VA content that advocates for environmental protection among hotels, thereby enhancing knowledge on customizing VA applications for marketing within the hospitality industry. Practically, it provides guidance for hospitality practitioners on market segmentation strategies and technology management, emphasizing that effective communication to guests of the environmental sustainability of products or services can be significantly enhanced through the strategic use of VAs.

Literature review

Voice assistant studies

VAs are software agents that recognize human conversations and respond through computer-generated voices (Flavián et al., 2020). They help consumers perform various tasks, including the retrieval of product or service information (Fan et al., 2022). VAs can shape consumers' purchase journeys, from filtering product search results to making purchase decisions.

Previous research on VAs, albeit in the fledgling stage, has focused on the effect of human-like attributes in VAs on consumer – VA interaction, such as the effect of male or female voices and tone of expression (Poushneh, 2021; Schweitzer et al., 2019). It has also looked at VAs' warmth in interaction and competence to handle tasks (Guha et al., 2023) as well as the factors that attract consumers to adopt VA, such as the offering information on discounts (Lee and Pounders, 2019; McLean & Osei-Frimpong, 2019). Due to its practical applications, research on VAs has extended beyond the fields of marketing and information systems, gaining traction in the hospitality and tourism sector. For example, VAs are increasingly used to facilitate 24/7 contactless interactions between guests and hotels, enhancing service efficiency and guest experience (Cao et al., 2022). Table 1 provides a summary of previous research on VAs in the hospitality and tourism sector, highlighting the positioning of this study within the existing body of literature.

In examining travel-related uses of VAs in the hospitality and tourism industry, most previous studies have focused on the “during-travel” stage. The use of VAs during hotel stays has helped reduce operational costs by substituting labor for routine and repetitive inquiries, such as in-room service requests (Buhalis et al., 2019; Chi et al., 2020). Some of this research has also explored how hotel guests perceive and interact with VAs in their rooms. For instance, the perceived functional value of VAs has been identified as a key factor influencing both adoption intention and positive word-of-mouth (Cai et al., 2022; Cao et al., 2022). Additionally, certain studies have examined VA characteristics; an anthropomorphized VA has been shown to positively affect an individual's VA adoption intentions (Cai et al., 2022). Research by Tussyadiah and Miller (2019) underscores that VAs have the potential to promote pro-environmental behaviors among hotel guests through an automated social presence in hotel rooms. VA characteristics have also been investigated in the “post-travel” stage, particularly in service recovery scenarios. Lv et al. (2022) found that cuteness can improve guests' service tolerance to VAs. However, concerns about data privacy persist among some guests, hindering their VA adoption (Cai et al., 2022; Cao et al., 2022).

The present study argues that it is equally important to explore the use of VAs in the “pre-travel” or “planning” stage, as many travelers use VAs to gather hospitality and travel-

related information of various kinds (Al-Saad et al., 2019). Jiménez-Barreto et al. (2023) have examined VA use in the pre-travel stage and suggest that travelers tend to focus on information seeking when using VAs during planning. Jeong and Shin (2019) also highlight that one of the unique features of smart technologies in tourism, including VAs, is their ability to provide trustworthy, reliable, and credible information to assist travelers in decision-making. The information provided by VAs can be key in making pre-travel decisions, such as selecting and booking hotels (Acikgoz et al., 2023; Buhalis et al., 2019). However, there has been limited research on how to effectively communicate VA-provided information during the pre-travel stage, even as potential guests increasingly rely on VAs to gather information for more informed decision-making.

Environmentally sustainable VA recommendations

As environmental sustainability and protection receive increased attention, individuals expect more from companies and engage more frequently with ones that intend to adopt environmentally sustainable practices (Musgrave, 2011; Poushneh, 2021). This is particularly evident in the hospitality industry, where hotels and home-sharing services are implementing environmentally sustainable strategies (Gürlek & Koseoglu, 2021), such as water and energy conservation, eco-friendly purchasing policies, and emissions and waste reduction, to preserve the natural environment (Han et al., 2011). These environmental protection initiatives have become an important decision-making criterion used by potential guests when selecting accommodation during a trip (Liu et al., 2019). As travelers, in general, increasingly rely on VAs to access useful travel information during trip planning (Jiménez-Barreto et al. 2023), VAs can serve as a helpful tool for conveying the environmental sustainability practices of hospitality service providers. This facilitates the establishment of a human – AI connection, which in turn enhances the likelihood that potential guests will adopt VA recommendations of a hospitality service provider (Buhalis et al., 2019; Jiménez-Barreto et al. 2023). On this basis, further research is required to explore how VAs can be effectively used to communicate environmental sustainability messages in the hospitality sector, with the goal of increasing guest engagement with VAs.

User engagement

User engagement has garnered significant attention in the fields of information systems, marketing, hospitality and tourism. Engagement is widely recognized as a means to foster individual participation and enhance adoption intentions through experience, interaction, and connection between the individual and the object – in this case, the VA (Bitrián et al., 2021; Hollebeek et al., 2014; Xie-Carson et al., 2023). Studies in technology management (e.g., So et al., 2014) emphasize that individuals tend to disregard or resist advice from unfamiliar technologies. Instead, they immerse themselves in interactive experiences with familiar technology, engaging in ways that ultimately lead to the adoption of outputs and recommendations (Qiu et al., 2023). Furthermore, the interactive and connective aspects of engagement reveal that engagement is closely tied to an individual's motivation to participate and become involved with the object.

Previous research in hospitality and tourism has predominately focused on the conceptualization and measurement of engagement (e.g., So et al., 2014), challenges to engagement

(e.g., Chathoth et al., 2014), and the antecedents and outcomes of engagement (e.g., Touni et al., 2019). More recent studies have used engagement in a more specific context to investigate how travelers interact with the latest technologies, such as through social media posts by virtual influencers (Xie-Carson et al., 2023). While the use of new technologies to obtain information and compare various hospitality services is increasing among guests, user engagement between guests and VA in the pre-travel stage remains overlooked. Information systems research highlights that consumer – VA interaction strongly depends on the degree of user engagement with a VA (Loureiro et al., 2021; Moriuchi, 2019). Accordingly, VA user engagement in the pre-travel stage is likely to influence potential guests' selection of environmentally sustainable hotels recommended by the VA.

Self-affirmation theory

Self-affirmation theory explains why guests are more likely to engage with VAs when they provide environmentally sustainable messages in hotel recommendations. The theory, developed from the concept of self-defense, outlines the process by which individuals strive to maintain and protect their self-esteem and signal their self-worth when their self-concept and self-worth are threatened (Trudel et al., 2019). According to this theory, individuals are motivated to safeguard their self-concept and self-worth by demonstrating positive self-values through their consumption decisions (Z. Gao, 2008). They seek and interpret information that reinforces their personal values and sense of self-worth within society (Howell & Shepperd, 2012; Steele, 1988).

Building on this, individuals are more likely to adopt environmentally sustainable consumption habits to signal their self-worth to society and as global citizens by expressing positive moral and global self-values (Lalwani & Shavitt, 2009). For example, when presented with a green hotel option that is perceived to align with positive personal values, guests are more inclined to signal their own positive self-values by engaging with and choosing the green hotel (Y. L. Gao & Mattila, 2016).

Research on self-affirmation theory has also shown that self-affirmed individuals are more likely to participate in prosocial activities, such as recycling (Sparks et al., 2010), donating to charity (Lindsay & Creswell, 2014), volunteering, pursuing unpaid education (Schneider & Weber, 2021), and reducing food waste (Graham-Rowe et al., 2019). Therefore, guests are expected to be motivated to reinforce their personal values and engage with VAs that recommend information consistent with their positive personal values, including details about environmentally sustainable hospitality practices.

VA use purposes

As previously mentioned, existing studies suggest that guests' interactions with technology are shaped not only by the technology itself but also by differences among guests (Acikgoz et al., 2023). A user's motivation for using VA is therefore expected to moderate the effect of its environmental sustainability recommendations on user engagement. VAs help users search for information and recommendations, for both non-transactional and transactional purposes (Kazak et al., 2020). For non-transactional purposes, users are more motivated to acquire and assess product or service information for further consideration or discussion. Transactional use, such as booking a hotel for a trip, is goal-oriented, leading users to focus

on whether a product or service aligns with their requirements (Moliner-Tena et al., 2019). The merely transactional nature of a relationship can affect user engagement with VAs (Malhan & Dewani, 2022). In particular, when a VA provides information that meets the user's needs and personal values, user engagement will increase. The present research proposes that these usage contexts may affect user immersion with a VA, subsequently affecting their interaction and engagement.

Cultural orientation

Previous research indicates that user characteristics can affect their degree of technological engagement. For example, Sharafi et al. (2006) suggest that personal characteristics can affect how users perceive, interpret, and use technologies. Tassiello et al. (2021) add that the level of psychological control and empowerment among different individuals could affect their interaction with VAs. Self-affirmation theory emphasizes the importance of motivation to protect and express personal values, which vary amongst individuals with different characteristics (Nikolova, 2023). Overall, an individual's engagement in sustainable behaviors is influenced by how motivated they are to prioritize the environment and the future of society.

Previous studies also indicate that cultural orientations can shape how individuals from different cultural backgrounds form their motivations and perceptions regarding their relationships with others in society (e.g., Lee & Pounders, 2019). Whether individuals have an independent or interdependent cultural orientation influences their group identities and perceptions of social connections, creating different criteria for the fulfillment of their self-affirmation needs (Hsieh et al., 2021). In this sense, cultural orientation has been found to influence consumption behavior in the hospitality and tourism context (Hsieh et al., 2021). Peng et al. (2023) suggest that cultural orientation can influence travelers' cognitive, affective, and behavioral differences. Hence, VA users with different cultural orientations may respond differently to information provided by VAs in various contexts. The influence of cultural orientation on consumption behavior can be explained by the underlying psychological mechanisms within the individual user (Lalwani et al., 2020).

