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Virtual reality tourism to satisfy wanderlust without wandering: An unconventional innovation to promote sustainability

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ABSTRACT

The tourism sector has always been a target of criticism due to the adverse environmental effects of travel and activities at tourist destinations. It is thus imperative for researchers and managers to seek tourism solutions that make business sense without raising sustainability-related issues. Particularly in the aftermath of the COVID-19 pandemic, virtual reality tourism (VRT), a form of digitally-driven albeit unconventional ex-situ touristic travel, has attracted the attention of multiple stakeholders in the sector. However, consumers' perceptions of and motivations to use VRT as a sustainable solution for touristic activities are yet not fully understood. We address this deficiency in the literature by drawing upon expectancy theory to propose goal difficulty and reduction in the environmental impact of tourism (REI) as expectancy-related motivations, accomplishment as an instrumentality-related motivation and willingness to sacrifice as a valence-related motivation; we anticipate these motivations, in turn, to drive two outcomes: low- and high-effort pro-environmental behaviours. Analysing data collected from 350 individuals residing in the United States, we found support for all positive associations except for that of goal difficulty with high-effort pro-environmental behaviours and REI with both pro-environmental behaviours. We also tested and confirmed the moderating effects of the number of children in a household and daily green behaviours on some of the proposed associations. Our findings offer useful insights for future research and practice in the area.

1. Introduction

In 2015, the United Nations (UN) General Assembly announced the 2030 Agenda for Sustainable Development with the support of all member nations (Costanza et al., 2016). The agenda spans 17 Sustainable Development Goals (SDGs) aimed at promoting sustainable development by mitigating environmental, social and economic challenges (Gue et al., 2020; Ramirez et al., 2019). Of the social, economic and environmental issues on the agenda, the environmental concerns are perhaps the most challenging because they often result from misguided human efforts to pursue growth at both micro and macro levels. The scholarly literature notes that incessant environmental exploitation has reached a level where these corrosive actions no longer yield any benefits or growth but, instead, jeopardise the very survival of humankind (e.g. Meadows et al., 1972; Bybee, 1991).

In nearly any discussion regarding environmentally detrimental human actions, the tourism sector comes under intense scrutiny (Bhutto et al., 2021; Lenzen et al., 2018). Underscoring the severity of the impact, a recent report revealed that touristic travel accounted for 5% of global carbon emissions in 2016, and this number is estimated to increase to 5.3% by 2030 (Statista, 2021). In addition and perhaps more importantly, past studies have noted tourists' contributions to environmental damage at destinations, which, too, raises serious sustainability issues (Gössling et al., 2021; O'Connor & Assaker, 2021). Alongside these concerns, it is nevertheless important to acknowledge the positive contribution of tourism in promoting economic and cultural richness around the world (Movono et al., 2018). This means that stakeholders in the tourism sector must juggle two competing, high stake priorities: environmental sustainability, on one hand, and economic prosperity, on the other. Clearly, both are important, and neither can be sacrificed for

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the other.

As a culmination of the preceding discussion, we contend that the time is ripe to identify unconventional but viable tourism solutions that balance all competing priorities and offer universally acceptable alternatives. Consistent with recent studies (e.g. Crossley, 2020; Higgins-Desbiolles, 2020), we posit that the best way forward is to work more proactively to develop an environmentally friendly, economically beneficial and sustainable form of tourism. Taking a cue from recent tourism studies (e.g. Talwar, Kaur, Nunkoo & Dhir, 2022; Schiopu et al., 2021; Yung & Khoo-Lattimore, 2019), we present virtual reality tourism (VRT) as a sustainable way to satisfy people's wanderlust without contributing to environmental depletion.