Cultural orientation is considered to influence the tendency to identify with the collective or personal aspects of the self, which is expected to further influence how someone defends or expresses their personal values (Liang et al., 2024). People with an independent orientation view the self as autonomous and distinct from the larger society, emphasizing uniqueness, freedom, and self-expression (Yim et al., 2014). These individuals tend to prioritize independent thinking, self-care, and autonomy and to value personal achievement (Luan et al., 2023). They focus on fulfilling personal consumption goals, and expressing internal abilities in their purchase decisions (Hsieh et al., 2021). They are drawn to information that allows them to showcase their intelligence and strengths for self-enhancement (J. Gao et al., 2021). Individuals with interdependent orientations view themselves as part of a larger social fabric, giving precedence to collective goals and shared values (Markus & Kitayama, 1991). People influenced by interdependent cultures tend to exhibit traits like benevolence, adherence to tradition, and conformity (Sharma, 2010). These societies place high importance on fostering group cohesion, and valuing punctuality, as lateness is seen as disruptive to the well-being of others (Minkov et al., 2017; Peng et al., 2023). Due to individuals'

differences on preferences for expressing positive personal values within society, this study proposes that guests with different cultural orientations will engage with VA-provided environmental protection content of a hospitality and tourism product/service differently. This implies that cultural orientation may moderate the relationship between environmental protection content and VA engagement.

Hypothesis development

The impact of environmentally sustainable VA recommendations on user adoption and the mediating role of user VA engagement

The development and integration of VAs have provided potential guests with helpful tools for seeking information during the pre-travel stage of their journey, such as hotel information searching/booking. User engagement plays a critical role in fostering individual participation and increasing adoption intentions (Aggarwal et al., 2024; Prentice et al., 2023). Liu et al. (2022) suggest that individuals are unlikely to respond to or follow advice from technologies they are not familiar with or do not often engage with. Instead, people become immersed in interactive experience with familiar technologies and are drawn to the messages these technologies present, which fosters further engagement and leads to the adoption of their outputs, including recommendations. Therefore, to encourage potential guests using VAs to embrace VA recommendations, it is crucial that promotional messages effectively enhance user (potential guest) engagement with the VAs themselves.

This study proposes that the delivery of environmentally sustainable messages by VAs can enhance user engagement and motivate potential guests to adopt the recommended hospitality and tourism products or services. As environmental sustainability and protection have gained significant attention in recent years, consumers increasingly expect companies to implement sustainability strategies and to engage with ones that do (Poushneh, 2021). This trend is evident in the hospitality industry, where hotels are increasingly adopting environmentally sustainable practices (Gürlek & Koseoglu, 2021). Such sustainability initiatives have become a key factor in guests' decision-making when choosing travel accommodations (Cao et al., 2022).

In this context, self-affirmation theory suggests that individuals actively seek out and interpret information that aligns with their values and reinforces their self-esteem within a societal context (Howell & Shepperd, 2012; Steele, 1988). The theory holds that self-affirmation is triggered when individuals encounter a situation that threatens their self-concept (Steele, 1988). For example, acknowledging the critical importance of environmental sustainability to safeguard the planet for future generations can represent such a threat, as it challenges individuals to confront their role in addressing global issues. When environmentally sustainable messages are communicated within society, they serve as a reminder of these challenges and the associated responsibilities. In response, individuals are likely to seek to mitigate the perceived threat to their self-concept. They are often motivated to take action by demonstrating behaviors that align with positive personal values, such as those of a responsible global citizen. This can include adopting environmentally sustainable practices that visibly signal their commitment to these values, thereby reducing the threat and reinforcing their self-worth (Townsend & Sood, 2012).

When potential guests are exposed to environmental sustainability messages delivered by VAs, these messages may serve as a reminder that global efforts to protect the environment

remain insufficient (Graham-Rowe et al., 2019). In response, they may seek to reaffirm their personal values by engaging with sustainable practices, thereby signaling their self-worth and expressing positive moral values (Lalwani & Shavitt, 2009). As a result, potential guests are likely to be motivated to reinforce their values by interacting with VAs that promote information consistent with their values, including environmentally sustainable hospitality practices (Y. L. Gao & Mattila, 2016). These prosocial behaviors and ethical consumption practices enable individuals to project their “goodness” to society (Trudel et al., 2019). Similarly, engaging with a VA’s environmental sustainability messages reinforces consumers’ environmental consciousness, positively shaping how they perceive and express their values (Crocker et al., 2008).

Therefore, when a VA conveys the environmental sustainability aspects of a hospitality product or service, this can be expected to evoke positive sentiments and enhance motivation for continued interaction, reinforcing an individual’s positive personal values. By communicating information that aligns with users’ personal values, especially those related to environmentally sustainable hospitality and tourism practices, a VA is likely to encourage engagement, especially when compared to VAs whose suggestions lack this content. This may subsequently increase consumers’ intention to adopt a VA’s hospitality and tourism products or services recommendations, such as when searching for hotels. Consequently, this study hypothesizes:

H1: Incorporating environmental sustainability practices into VA recommendations positively affects potential guests’ intention to adopt them.

H2: User engagement mediates the impact of VA recommendations that incorporate environmental sustainability practices on potential guests’ intention to adopt them.

H1 primarily examines the direct effect of the independent variable (VA recommendations with environmental sustainability content vs. VA recommendations without such content) on the dependent variable (VA recommendation adoption intention). Building on H1, H2 tests the mediating effect of VA user engagement on the relationship between the presence or absence of environmental sustainability content in the VA recommendation and VA recommendation adoption intention.

Moderating effects of VA use purpose and user cultural orientation

To foster increased engagement between guests and VA, it is also imperative that messages and information are tailored to cater to individual preferences and needs (Acikgoz et al., 2023). This study explores how cultural orientation and VA-facilitated consumption motivation may influence guests’ psychological and sociological outlooks and how these factors together impact their engagement with VAs.

Individuals with an independent cultural orientation have been found to emphasize their own positive attributes and exhibit socially desirable behaviors (Wong and Liem, 2023). They are more likely to engage in pro-environmental actions due to self-goal satisfaction (Xiong et al., 2023). Building on self-affirmation theory, interacting with environmentally friendly products or services can serve as a way for these individuals to enhance their self-perception (Cho et al., 2013). Environmental sustainability messages from VAs can effectively engage users with an independent

cultural orientation and transactional goals, who tend to focus on their own internal responses and are less concerned with others' opinions (Park et al., 2023). In addition, individuals with an independent cultural orientation exhibit an analytic thinking style, carefully analyzing information and being less influenced by context (Ma & Li, 2023). This analytical approach extends to evaluating environmental sustainability messages from VAs, aligning the product or service with their self-expression and enhancement goals. Previous research indicates that such individuals also often have stronger affective responses and engagement, allowing them to stand out in society and express their eco-centric lifestyles (Xiong et al., 2023). Therefore, potential guests with an independent cultural orientation are likely to protect their self-values by engaging in environmentally friendly behavior without seeking input or consultation from others. This tendency stems from their preference for autonomy and self-reliance, which aligns with their desire to make decisions that reflect their personal beliefs and values. In such cases, these individuals are more inclined to act independently, driven by their intrinsic motivation to uphold their self-concept and demonstrate their commitment to sustainable practices. Consequently, they may adopt environmentally responsible behaviors as a means of affirming their personal values without the need for external validation or influence.

In contrast, individuals with an interdependent cultural orientation perceive themselves as integral to the broader society and value group affiliation (Markus & Kitayama, 1991). Societies that are interdependently oriented prioritize harmony, in-group cohesion, and punctuality (Minkov et al., 2017). Unlike independently oriented individuals, those with an interdependent orientation derive self-affirmation through collective actions with their affiliated group, engaging in cooperative decision-making (Peng et al., 2023). From an information processing perspective, interdependently oriented individuals process information as an integrated unit and adopt holistic thinking (Ma & Li, 2023). They tend to keep their options open and maintain flexibility by considering and evaluating suggestions from various sources before drawing conclusions or making decisions (Wong and Liem, 2023).

For those with an interdependent orientation, environmental sustainability is perceived as a societal issue, and their decision-making and behavior are influenced by diverse sources (Y. Gao et al., 2022). Seeking harmony, individuals with an interdependent cultural orientation are likely to engage more with a VA that provides environmental sustainability messages with a non-transactional purpose. These people tend to gather information, generate thoughts, and deliberate on decisions within their closely connected group before arriving at a conclusion. Diverse opinions provide interdependent individuals with an opportunity to fulfill social connection goals and address self-enhancement and affirmation needs. They are driven to contribute to broader environmental goals and view pro-environmental behaviors as a way to benefit society as a whole (Xiong et al., 2023). Therefore, when interdependent potential guests engage in non-transactional purpose, they are likely to carefully consider VA recommendations about hospitality and tourism products or services and discuss them within their community. Consequently, this study hypothesizes:

H3: Cultural orientation and VA use purpose jointly moderate the impact of environmental sustainability-related content on user engagement, such that:

H3a: When a VA provides content related to environmental sustainability features, potential guests with an independent cultural orientation who use the VA for transactional purposes will engage more compared to those using it for non-transactional purposes.

H3b: When a VA provides content related to environmental sustainability features, potential guests with an interdependent cultural orientation who use the VA for non-transactional purposes will engage more compared to those using it for transactional purposes.

Based on H1 and H2, H3 examines the moderating effects of VA users' cultural orientation and usage purpose on the relationship between the presence or absence of environmental sustainability content in VA recommendations and VA user engagement.

The research framework is depicted in [Figure 1](#).

Study 1: online scenario-based experiment

Study 1 adopted a full factorial experiment design. The experimental group received environmental sustainability practice information and basic recommendations from a VA, while the control group received basic recommendations without environmental sustainability information. Cultural orientation was treated as a within-group variable, while the purpose of VA usage was manipulated as a between-group variable. Ethical approval for this study was issued by the Research Ethics Committee of the authors' affiliations.

Study design

Participants from the UK and Taiwan were recruited for this study. According to Hofstede's (2024) cultural dimensions, residents in the UK are more individualistic and independently oriented (with a score of 76 out of 100) than residents in Taiwan, who are more collectivistic and interdependently oriented (with a score of 40 out of 100). Existing studies also support the significant cultural differences in individualism levels between the UK and Taiwan, with British people tending to be more independent and make decisions individually compared with Taiwanese people, who tend to work interdependently in groups (Beckert et al., 2020;

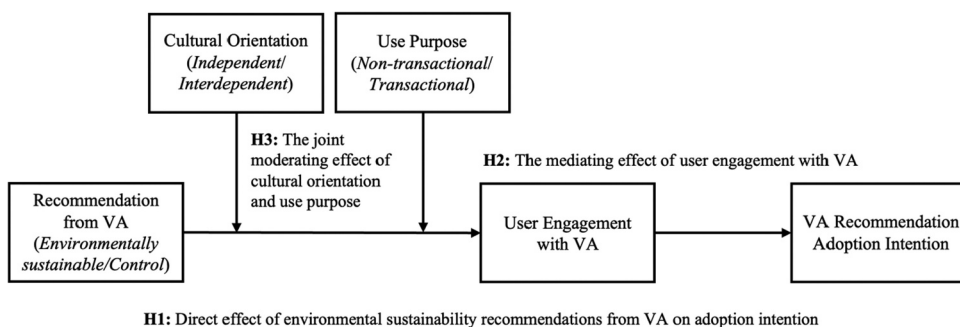


Figure 1. Research framework.

Table 2. Measurements.

(All the items were assessed using a seven-point scale)		EFA Loadings	
User engagement with VA (adapted from Vivek et al. 2014)			
1.	Things related to the voice assistant can grab my attention.	0.81 (0.77)	0.94 (0.92)
2.	I like to learn more about the voice assistant	0.75 (0.80)	
3.	I pay attention to things about the voice assistant.	0.82 (0.79)	
4.	I would spend a lot of my discretionary time using the voice assistant.	0.78 (0.75)	
5.	I am heavily into the voice assistant.	0.73 (0.78)	
6.	I am passionate about the voice assistant.	0.70 (0.72)	
7.	My days would not be the same without the voice assistant.	0.72 (0.80)	
Cultural orientation (adapted from Sharma, 2010)			
1.	I would rather depend on myself than others. ()	0.83 (0.78)	0.82 (0.88)
2.	My personal identity, independent of others, is important to me. ()	0.81 (0.84)	
3.	I rely on myself most of the time, rarely on others. ()	0.75 (0.80)	
4.	It is important that I do my job better than others. ()	0.72 (0.71)	
5.	I enjoy being unique and different from others in many respects. ()	0.74 (0.77)	
6.	The well-being of my group members is important to me. ()	0.85 (0.81)	0.87 (0.93)
7.	I feel good when I cooperate with my group members. ()	0.82 (0.84)	
8.	It is my duty to take care of my family members, whatever it takes. ()	0.79 (0.76)	
9.	Family members should stick together, even if they do not agree. ()	0.71 (0.80)	
10.	I enjoy spending time with my group members. ()	0.77 (0.72)	
VA recommendation adoption intention (adapted from Liu et al., 2019)			
After receiving the hotel recommendations from the voice assistant,		0.86 (0.80)	0.90 (0.91)
1.	All things considered, I expect to adopt and use tourism services/products that are recommended by voice assistants.		
2.	I can see myself supporting tourism services/products that voice assistants recommend.	0.82 (0.77)	
3.	I can see myself increasing tourism services/products adoptions that are suggested by voice assistants if possible.	0.74 (0.71)	
4.	It is likely that I will participate in tourism services/products if suggested by voice assistants.	0.76 (0.79)	

*The values in parentheses are the values from Study 2.

Chen & Weng, 2023; Lomas et al., 2022). It is worth noting that Hofstede's tool provides relative values rather than median scores, with higher scores indicating relatively stronger independence and lower scores suggesting relatively greater interdependence. In our analysis, we used Sharma's (2010) scale (Table 2) rather than nationality alone to assess cultural orientation. Participants were sampled from Taiwan and the UK with the general expectation that they would differ in independence and interdependence between the two nations, ensuring a balanced sample.

To enhance face validity, this study followed experimental research practices in tourism while examining sustainability content and purpose of use (e.g. Tussyadiah & Miller, 2019).

The scenarios were designed based on two-scenario development discussions, considering user experience with VA to enhance the reliability and realism of the experimental scenarios. The total number of participants was 12, with 6 UK participants sourced from Prolific and 6 Taiwan participants from Meta Survey Marketing Research Co. Ltd. Both data collection platforms are highly reliable and have been adopted in previous studies (Douglas et al., 2023; Krendl et al., 2023, Tan & Chou, 2023). Participants were required to have previous experience using a VA, including experience using the VA to search for travel-relevant information or place an order. A total of 131 participants were recruited via Amazon Mechanical Turk to further evaluate the realism of the scenario design. To assess this, two items from Kim et al. (2022) were used on a 7-point Likert scale: (a) How realistic was the scenario you just read? and (b) How easy was it for you to imagine what happened in the scenario? Following Kim et al. (2022), the two items were averaged (Cronbach's $\alpha = .86$). A series of one-sample t-tests indicated that the mean scores for the realism of the four scenarios (Use Purpose * Sustainability Content) were all significantly greater than the scale midpoint of 4.0 ($p < 0.001$), supporting the realism of the scenario design: $M_{\text{Transactional}} = 6.22$, $SD = .84$; $M_{\text{Non-Transactional}} = 6.23$, $SD = .80$; $M_{\text{with Sustainability Content}} = 6.34$, $SD = .75$; $M_{\text{without Sustainability Content}} = 6.11$, $SD = .87$.

The study applied hotels as the context, given that they are experience-based goods that require significant time and effort to search for and evaluate (Huang & Zhang, 2020). Barcelona, Spain, was selected as the destination for UK travelers, aligning with popular choices based on 2024 statistics data (Florida-Benítez, 2023; Statista, 2024). Similarly, Osaka, Japan, was chosen as the destination for Taiwanese travelers, consistent with the 2024 database of the Taiwan Ministry of Transportation and Communications Tourism Bureau, which indicates Osaka as a top destination (Taiwan Ministry of Transportation and Communications [MOTC], 2024, Yang et al., 2021). The scenario was posed as follows: "You are planning a trip to Barcelona, Spain/Osaka, Japan. You have not booked a hotel yet."

As highlighted earlier, transactional use refers to interactions or activities that involve exchanges or transactions, often with a clear goal of completing a business process or achieving a specific outcome. Non-transactional use refers to interactions or activities that do not involve direct exchanges or transactions, focusing instead on information browsing, searching, or other non-exchange-based activities. On this basis, two scenarios for VA use were developed with different purposes. The first was a transactional scenario where the clear goal was to make a booking through a straightforward interaction focused on completing a reservation ("You would like to make your booking today. You ask the voice assistant for a recommendation, and the voice assistant replies [with or without an environmental sustainability message]"). The second was a non-transactional scenario, with the primary emphasis on seeking recommendations rather than completing a specific transaction ("You would like to browse for options and receive suggestions to get some ideas today. You ask the voice assistant for a recommendation, and the voice assistant replies [with or without an environmental sustainability message]").

The environmental sustainability scenario involved the VA providing information about hotel sustainability practices. Pre-test participants identified energy savings, carbon emissions reduction, and participation in local recycling activities as common hotel environmental protection practices: VA: "I have found some conveniently located hotels with fair

price that may fit your requirements. These hotels have received positive reviews from TripAdvisor and Google. The best thing is that they have policies to protect the environment, including housekeeping service upon request to reduce waste, energy efficiency promises to reduce greenhouse gas from the hotel, and participation in local recycling scheme to reduce waste. I have just sent these recommendations to your mobile phone.” (The alternative choices were presented in a different display; [Figure 2](#)).

The scenario without environmental sustainability content from the VA only included information that did not address the hotels’ sustainability practices: VA: “I have found some conveniently located hotels with fair price that may fit your requirements. These hotels have received positive reviews from TripAdvisor and Google. I have just sent these recommendations to your mobile phone.” (The alternative choices were presented in a different display; [Figure 3](#)).

To replicate actual usage scenarios and user language habits more accurately, the descriptions in the experimental scenarios and the scale items for Taiwanese participants were communicated in Mandarin. The scenarios and scale items were translated back and forth from English to Mandarin Chinese by two bilinguals to ensure accuracy of expression.


Procedures


The study recruited 329 valid respondents from Taiwan (through Meta Survey) and 320 respondents from the UK (via Prolific). As the study involved VAs, certain screening questions were adopted to ensure that respondents (1) owned a device capable of using a VA, such as a smartphone or tablet; (2) had used a VA to search for travel-related information in the past year; and (3) were aged 18–64 years (to address research ethics concerns). If the respondents did not meet all of these criteria, they were directed to the final page without participating in the study. Participant IDs were cross-checked, and no participant had participated in the scenario development discussions. The participants were randomly assigned to one of the four scenarios and instructed to read it. They then answered survey questions on user engagement with the VA (adapted from Vivek et al., 2014) and VA recommendation adoption intention (adapted from Liu et al., 2019). Cultural orientation items (adapted from Sharma, 2010, [Table 2](#)) were presented alongside demographic questions on the subsequent page of the study.