VRT involves the real-time simulation of a touristic destination via visualisation, immersion and interactivity (Gutierrez et al., 2008; Williams & Hobson, 1995; Guttentag, 2010). It thus enables individuals to experience tourist destinations without leaving their current location. Because it does not require physical travel or the physical presence of tourists at destinations, VRT does not generate pollution, nor does it cause environmental degradation at tourist destinations. The question, however, is whether this alternative is acceptable to all stakeholders. The existing evidence is quite positive in this regard. Scholars have noted that in the past few years, the quality of virtual reality technology has improved significantly, which has increased its impact on tourism (e.g. Wei et al., 2019). COVID-19 prevention and control measures have also provided an impetus to VRT, elevating it from a 'gimmicky' mode of tourism to a real option (Debusmann, 2020). Nevertheless, scholars must determine whether the use of VRT will continue at the same pace once the COVID-related restrictions and anxieties have ended. In other words, research must explore the factors that can motivate individuals to continue using VRT in the future. We contend that the answer lies in understanding people's perceptions about VRT, particularly their perceptions that VRT is not only a contextually appropriate solution during the COVID-19 pandemic but, in fact, a long-term solution to address the sustainability-related issues associated with in-situ travel. Recent studies support our endeavour, calling for a closer examination of individuals' perceptions of and attitudes towards using VRT as a sustainable tourism solution after the pandemic (e.g. Talwar, Kaur, Nunkoo & Dhir, 2022). Understanding perceptions and subsequent behavioural changes is also important because supply-side innovations alone are not sufficient to promote a sustainability orientation at the societal, national or global level; rather, consumer-side behavioural changes also play an important role in driving sustainable consumption (Anderson & Bows, 2011; Lorek & Fuchs, 2013). Synthesising these elements, our study examines the factors that motivate individuals to use VRT as a sustainability-oriented, pro-environmental solution for touristic pleasure.

To conceptualise the variables of interest and capture the varied contours of people's perceptions about VRT as a sustainability-aligned option, we drew upon the theoretical framework of expectancy theory (Vroom, 1964). Our choice of this theory is grounded in its acceptance in the scholarly literature as a suitable and substantial framework for explaining the motivations behind individuals' voluntary choices when they have multiple options from which to choose (Abrate et al., 2021; Zboja et al., 2020). In the present context, we view the decision to use VRT for ex-situ, sustainability-oriented touristic travel—despite the possibility of indulging in the traditional, in-situ mode of tourism—as a voluntary choice. Because the theory is woven around three central tenets pivots—expectancy, instrumentality and valence, which jointly create motivational forces driving individuals' choices/behaviours, our intellectual curiosity lies in determining the ways in which these three components drive the choice of VRT as a sustainability-oriented, pro-environmental option. Specifically, we propose to answer the following research questions: **RQ1.** How do expectancy, instrumentality and valence-related factors associate with pro-environmental behaviours? **RQ2.** Do family-related factors and personal environmental inclinations moderate the proposed associations, and if so, how?

Based on our extensive review of the literature on expectancy theory,

consumers' pro-environmental behaviour and tourism (e.g. Chiang & Jang, 2008; Beall et al., 2021; Tang et al., 2021), we identified goal difficulty and reduction in the environmental impact of tourism as the variables to measure expectancy, accomplishment to measure instrumentality and willingness to sacrifice to measure valence. Similarly, we carefully reviewed past studies to understand the evolving views on the measures of pro-environmental behaviour. In doing so, we observed that behavioural manifestations in this context have been measured in terms of individuals' varying degrees of commitment to behave in a pro-environmental manner (e.g. Wu et al., 2020; Halpenny, 2010; Ramkissoon et al., 2013; Song & Soopramanien, 2019; Han, 2015). Hence, we selected high-effort pro-environmental behaviour and low-effort pro-environmental behaviour as the variables of interest to capture the related behaviours. Meanwhile, drawing upon the related literature regarding the influence of household and personal characteristics on sustainability-oriented/pro-environmental choices (e.g. Liu et al., 2020; Sreen et al., 2021; Kumar, Dhir et al., 2021), we sought to investigate the potential moderation effect of the number of children in a household (i. e. households with children versus households without children) and daily green behaviours.

Consistent with recent studies (e.g. Dhir, Talwar, Sadiq et al., 2021; Talwar et al., 2020), we tested the proposed model by collecting data from 350 individuals residing in the United States (US) and analysed it using structural equation modeling. Our findings provide useful theoretical and practical insights. The novel contributions of our study can be enumerated as follows: (a) It answers the persistent calls for research examining pro-environmental behaviours in the tourism sector, particularly in the context of increasing sustainability-related concerns, which have only increased following the pandemic (Gössling et al., 2021; Higgins-Desbiolles, 2020). (b) By promoting VRT as a potentially sustainable tourism option, our study advances the debate regarding the synergy between digitalisation and sustainability, an area that has recently excited the interest of both industry and academia (Gössling, 2020; Gössling & Hall, 2019). (c) Ours is the first study to bring personal efficacy, social orientation, sense of obligation and environmental concerns together as motivational factors that may drive responsible choices in the digital domain.