Study 1 results

The Cronbach’s alpha results showed good internal consistency regarding user engagement with the VA ($\alpha = 0.94$), cultural orientation ($\alpha = 0.82$ for independent and $\alpha = 0.87$ for interdependent), and VA-recommended product/service adoption intentions ($\alpha = 0.90$). An exploratory factor analysis (EFA) (varimax rotation with Kaiser normalization and eigenvalues > 1) extracted four factors (74.14% cumulative variance), all with loadings greater than 0.70 and items matching the original constructs. No significant differences were found in terms of gender ($p = 0.78$), education level ($p = 0.53$), or age ($p = 0.12$) among the four scenarios, suggesting a successful random assignment. Following pertinent studies, this study categorized participants into different cultural orientations based on their responses to the

Barcelona, Spain (For UK participants):







Cerulean Tower Premium
Barcelona, Spain


A choice that meets your specified requirements

9.2 Excellent
1,001 reviews



- ✓ Housekeeping service upon request to reduce waste
- ✓ Energy efficient
- ✓ Participation in local recycling scheme







Hotel Royal Park
Barcelona, Spain


A choice that meets your specified requirements

9.0 Wonderful
1,008 reviews



- ✓ Housekeeping service upon request to reduce waste
- ✓ Energy efficient
- ✓ Participation in local recycling scheme






Ionia Hotel
Barcelona, Spain

A choice that meets your specified requirements

9.4 Exceptional
1,010 reviews



- ✓ Housekeeping service upon request to reduce waste
- ✓ Energy efficient
- ✓ Participation in local recycling scheme

Osaka, Japan (For Taiwanese participants):





華藍塔高級飯店
大阪, 日本

符合您所列需求的選擇

9.2 有夠讚
1,001 則評論



- ✓ 依據需求提供客房服務以減少浪費
- ✓ 節省能源
- ✓ 參與當地回收計劃





皇家公園飯店
大阪, 日本

符合您所列需求的選擇

9.0 好極了
1,008 則評論



- ✓ 依據需求提供客房服務以減少浪費
- ✓ 節省能源
- ✓ 參與當地回收計劃





艾奧尼亞飯店
大阪, 日本

符合您所列需求的選擇


9.4 太棒了
1,010 則評論



- ✓ 依據需求提供客房服務以減少浪費
- ✓ 節省能源
- ✓ 參與當地回收計劃

Figure 2. Study 1 - VA recommendations presented to the participants in the experimental group (with environmental sustainability content; the hotel names are fictitious).


Barcelona, Spain (For UK participants):



Cerulean Tower Premium
Barcelona, Spain

A choice that meets your specified requirements


9.2 Excellent
1,001 reviews



Hotel Royal Park
Barcelona, Spain

A choice that meets your specified requirements

9.0 Wonderful
1,008 reviews




Ionia Hotel
Barcelona, Spain

A choice that meets your specified requirements

9.4 Exceptional
1,010 reviews


Osaka, Japan (For Taiwanese participants):



華藍塔高級飯店
大阪, 日本

符合您所列需求的選擇


9.2 有夠讚
1,001 則評論



皇家公園飯店
大阪, 日本

符合您所列需求的選擇

9.0 好極了
1,008 則評論



艾奧尼亞飯店
大阪, 日本

符合您所列需求的選擇

9.4 太棒了
1,010 則評論

Figure 3. Study 1 - VA recommendations presented to the participants in the control group (no environmental sustainability content; the hotel names are fictitious).

Table 3. Study 1 - sample demographics.

	Independently oriented participants (N = 322)		Interdependently oriented participants (N = 327)	
	N	Percentage	N	Percentage
Gender				
Male	150	46.6%	154	47.1%
Female	172	53.4%	173	52.9%
Age				
19–25	58	18.0%	63	19.3%
26–30	74	23.0%	66	20.2%
31–35	47	14.6%	41	12.6%
36–40	39	12.1%	48	14.7%
41–45	40	12.4%	45	13.8%
46–50	32	10.0%	31	9.5%
51–55	22	6.8%	20	6.1%
56 +	10	3.1%	13	4.0%
Education				
High school or below	49	15.3%	46	14.0%
Undergraduate	226	70.3%	214	65.5%
Postgraduate	47	14.4%	67	20.5%

cultural orientation measures. If the independence score was greater than the interdependence score, independence was used as the participant's cultural orientation, and vice versa (Sharma, 2010). In line with the findings of previous studies and reports, the results showed a significant cultural orientation difference between the Taiwan and UK participants. Overall, 322 participants were categorized as independently oriented, of whom only 9 were Taiwan participants, while 327 participants were identified as interdependently oriented, of whom 7 were from the UK. The participants demographics are shown in Table 3.

Testing hypothesis 1

We employed VA recommendations containing environmental sustainability content as a dummy variable, using the control group (no environmental sustainability content) as the baseline in a regression analysis. The dependent variable was VA recommendation adoption intention. Supporting H1, the results demonstrated a significant positive effect of VA environmental sustainability content on intention to adopt VA-recommended hospitality and tourism services/products recommendations (standardized $\beta = 0.62$, $p < 0.01$).

Testing hypothesis 2

Following Baron and Kenny's (1986) mediation testing approach, a regression analysis revealed that VA environmental sustainability content had a significant positive effect on VA user engagement (standardized $\beta = 0.49$, $p < 0.01$). In another regression analysis, user engagement with VA also had a positive impact on VA recommendation adoption intention (standardized $\beta = 0.73$, $p < 0.01$). Using a regression analysis including both VA environmental sustainability content and user engagement with VA as independent variables for VA recommendation adoption intention (dependent variable), we found the standardized β ($p < 0.01$) for user engagement with VA (standardized $\beta = 0.59$) surpassed that for VA environmental sustainability content (standardized $\beta = 0.27$). This revealed that

user engagement with VA significantly mediated the relationship between VA recommendations containing environmental sustainability content and VA-recommended hospitality and tourism service/product adoption intention, supporting H2.

Testing hypothesis 3

A three-way ANCOVA (with age, gender, and education set as the covariates) was conducted ($F(1, 638) = 224.06, p < 0.01$; Table 4). The significant direct effect of sustainability content on user engagement again indicated that the participants had a significantly higher level of engagement with the VA ($p < 0.01$) when its recommendation contained environmental sustainability-related content ($M = 4.92$; $SD = 1.52$) compared with scenarios where the VA's recommendation contained no such content ($M = 3.80$; $SD = 1.33$).

A post-hoc test with Bonferroni correction revealed that the independently oriented users were more engaged with the VA providing environmental sustainability content when seeking a transaction versus non-transactional information ($M_{Independent, transactional, with sus. content} = 5.94, SD_{Independent, transactional, with sus. content} = 0.49$ vs $M_{Independent, non-transactional, with sus. content} = 4.54, SD_{Independent, non-transactional, with sus. content} = 0.56, p < 0.01$; Figure 4). In contrast, the interdependently oriented participants were more engaged with the VA that provided environmental sustainability content when searching for non-transactional information ($M_{Interdependent, non-transactional, with sus. content} = 5.52, SD_{Interdependent, non-transactional, with sus. content} = 0.63$ vs $M_{Interdependent, transactional, with sus. content} = 4.09, SD_{Interdependent, transactional, with sus. content} = 0.40, p < 0.01$; Figure 4). The results demonstrated the interaction effects of VA users' cultural orientation and using purpose on the relationship between VA hospitality recommendations containing environmental sustainability content and VA user engagement. Thus, H3a and H3b were both supported. The findings also showed no significant difference ($p > 0.05$) between the four control groups with VA recommendations that contained no environmental sustainability content.

Study 2: lab-based experiment

Study 1 provided support for the proposed hypotheses. Although online scenario-based experiments are widely applied in marketing and hospitality management research (e.g., Cicek et al., 2025), we acknowledge their limitations in terms of interaction capabilities. Study 2 employed a lab-based experiment to 1) better capture the interaction between

Table 4. Study 1 - the effects of use purpose, cultural orientation, and sustainability messaging on VA user engagement.

Measure	SS	df	MS	F	Sig.
Age (covariate)	0.016	1	0.016	0.043	0.835
Gender (covariate)	0.115	1	0.115	0.308	0.579
Education (covariate)	0.034	1	0.034	0.090	0.764
Cultural orientation	0.503	1	0.503	1.350	0.264
Use purpose	10.233	1	10.233	27.429	0.000
Sustainability content	94.456	1	94.456	253.191	0.000
Cultural orientation*Use purpose	35.945	1	35.945	96.350	0.000
Cultural orientation*Sustainability content	2.691	1	2.691	7.213	0.007
Use purpose*Sustainability content	0.057	1	0.057	0.154	0.695
Cultural orientation*Use purpose*Sustainability content	83.590	1	83.590	224.063	0.000

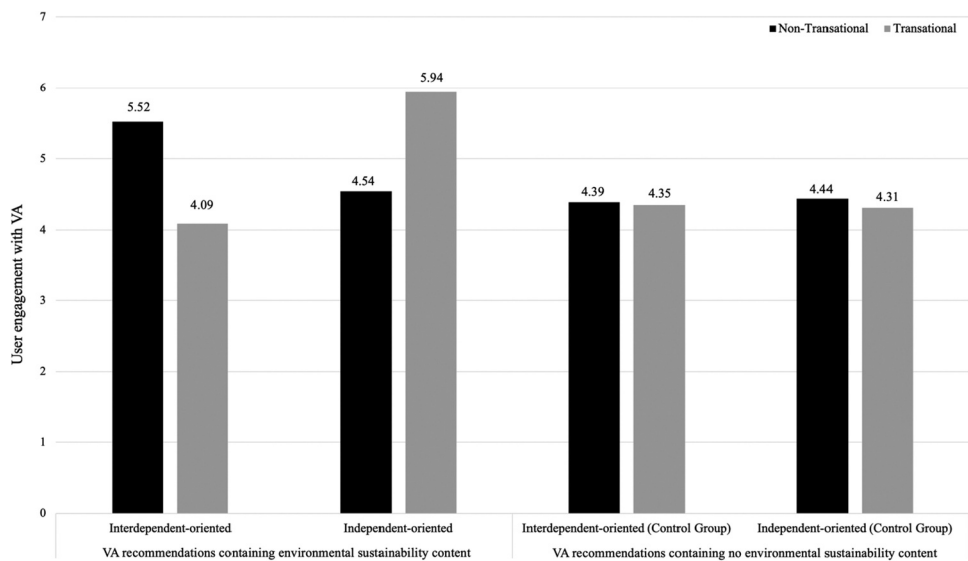


Figure 4. Study 1: the effect of use purpose, cultural orientation, and sustainability content on user engagement with VA.

respondents and VA, 2) include a behavioral measure for intention to engage with VA and adopt recommendations from VA, and 3) further examine and verify the hypotheses.

Participants of the lab-based experiment were recruited from the authors’ affiliated institutions, one located in Northern Taiwan and the other in Southeast England, ensuring cultural representativeness, consistent with Study 1. Executive Master of Business Administration and undergraduate students with prior experience using VAs were invited to participate. The lab-based experiments were conducted over three separate days (participants signed an agreement not to share their experiment experience with others after participating in the study to ensure independent participation of the between-subject experimental design) by the authors in Taiwan and the UK. Ethical approvals were obtained from both institutions. Participation was voluntary, and participants were required to provide a brief description of their previous VA usage experience. Each participant received a £5/NTD 200 incentive as a token of appreciation upon completing the experiment. In total, 94 Taiwanese participants and 97 UK participants were recruited.

Study design and procedures

To balance control over and manipulations of experimental conditions and authentic user experiences, Study 2 employed a human-operated VA approach. Experimenters (research assistants) remotely controlled the VA’s responses, while participants interacted with the VA without seeing the experimenters’ operations behind it. Responses from the VA were prerecorded AI-generated messages (using ElevenLabs, <https://elevenlabs.io/>), and experimenters remotely triggered the playback of relevant responses and information. Four Taiwanese postgraduate-level research assistants majoring in marketing and four UK postgraduate-level research assistants in marketing and management were recruited as

experimenters/operators for the VA. Training sessions were conducted before the actual participant sessions to ensure standardized procedures and fluency. Pilot tests were performed with 11 pretest participants. Amazon Alexa was chosen as the VA for this experiment primarily because it was the first VA to assist with hotel booking services and offered services in both Taiwan and the UK (Forgione, 2017).

Participants were randomly assigned to one of four experimental conditions: *VA sustainability recommendation* vs. *no VA sustainability recommendation* * *transactional purpose* vs. *non-transactional purpose*. Upon entering the lab (a quiet meeting room with proper temperature control), participants were told that they could find the task instructions on the desk (in the form of a note, which they were instructed to read beforehand). To maintain consistency, the same tasks and descriptions as pre-tested and designed in Study 1 were applied, Taiwanese participants were assigned a trip to Osaka, while UK participants were assigned a trip to Barcelona scheduled for six weeks later. The manipulation materials for transactional and non-transactional purposes were similar to Study 1. For transactional purposes, participants were given a clear VA interaction goal focused on booking a hotel and completing a reservation (“You would like to make your booking today. You ask the voice assistant for a recommendation”). For the non-transactional scenario, the instruction emphasized on seeking recommendations rather than completing a specific reservation (“You would like to browse for options and receive suggestions to get some ideas today. You ask the voice assistant for a recommendation”). One question on a seven-point scale (“Is the task instruction clear to you?”) and one manipulation check item on a seven-point bipolar scale (“According to the instruction, my understanding of the task is transactional (‘booking/payment-focused’ [coded as 7]) or non-transactional (‘general information search-focused’ [coded as 1])”) were asked after the participants read the task instructions. Results showed that participants clearly understood the task requests ($M = 6.13$), and that the transactional and non-transactional manipulations were successful ($M = 5.74$ for transactional, $M = 2.20$ for non-transactional, $t(189) = 30.68$, $p < 0.01$). The Taiwanese participants interacted in Mandarin, while the UK participants interacted in English. The consistency of the VA response messages was verified by two bilinguals.

In the experimental setup, each participant interacted with an iPad (Mini 6), controlled remotely by an experimenter (using the Universal Control function of macOS) stationed outside the lab. The experimenter could hear the participants’ voice commands from the speaker installed in the lab. The iPad initially displayed the interface of the Alexa VA app (Figures 5 and 6). Participants were instructed to use the VA app to search for hotel options to fulfill the assigned task. When participants used appropriate voice commands, such as “Alexa, I want to find hotels in Osaka for March 20th” or “Alexa, search for hotels near Barcelona in March,” the experimenter played prerecorded AI-generated voice responses: “Sure, I can help with that. Here are some hotels near Osaka/Barcelona available in March. I’ve sent the information to you.” Pre-designed hotel recommendations were then remotely displayed on the iPad by the experimenter (Figures 7 and 8). Experimenters evaluated participants’ utterances based on semantic understanding, allowing for variations in wording. For example, phrases like “Alexa, I hope to book hotels in Osaka for March 20th” or “Alexa, I need to book hotels in Osaka for the third week of March” would also trigger the experimenters to operate the VA to respond with the same hotel options and information. If the commands were incomplete or unclear, standardized responses were played: “I’m not sure I understand your question. Could you provide more specific information?” For hotel

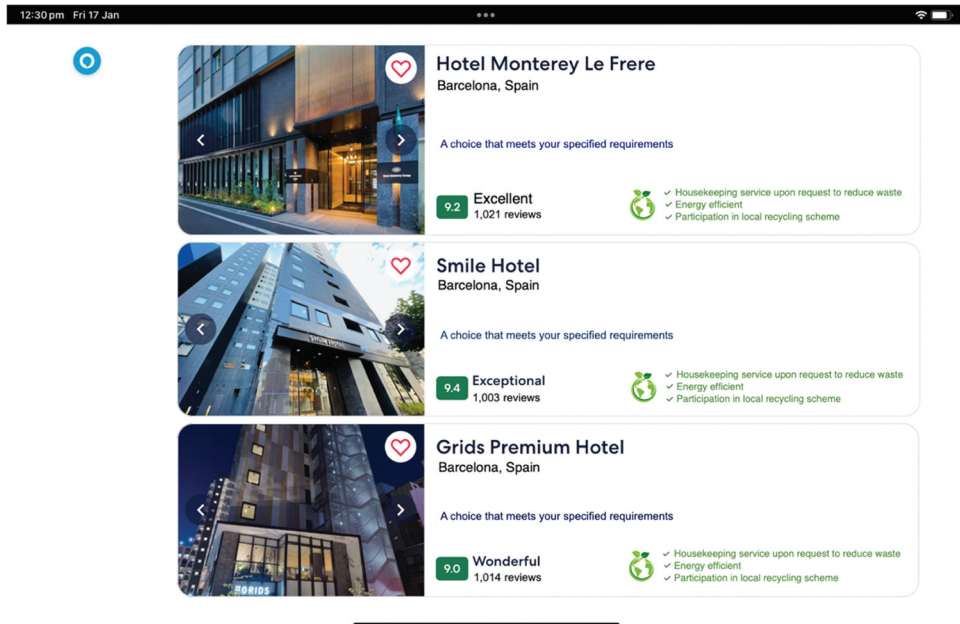
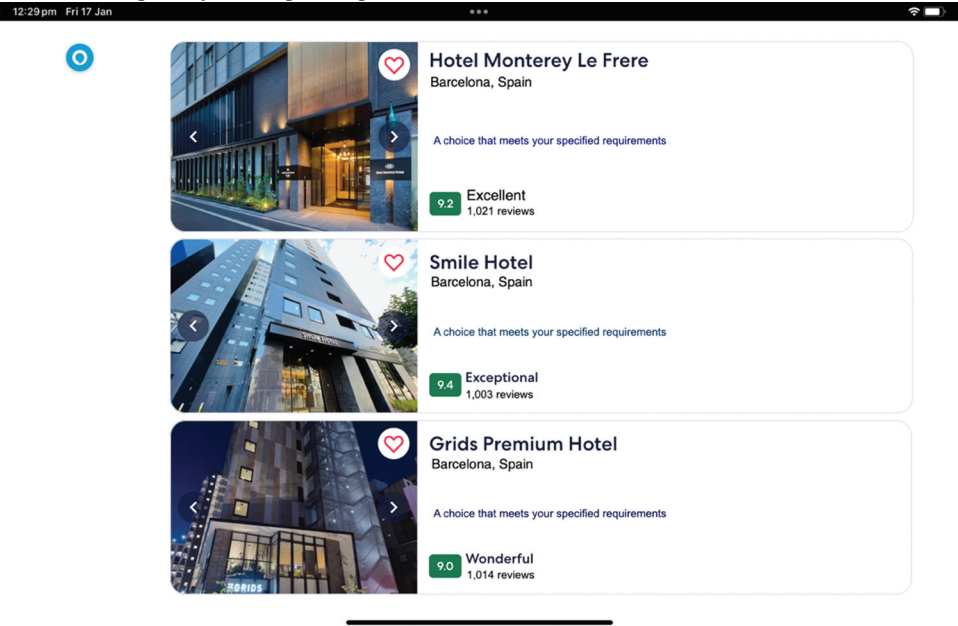
Barcelona, Spain (for UK participants):*Osaka, Japan (for Taiwanese participants):*

Figure 5. Study 2 - VA recommendations presented to the participants in the experimental group (with environmental sustainability content; the hotel names are fictitious).