The remainder of the study is structured as follows. Section 2 presents the study's theoretical foundation in terms of theory, its extension to the present context and the conceptualised model while Section 3 presents the hypotheses and their formulation. Data and analysis appear in Section 4 followed by the results in Section 5 and the discussion in Section 6. Finally, Section 7 discusses the implications, limitations and future research avenues.

2. Theoretical foundation

2.1. Expectancy theory

Vroom (1964) proposed expectancy theory as a theory of motivation. Conceptualised to explain and illuminate subjectively rational human behaviour, expectancy theory suggests that when making decisions, humans evaluate various alternatives while keeping the most desirable outcome in mind. In doing so, they attempt to maximise pleasure and minimise pain from a personal perspective (Zboja et al., 2020). Tang et al. (2021) describe it as a theory that explicates the process of human decision-making in the face of multiple behavioural choices. To elaborate, the key premise of the theory is that its three constructs—expectancy, instrumentality and valence—drive individuals' motivations, which, in turn, impact those individuals' specific behaviours. In our study, as in past studies (e.g. Chiang & Jang, 2008; Hsu et al., 2010), expectancy captures people's perceptions that actions and performance are linked with attractive outcomes; meanwhile, instrumentality links the achievement of desired outcomes with the extent of effort deployed, and valence represents an individual's assessment of how attractive a particular outcome is. Recent studies have employed

this theory in various contexts, such as online dating (Sharabi, 2020), dividend decisions (Sarwar & Hassan, 2021), employee ownership and firm productivity (Kim & Patel, 2021), tourism (Abrate et al., 2021), team gossip (Spoelma & Hetrick, 2021), cognitive understanding (Weber et al., 2020) and government research and development (R&D) subsidies (She et al., 2021).

Based on our understanding of the related literature, we contend that expectancy theory is ideal to extrapolate to the current research context because the theory implies that right actions produce desired personal outcomes and that increased effort increases the probability of attaining such outcomes. Specifically, expectancy theory is suitable to conceptualise consumer behaviour related to VRT for five main reasons. First, originally postulated as a theory of motivation, expectancy theory is a well-regarded and investigated theory by industrial and organisational researchers to understand behaviours (e.g. Karatepe & Sokmen, 2006; Kilic & Okumus, 2005). Second, previous scholars have successfully utilised the theory to examine pro-environmental behaviours in various contexts (e.g. Kiatkawsin & Han, 2017; Tang et al., 2021). Third, scholars have employed expectancy theory in the specific context of tourism to explain tourists' choices in terms of destinations, activities, etc. (e.g. Hsu et al., 2010). Fourth, a substantial and robust body of literature establishes and supports expectancy theory's premise that beliefs (in the present context, sustainability-oriented ones) shape people's perceptions and behaviours (e.g. Crum & Phillips, 2015). Finally, the three components of the theory, proposed as antecedents, allow us to contemplate a variety of aspects associated with tourists' sustainability-oriented decision-making process; these aspects span the subjective, cognitive and affective dimensions, enabling us to present a model that delves deeper into consumers' assessment process.

2.2. Conceptualising variables of interest within the expectancy theory framework

Expectancy refers to an individuals' belief that effort will lead to the intended performance goals. Typically, this belief is based on the individual's past experience and self-confidence as well as the perceived difficulty of the performance standard or goal. Factors associated with expectancy perception include goal difficulty and intended performance goals, among others. We identified goal difficulty and intended performance goals as the two measures of expectancy that are aligned with the context of our study. Accordingly, we formulated the items by reviewing the past literature to measure goal difficulty (Chiang & Jang, 2008; Shi et al., 2017; Han, 2015; Han, Jae & Hwang, 2016). Next, to suitably reflect the context, we captured intended performance goals through a variable termed 'reduction in the environmental impact of tourism' based on pertinent scholarly literature (e.g. Toivonen, 2020; Xu et al., 2020).

Instrumentality is an individual's belief that he or she will receive the desired outcome by meeting the performance expectation. The desired outcome may take the form of a pay increase, promotion, recognition or sense of accomplishment. In the present study, we captured instrumentality through accomplishment to underscore the notion that the sense of accomplishment that arises from engaging in sustainability-oriented behaviours would serve as a motivational force. We formulated the related items by reviewing the past literature (e.g. Chiang & Jang, 2008; Nimri et al., 2015).