Barcelona, Spain (for UK participants):



Osaka, Japan (for Taiwanese participants):

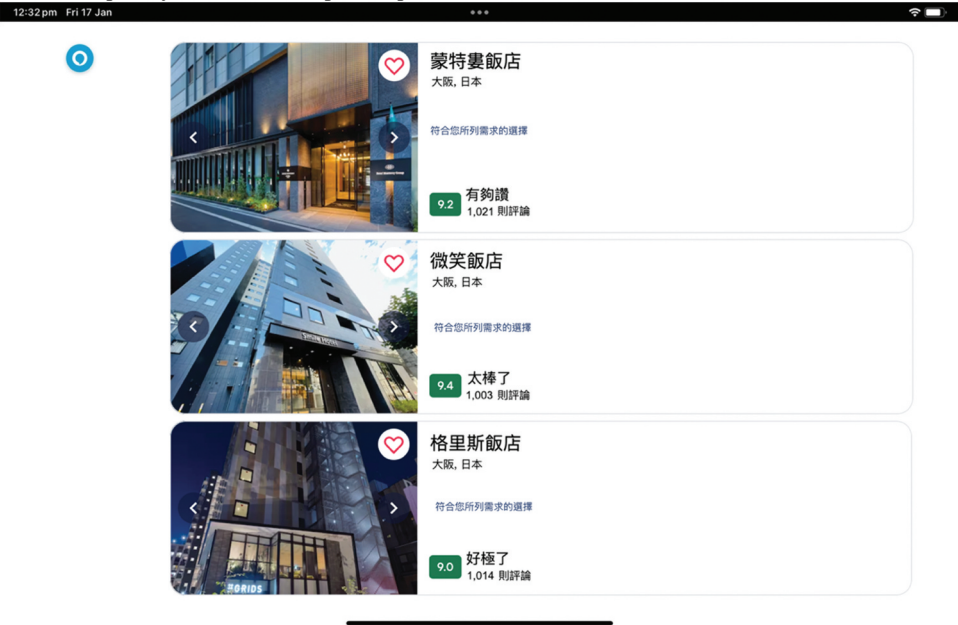


Figure 6. Study 2 - VA recommendations presented to the participants in the control group (no environmental sustainability content; the hotel names are fictitious).

search unrelated queries, the VA experimenter responded with generic responses: “I’ve searched for relevant information on the web” with the search results displayed on the iPad.

It is worth noting that, unlike Study 1, Study 2 allowed participants to freely interact with the VA (experimenter) during this stage. The manipulations (and manipulation check) of transactional and non-transactional tasks were conducted before participants interacted with the VA. Participants were provided with instructions on the purpose of VA usage – either for a general search of hotel information (non-transactional) or for making a booking (transactional). Therefore, the participants had to first use the VA search function to prompt the VA to provide recommendations; otherwise, they would not have any VA hotel recommendations. If a participant did not request a recommendation at this stage, they would be excluded from the study. In other words, the wording used by the participants at this stage, such as “Alexa, I want to book a hotel. Give me some recommendations” or “Alexa, I’m looking for a hotel to stay. Can you give me suggestions?” would receive the hotel recommendations with the random assignment of whether the group included environmental sustainability or not, rather than the results of “purpose” manipulation. In contrast, Study 1 directly provided hotel recommendations within the scenarios.

As in Study 1, participants in the sustainability VA recommendation group (experimental group) received recommendations information, which included general hotel information and environmental sustainability emphasis (Figure 5), while those in the non-sustainability VA recommendation group (control group) received only general hotel recommendation information (Figure 6). To avoid confounding factors, such as price and popularity, the study controlled hotel pricing (described as meeting the search requirements) and maintained uniformly high ratings (all above 9/10), in line with Study 1.

After initiating the search (Figures 7 and 8), the VA (controlled by the experimenter) asked participants: “Would you like to hear more details about these hotels?” If participants responded in the affirmative, the experimenter provided additional details

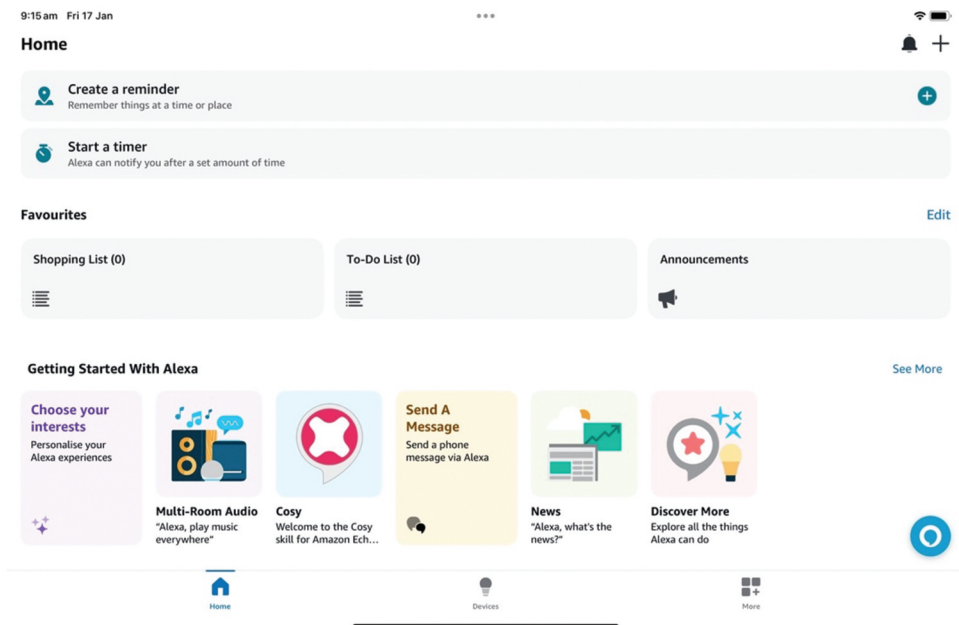


Figure 7. The standby screen upon entering the laboratory.

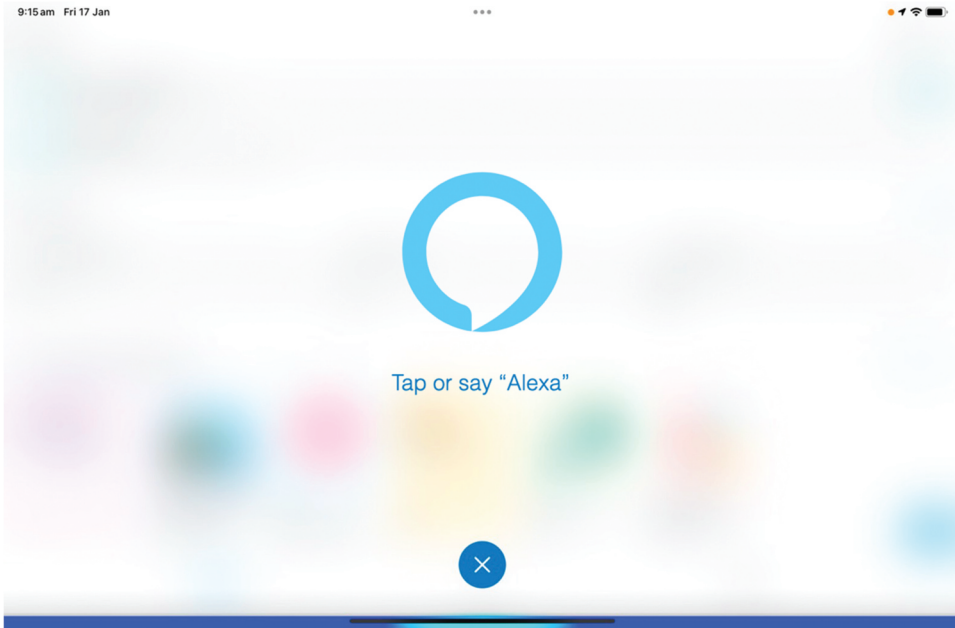


Figure 8. The screen displayed after the test subject clicked on the voice search function.

about the three hotels, such as proximity to the destination, high ratings, and the presence (or absence, depending on the group) of environmental sustainability information (no new information was introduced, only more detailed descriptions of existing information). The VA then asked (the experimenter played the prerecorded audio): “Do any of these hotel options work for you and make you want to stay?” Affirmative responses were recorded as “Yes,” while negative or uncertain responses (e.g., “No” or “I need to think about it”) were recorded as “No.” This can be considered a behavioral response question measuring participants’ intention to adopt the recommendation from VA. After completing this phase, participants were invited to complete a series of scale questions on the iPad, including measures of user engagement, VA-recommended hospitality and tourism product/service adoption intention, cultural orientation, realism of the experiment, and demographic variables (as in Study 1).

At the end of the experiment, the VA (experimenter) played the prerecorded audio and asked, “What else can I assist you with today?” Participants who responded affirmatively were allowed to explore the Alexa app installed on the iPad (not controlled by the experimenter), while those who declined concluded their session. For participants who did not proceed with further VA usage, the average session duration was 26 minutes and 32 seconds (Taiwan)/27 minutes and 45 seconds (UK) from the time they entered the lab. For those who continued exploring additional VA features, the average session duration was 37 minutes and 30 seconds (Taiwan)/35 minutes and 18 seconds (UK).

To further understand participants’ experiences during the experiment and their previous interactions with VAs, they were invited to write down and share their thoughts (open-ended, optional questions) on (1) their experience of the experiment, (2) the use of VA for finding hotel information, and (3) their views on sustainability recommendations.

Table 5. Study 2 - sample demographics.

	Independently Oriented Participants (N = 95)		Interdependently Oriented Participants (N = 96)	
	N	Percentage	N	Percentage
Gender				
Male	40	42.1%	43	44.8%
Female	55	57.9%	53	55.2%
Age				
19–25	19	20.0%	16	16.7%
26–30	16	16.9%	15	15.6%
31–35	15	15.8%	16	16.7%
36–40	14	14.7%	13	13.5%
41–45	14	14.7%	17	17.7%
46–50	8	8.4%	12	12.5%
51–55	5	5.3%	3	3.1%
56 +	4	4.2%	4	4.2%
Education				
Undergraduate	55	57.9%	58	60.4%
Postgraduate	40	42.1%	38	39.6%

Study 2 results

The results of Cronbach's alpha indicated good internal consistency across the scales: user engagement with the VA ($\alpha = 0.92$), cultural orientation ($\alpha = 0.88$ for independent and $\alpha = 0.93$ for interdependent), and VA recommendation adoption intentions ($\alpha = 0.91$). An EFA using varimax rotation with Kaiser normalization (Eigenvalues >1) identified four factors, accounting for 78.76% of the cumulative variance. All factor loadings exceeded 0.70, and the items aligned well with their respective constructs (Table 2). There were no significant differences in gender ($p = 0.27$), education level ($p = 0.92$), or age ($p = 0.51$) across the scenarios, indicating that the random assignment was effective.

Consistent with the results of Study 1, most UK participants ($n = 90$) were classified as having an independent cultural orientation, whereas most Taiwanese participants ($n = 89$) were classified as having an interdependent cultural orientation. Participant demographics are in Table 5.

Verifying hypothesis 1

We analyzed the impact of VA recommendations incorporating environmental sustainability content by treating it as a dummy variable, with the control group (no sustainability content) serving as the baseline in a regression analysis. The dependent variable was the intention to adopt VA-recommended hospitality and tourism products or services. Supporting H1, the results showed a significant positive direct effect of VA sustainability content on adoption intention (standardized $\beta = 0.66$, $p < 0.01$).

Responses to the question “Do any of these hotel options work for you and make you want to stay?” provided further empirical support for H1. Chi-square results revealed ($\chi^2(1, N = 191) = 13.62$, $p < 0.01$) that significantly more participants in the group to which the VA did provide sustainability recommendations were willing to consider staying in the VA-recommended hotels (Count_{Yes} = 63, Expected count = 50.3 vs. Count_{No} = 33, Expected count = 45.7) compared with the group to which the VA did not provide environmental sustainability hotel recommendations (Count_{Yes} = 37, Expected count = 49.7 vs. Count_{No} = 58, Expected count = 45.3).

Verifying hypothesis 2

The test of H1 confirmed the direct effect of VA environmental sustainability content on VA recommendation adoption intention. To test the mediation effect role of VA user engagement, following Baron and Kenny's (1986) mediation testing approach, we next conducted a series of regression analysis. The results demonstrated a significant positive effect of VA sustainability content on user engagement with VA (standardized $\beta = 0.89$, $p < 0.01$). A separate regression analysis revealed that user engagement with VA positively influenced the intention to adopt VA recommendation (standardized $\beta = 0.68$, $p < 0.01$). When both VA sustainability content and user engagement were included as independent variables in the regression analysis, user engagement (standardized $\beta = 0.63$) had a stronger significant effect on adoption intention ($p < 0.01$) than sustainability content (standardized $\beta = 0.15$). These findings suggest that user engagement mediates the relationship between VA sustainability content and the intention to adopt VA-recommended hospitality and tourism services or products, supporting H2.

To further examine the effect of VA with (vs. without) environmental sustainability recommendations on engagement with VA, a behavioral measure of willingness to engage with VA recommendations and hear more information about the VA-recommended hospitality and tourism product/service was conducted by asking "Would you like to hear more details about these hotels?" For the group without VA environmental sustainability recommendations, significantly more participants answered "No" compared with those who answered "Yes" (Count_{Yes} = 32, Expected count = 46.3 vs. Count_{No} = 63, Expected count = 48.7). Conversely, in the group with VA environmental sustainability recommendations, a higher number of participants answered "Yes" (Count_{Yes} = 61, Expected count = 46.7 vs. Count_{No} = 35, Expected count = 49.3). This result indirectly supports the notion that VA environmental sustainability recommendations can enhance engagement with VA use (χ^2 (1, $N = 191$) = 17.04, $p < 0.01$).

Verifying hypothesis 3

To examine the moderation effects of VA users' cultural orientation and VA use purpose, a three-way ANCOVA with age, gender, and education as covariates was performed (F (1, 180) = 25.91, $p < 0.01$; Table 6). Again, the analysis revealed a significant direct effect of VA sustainability-related content on user engagement. Participants showed a significantly higher level of engagement with the VA when its recommendations included environmental sustainability-related content ($M = 4.94$, $SD = 0.58$) compared with recommendations that lacked such content ($M = 4.11$, $SD = 0.75$; $p < 0.01$).

A post-hoc Bonferroni correction test further indicated that independently oriented users were more engaged with the VA providing sustainability content when seeking transactional information compared with non-transactional information ($M_{Independent, transactional, with sus. content} = 5.28$, $SD = 0.36$ vs. $M_{Independent, non-transactional, with sus. content} = 4.26$, $SD = 0.59$; $p < 0.01$; Figure 9). Conversely, interdependently oriented participants were more engaged with the VA offering sustainability content during searches for non-transactional information ($M_{Interdependent, non-transactional, with sus. content} = 5.35$, $SD = 0.59$ vs. $M_{Interdependent, transactional, with sus. content} = 4.85$, $SD = 0.83$; $p < 0.01$; Figure 9). No significant differences ($p > 0.05$) were found among the four control groups. These findings provided further verification for H3a and H3b.

Table 6. Study 2 - the effects of use purpose, cultural orientation, and sustainability messaging on VA user engagement.

Measure	SS	df	MS	F	Sig.
Age (covariate)	0.108	1	0.108	0.301	0.584
Gender (covariate)	0.112	1	0.112	0.313	0.577
Education (covariate)	0.068	1	0.068	0.188	0.665
Cultural orientation	0.469	1	0.469	1.306	0.255
Use purpose	1.52	1	1.52	4.235	0.041
Sustainability content	31.902	1	31.902	88.867	0.000
Cultural orientation*Use purpose	4.495	1	4.495	12.523	0.000
Cultural orientation*Sustainability content	2.465	1	2.465	6.868	0.010
Use purpose*Sustainability content	0.16	1	0.16	0.445	0.506
Cultural orientation*Use purpose*Sustainability content	9.243	1	9.243	25.747	0.001

Additional analyses were performed for the interaction effect using the behavioral measure of willingness to hear more information about the VA-recommended environmentally sustainable hospitality and tourism product/service. Based on the findings above, we focused on analyzing the groups *with* VA sustainability recommendations using Chi-square analysis. For VA with environmental sustainability recommendations, Interdependent-oriented participants assigned to non-transactional tasks (Count_{Yes} = 17, Expected count = 14.6 vs. Count_{No} = 6, Expected count = 8.4), and Independent-oriented participants assigned to transactional tasks (Count_{Yes} = 20, Expected count = 15.9 vs. Count_{No} = 5, Expected count = 9.1) showed more willingness to hear more VA-recommended hotel information compared with Interdependent-oriented participants assigned to transactional tasks (Count_{Yes} = 14, Expected count = 15.3 vs. Count_{No} = 10, Expected count = 8.8) and Independent-oriented participants assigned to non-transactional tasks (Count_{Yes} = 10, Expected count = 15.5 vs. Count_{No} = 14, Expected count = 8.8) (χ^2 (3, N = 96) = 9.23, p < 0.05). Similar to the findings from Studies 1 and 2, we

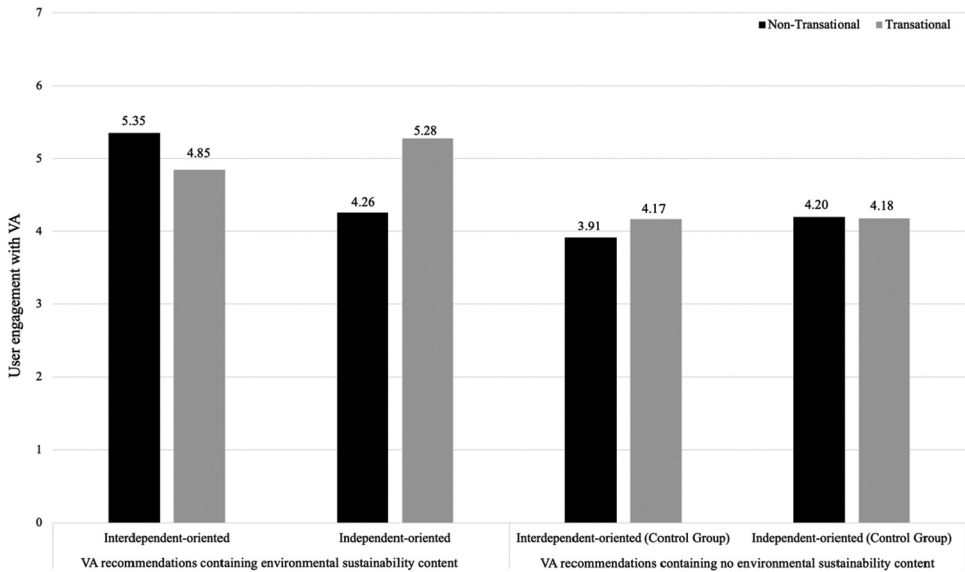


Figure 9. Study 2 - the effect of use purpose, cultural orientation, and sustainability content on user engagement with VA.

further confirmed that there was no significant difference in the groups without VA sustainability recommendations regarding their willingness to ask the VA for more information ($\chi^2(3, N = 95) = .11, p = 0.75$).

These findings provide support for H3, highlighting how VA sustainability recommendations can enhance user engagement and involvement, particularly when aligned with guests' cultural orientations and purposes.

In addition, although not the primary focus of this experiment and also aimed at avoiding the epistemological issues of mixing qualitative and quantitative findings (e.g., Brannen, 2017), the responses to the optional open-ended questions further supported the study's findings. Participants mentioned that, overall, the process of this study aligned with their previous experiences of using VAs (not necessarily Alexa) to search for hotel information, which supports the experimental design realism. Additionally, some participants pointed out that the timing of using VAs differs from general searches. Increasing engagement with VAs would make them more inclined to use VAs in more situations and trust the recommendations provided by VAs more. Some participants noted that the VA's recommendations emphasized the sustainability practices of hotels, which created a positive impression of the recommended hotels and enhanced their perception of the VA itself. Furthermore, participants mentioned that sustainability content served as an additional criterion in their shopping decisions. While it may not have played the most decisive role all the time, the promotion of sustainability did indeed give them significant greater confidence in their purchasing and hotel choices.