Valence captures the exclusive value that individuals place on a given result. Needs and goals are the key factors associated with valence, along with aspects such as values, preferences, motivations and the strength of one's preference for the said result/outcome. The role of valence is important to understand an individual's preference for a given outcome since different people are motivated by different things. For example, one employee might find a bonus desirable, while another might find flexible working hours more desirable than a bonus. Keeping in mind the relevance of the variables in the sustainability-oriented/pro-environmental context of the present study, we measured preferences

and the strength of individuals' preferences for particular outcomes through their willingness to sacrifice, which is a key construct in tourism and pro-environmental settings (e.g. O'Connor & Assaker, 2021; Talwar, Kaur, Nunkoo & Dhir, 2022).

Next, we conceptualised the outcome variables based on ongoing discussions in the literature about pro-environmental behaviours. Offering a practically appealing view, scholars have argued that pro-environmental behaviours include different types (e.g. Stern, 2000), further suggesting that one way of delineating the type of behaviour is the degree of difficulty required to implement or practice it (e.g. Thøgersen, 2004). The literature has further categorised pro-environmental behaviours as low and high effort, with low-effort behaviours referring to acts that require a smaller commitment of physical resources than do high-effort behaviours, which are relatively more challenging and demanding (Coelho et al., 2017). Drawing upon this categorisation and the relevant literature (e.g. Wu et al., 2020; Halpenny, 2010; Ramkissoon et al., 2013; Song & Soopramanien, 2019; Han, 2015), we measured our study's outcome variables in terms of these two degrees of pro-environmental behaviours: low-effort and high-effort.

To conceptualise the intervening variables and evaluate the potential influence of individual differences on the strength of the proposed direct associations, we further extended the basic expectancy theory. After comprehensively reviewing the literature we identified two potential moderators: (a) daily green behaviours (e.g. Liu et al., 2020) and (b) the number of children in a household. Our choice of the number of children as a moderating variable was guided by the fact that family size may affect family members' pro-environmental choices (Kumar, Dhir et al., 2021).

In sum, our proposed research model theorises goal difficulty, reduction in the environmental impact of tourism, accomplishment and willingness to sacrifice as motivational forces representing the three core components of expectancy theory: expectancy, instrumentality and valence. We propose that these variables, in turn, drive the two outcomes: low-effort and high-effort pro-environmental behaviours. We further hypothesise daily green behaviours and the number of children in a household to moderate these associations. Finally, our proposed model controls for the possible confounding effects of other demographic and travel-related variables, including age, gender, household size, educational background, preferred travel mode (solo/group) and preferred travel type (domestic/international and VRT experience). Table 1 provides the operational descriptions of the study variables while Fig. 1 presents the research model.

3. Hypotheses development

3.1. Expectancy and pro-environmental behaviours

Prior findings suggest that both cognitive and affective aspects influence individuals' intentions to exhibit pro-environmental behaviours (Kazeminia et al., 2016). In other words, because pro-environmental behaviours are not monolithic but, to a large extent, utilitarianly as well as effectively driven and dependent on the discretion of the concerned individuals, various related factors may serve to motivate or dissuade such behaviours.

In the present context, the expectancy component of expectancy theory captures individuals' belief that given their self-efficacy and perceived goal difficulty, their effort will lead to a desirable result (Chiang & Jang, 2008). We have thus used goal difficulty to measure the cognitive aspect of the motivational force that may deter or encourage individuals to use VRT to derive touristic pleasure. Similarly, we have captured the affective aspect through the reduced environmental impact of tourism, which represents individuals' perceived probability that their effort is likely to lead to a desirable outcome.

Goal difficulty is an important consideration here because VRT is a technological innovation, which is subject to both adoption and non-

Table 1
Operational description of study variables.