Discussion and conclusion

General discussion

The results of the two studies provide empirical support for the proposed hypotheses, confirming that VAs promoting and environmental sustainability-related hospitality content can affectively increase user engagement and recommendation adoptions. While previous research has predominantly focused on VA usage during or post travel (in Table 1), the current research makes an important contribution to the VA literature in the hospitality field by demonstrating that VAs can aid guests in making pre-travel decisions, with efforts toward environmental sustainability from various hospitality service providers being a crucial decision-making factor. These findings complement Jiménez-Barreto et al.'s (2023) results showing that guests often interact with VAs to seek information. This use purpose makes VAs useful marketing tools, significantly boosting the likelihood that their recommendations will be adopted. This can be attributed to guests' heightened engagement with the information and recommendations, as they express their self-worth within society, a concept supported by self-affirmation theory (e.g., Schneider & Weber, 2021; Graham-Rowe et al., 2019).

Extending the research by Acikgoz et al. (2023), which shows that different individuals have different motivations to engage with VAs, the findings further reveal significant differences in the impact of VA-provided environmental sustainability information resulting from cultural orientation and use purpose. For interdependently oriented guests, when their intention to use a VA is non-transactional, the provision of environmental

sustainability information by the VA substantially enhances their engagement. For independently oriented guests, this phenomenon is reversed; when these guests use a VA with transactional intentions, VA-provided environmental sustainability information more effectively enhances their engagement. This inverse relationship underscores the complex interplay between use purpose and the effectiveness of sustainability content delivered by VAs. This finding further expands on Lalwani and Shavitt's (2009) argument, providing additional evidence that self-affirmation theory manifests differently depending on cultural orientation. Specifically, it supports the assumption that individuals from various cultural backgrounds express and affirm their self-worth in different ways, shaped by the values and norms of their respective societies.

These findings underscore the importance of customizing information on sustainable hospitality provided by VAs. To effectively promote sustainable hospitality through VAs, it is crucial to tailor the information provided based on guests' specific intentions and cultural backgrounds. This approach will ensure that AI interactions and problem-solving are well-aligned with user needs, enhancing engagement and effectiveness.

Theoretical implications

While past studies have explored the obstacles and opportunities hotels face when implementing additional hardware to support sustainability initiatives, this research shifts the focus to a more strategic aspect: the need for hotels to recognize, showcase, and effectively communicate their existing sustainability efforts. By doing so, hotels can not only reinforce their commitment to environmental responsibility but also enhance their brand reputation among eco-conscious guests. In particular, this study underscores the crucial role of VAs in this communication process, highlighting how strategically promoting engagement with VAs can serve as a compelling mechanism for delivering messages about environmental sustainability. This addresses the pressing question of how tourism managers can implement VAs more strategically and efficiently to align with sustainability goals (Sigala, 2018).

In addition to advancing knowledge on hotel sustainability communication, this research contributes to the growing body of literature on consumer and guest-related VA engagement, particularly in the realm of tailored messaging. By examining how use purpose and cultural background influence guests' interactions with VAs, this study sheds light on the nuanced ways in which different consumer segments respond to sustainability-focused content (e.g., Acikgoz et al., 2023; Tussyadiah, 2020). Specifically, findings reveal that consumers who are independently oriented – those who value individuality, personal freedom, and self-expression – exhibit heightened engagement with VAs when they deliver environmentally sustainable content in transactional contexts. This suggests that these individuals perceive such interactions as opportunities for self-affirmation and the reinforcement of their eco-friendly identity. By making choices such as selecting sustainable accommodation options, these guests actively construct and project an image of environmental consciousness.

Conversely, interdependently oriented consumers – who place greater emphasis on social harmony, collective relationships, and maintaining group cohesion – demonstrate increased engagement with VAs when sustainability messages are embedded within non-transactional interactions. This pattern suggests that these consumers approach decision-making with a greater degree of flexibility, seeking to gather diverse perspectives and

potentially consulting with their social networks before committing to sustainable travel choices. Their heightened engagement with sustainability messaging in these contexts reflects their inclination to align their actions with broader communal values rather than purely individual preferences.

While previous research on consumer – technology interactions has predominantly drawn upon frameworks such as social exchange theory and the Technology Acceptance Model (e.g., Loureiro et al., 2021), this study takes a different approach by integrating user engagement with the principles of self-affirmation theory. By doing so, we provide a more comprehensive explanation of how consumers interact with VAs when exposed to sustainability-related messaging. Furthermore, this study extends self-affirmation theory into the hospitality domain, underscoring the significance of an individual's sense of self-worth within a societal context. Such findings are consistent with previous studies on how individuals are likely to engage with other pro-social behaviors (e.g. Sparks et al., 2010). Understanding these psychological drivers is essential for optimizing consumer – VA engagement, particularly in ways that enhance awareness and support for environmental sustainability initiatives in the hospitality sector. By leveraging these insights, managers and sustainability advocates can design more effective VA interactions that resonate with diverse consumer segments, ultimately fostering a more environmentally responsible hospitality industry.

Practical implications

Starting from 2017, Amazon began offering hotel booking features in partnership with Expedia, allowing users to inquire about hotel information and make reservations through Alexa. Over time, VAs' hotel booking capabilities have expanded, and now users can easily book hotel rooms using more advanced voice commands. While an increasing number of VA applications now request users' residential regions during account registration, with user consent, to enhance service accuracy. For instance, Apple.com requires users to link their nationality when creating an account to establish the appropriate service region for Apple and Siri (Change your Apple Account country or region - Apple Support UK, 2024). The findings of this study suggest that developers should customize VA messages based on use purpose and cultural orientation. For instance, during the VA setup process, it is recommended that personalized questions be included regarding the user's residential regions (with the user's consent and in compliance with relevant data protection regulations). Additionally, developers should focus on optimizing the identification of user queries to ensure clarity in understanding their usage intentions. Upon obtaining users' consent to send tailored messages, developers can use this information to discern cultural orientation and usage intent. These insights can assist marketing practitioners in the hospitality industry in effectively promoting the environmental sustainability practices associated with their products and services. In raising awareness of environmental sustainability, VAs can also do more than just recommend sustainable products; they can also provide information related to eco-friendly hospitality practices automatically. Highlighting the eco-friendly features of hospitality offerings through VA can also help companies establish environmental sustainability as a lasting competitive advantage.

Additionally, VA devices with AI can actively filter information by interacting with users. When suggesting hospitality products and services, VAs can ask follow-up questions to discern users' goals and plans (Kinsella, 2018; Song et al., 2022). They can present more environmentally sustainable choices for transactional purposes among independently oriented individuals and additional environmental sustainability content for non-transactional purposes among interdependently oriented users. VAs can also enhance consumer experience by providing personalized suggestions based on users' consumption history and preferences. For example, a VA can infer the user's preferences based on their previous hotel bookings and the environmental protection measures emphasized by those hotels, then briefly summarize the sustainability efforts of different hotels that the user values, helping guests make informed travel decisions. Such recommendations can also be contextualized in different countries based on the registered location of the application store to determine the likelihood of users' cultural orientation.

Moreover, these findings shed light on the market segmentation of VA. Although there is global standardization, our research underscores the importance for VA developers to consider cultural differences and various shopping purposes. To optimize effectiveness, developers should acknowledge these distinctions, conduct market research on cultural orientation, and tailor messages to enhance user engagement. By doing so, VA developers can optimize VA algorithms and ask the right questions to uncover the cultural backgrounds and usage purposes of guests. This will help them provide information that more strongly affects guest engagement and promotes the adoption of environmentally sustainable hospitality options. It is equally important for hospitality providers to communicate their environmental sustainability efforts via VA by using paid advertisement with VA developers.

From a marketing strategy perspective, as consumers increasingly prefer faster but more accurate information search, the integration of VA and AI technology to promote environmental protection activities in the hospitality industry is a foreseeable trend. Marketing practitioners in the hospitality sector should leverage VA more extensively and optimize information based on guest usage differences and background variations. In this way, they can enhance VA users' experience and increase their reliance on the VA, thereby boosting its influence on potential guests' final decision-making regarding hospitality choices.

Limitations and future research

We acknowledge that while experiments effectively control biases and study variable relationships (Zhang et al., 2024), the artificial setting may limit real-life applicability. Future studies could replicate these findings across sectors and consider alternative measures, such as social media engagement, to enhance generalizability. Future research could also delve into how such engagement influences long-term outcomes, such as re-purchase behavior or sustained positive attitudes toward a product or service, through longitudinal studies or qualitative methods. The scenarios used in this study were developed with the assistance of pretest participants, ensuring sufficient validity. Future studies are encouraged to test this study's model using different scenarios, which can serve as a reference for VA developers.

Despite the fact that residents of Taiwan and the UK serve overall well as populations with interdependent and independent cultural orientations, respectively, future research could consider replicating the model and assessing the generalizability of results to different countries or regions with more diverse cultural orientations. As new channels and media continue to emerge in the market, particularly for experience-based goods such as hospitality services, practitioners should leverage the unique features of VA to enhance user engagement and service promotion by following this evolving trend.

VAs are increasingly recognized as effective marketing recommendation tools, surpassing traditional channels due to their capacity to learn user preferences and deliver relevant personalized recommendations. The findings of this study indicate that when guests become aware of environmental protection activities through their VA, they tend to engage more deeply and appreciate the sustainable recommendations provided. This suggests that integrating environmentally sustainable practices into hospitality can be a powerful marketing strategy. Going forward, these practices should be leveraged across various technological platforms, both in marketing practice and research. This study focuses on the impact of VA user engagement and VA recommendation adoptions for potential guests using VA under different cultural orientations and usage purposes. Future research could explore the differences between VA and various information search channels.

This study departs from conventional approaches by integrating environmental sustainability information into VA recommendations. The integration of these elements into VA responses was found to resonate with both independently and interdependently oriented users, helping cultivate a preference for green practices within a context of growing environmental consciousness. It is intended that this study of applying VA in hospitality marketing will attract further attention from researchers and practitioners alike.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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