Study variable	Description
MOTIVATIONAL FORCES	
<i>Expectancy</i> : Goal difficulty (GD)	GD captures individuals' view that VRT is not too difficult to use. In other words, it refers to individuals' belief that learning to use VRT to enjoy touristic travel in an environment-friendly way does not require significant effort—that it is easy and not excessively time-consuming. It also reflects people's belief that they can use VRT effectively.
<i>Expectancy</i> : Reduction in the environmental impact of tourism (REI)	REI represents individuals' belief that their use of VRT can reduce the negative impact of both their travel to a destination and their activities at the destination. In other words, it measures individuals' belief that using VRT can reducing the ecological footprint of their touristic travel by limiting the environmental damage and emissions that result from travel, on the one hand, and decreasing sustainability issues, protecting the natural environment and reducing waste generation at tourist destinations on the other.
<i>Instrumentality</i> : Accomplishment (AC)	AC captures individuals' belief that using VRT to enjoy touristic travel in an environment-friendly way enables them to make a greater impact on the community/society. In other words, it reflects individuals' belief that by using VRT as an environment-friendly mode of tourism, they can encourage their friends, family, social circle and peers to do the same.
<i>Valence</i> : Willingness to sacrifice (WS)	WS is a key sustainability-oriented motivator, which indicates the preference of individuals to sacrifice the pleasure and enjoyment they can derive from in-situ/real-time travel and use VRT instead because it will protect the environment, support sustainability initiatives and reduce the pollution associated with tourism. The variable also represents individuals' acceptance of VRT due to its contribution to minimising transportation-related greenhouse gas emissions and supporting sustainability initiatives at destinations that have been closed for environmental reasons. Finally, it captures the pandemic context by measuring individuals' view that they can forgo the enjoyment of real-time travel and use VRT instead because it helps to reduce the spread of viral infections.
OUTCOMES	
Low-effort pro-environmental behaviour (LP)	LP captures individuals' pro-environmental behaviour related to their willingness to use VRT to enjoy touristic travel in an environment-friendly way in the near future. It also measures their willingness to expend effort to use, learn more about and support the use of VRT, a sustainability-oriented touristic travel option, when the opportunity arises. The word 'low' represents the limited investment that individuals must make to behave in these pro-environmental ways.
High-effort pro-environmental behaviour (HP)	HP captures individuals' pro-environmental behaviour related to their willingness to expend additional effort to undertake touristic travel—for example, by spending money to purchase subscription VR tourism apps. It also measures individuals' additional commitment to increase VRT's popularity as a sustainability-oriented choice by writing blogs, posts and vlogs, writing online reviews on various sites and apps to inform others about VRT and volunteering their

Table 1 (continued)

Study variable	Description
	time to participate in projects to promote VRT as an environmentally-friendly mode of touristic travel. The word 'high' represents the appreciable investment individuals must make to behave in these pro-environmental ways.
MODERATORS	
Daily green behaviours (DGs)	DGs capture individuals' day-to-day, environmentally responsible and sustainability-oriented behaviours. Such behaviours include individuals' active participation in green (environment-related) activities, preference for renewable energy sources in their daily lives and regular recycling of waste generated at home. DG also encompasses individuals' readiness to talk to friends about problems related to the environment and make conscious efforts to conserve water and electricity in their homes.
Number of children	Number of children is a categorical variable composed of two groups: respondents with children and respondents without children.
CONTROLS	
Demographic profile-related variables	The demographic variables are age, gender, household size and educational background; of these, gender is a binary variable, while the others are ordinal variables.
Travel-related variables	Preferred travel mode (solo/group), preferred travel type (domestic/international) and VRT experience are all measured as dichotomous categorical variables composed of two groups each.

adoption related aspects, such as perceived ease of use (tom Dieck et al., 2018), resistance to technology and technological anxiety (Kamal et al., 2020). To explain further, past findings have linked technology use with complexity, suggesting that if an innovation is complex or difficult to use, it is less likely to diffuse among potential users (Rogers, 1995). At the same time, existing scholarship suggests that it would be more insightful to view complexity holistically by considering individuals' ability to use an innovation, which is dependent on self-efficacy (Bandura, 2000). In the context of this study, the preceding discussion on complexity and ability implies that perceived goal difficulty may play an important role in motivating individuals to use VRT. Because lack of information and time have been found to dissuade pro-environmental behaviours (McKenzie-Mohr & Smith, 1999), moreover, we anticipate that perceived goal difficulty—how easy, effortless and quick VRT is to learn and use for touristic travel—will positively motivate individuals' pro-environmental behaviour of both low and high effort. Hence, we propose the following hypothesis:

H1: Goal difficulty is positively associated with (a) low-effort pro-environmental behaviour and (b) high-effort pro-environmental behaviour.

Recognising the environmental damage caused by human activities, scholars have repeatedly asserted the need for consumers to develop a sense of responsibility towards sustainability and the environment (e.g. Segarra-Oña et al., 2015). Such an emphasis has produced positive effects, with recent studies categorically noting an observable increase in consumers' environmental awareness; this awareness, in turn, has translated into an increased demand for green and environmentally friendly products (Campos-Soria et al., 2018; Aibar-Guzmán & Somohano-Rodríguez, 2021; Dhir, Talwar, Sadiq et al., 2021). Because the tourism sector is among the key contributors of environmental damage (Gössling et al., 2021; Talwar, Kaur, Nunkoo & Dhir, 2022), the same trend of growing awareness to avert negative environmental impact

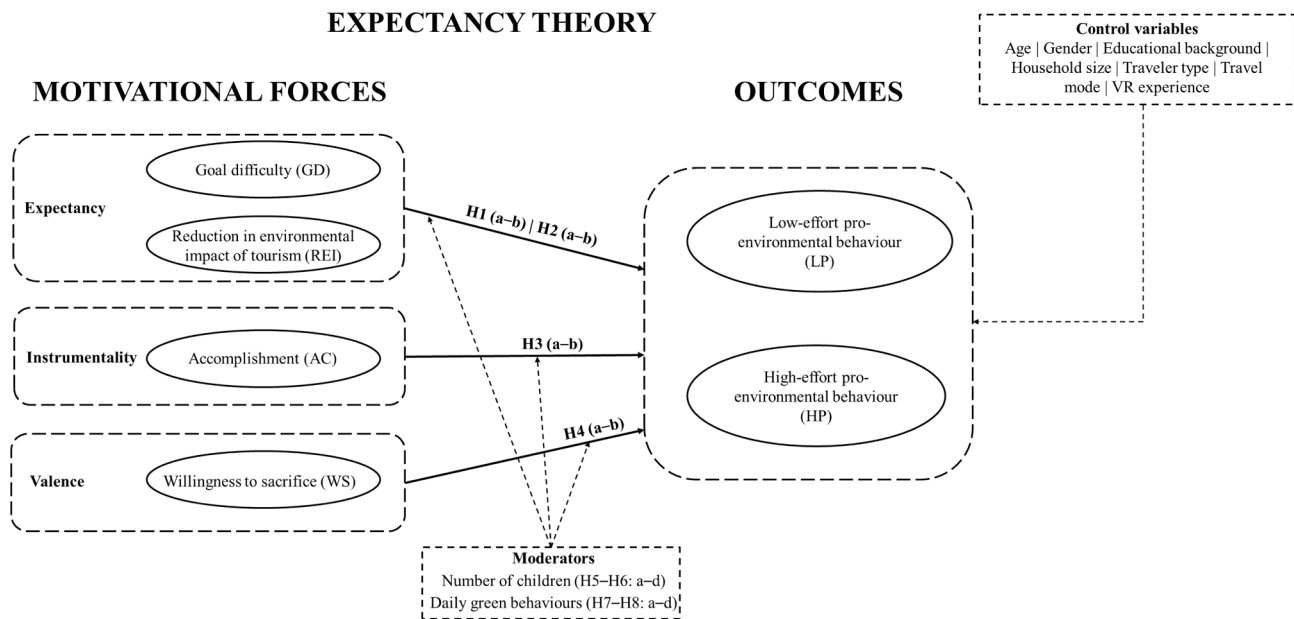


Fig. 1. Proposed research model.

appears there as well, with efforts being made to utilise products and improvements that facilitate outcomes such as energy efficiency (S. Kim, Filimonau & Dickinson, 2020). Other studies have also provided evidence in this regard (e.g. Han, Yu et al., 2019; Shin et al., 2018).

The preceding argument indicates that increasing concerns about human actions that deplete the environment and raise sustainability issues drive consumers' pro-environmental behaviours and decisions. This provides us a basis to suggest that in the present context, individuals' awareness about environmental issues may increase as a result of their touristic activities. We expect that this increasing awareness, coupled with the existence of VRT as an environmentally friendly mode of touristic travel, will cause individuals to exhibit low- and high-pro-environmental behaviours. Hence, we posit as follows:

H2: A reduced environmental impact of tourism is positively associated with (a) low-effort pro-environmental behaviour and (b) high-effort pro-environmental behaviour.

3.2. Instrumentality and pro-environmental behaviours

A substantial segment of the scholarly literature considers pro-environmental behaviour a manifestation of the sense of moral obligation that individuals feel they and those around them have to avoid actions that damage and take actions that preserve the environment (e.g. Han, Yu et al., 2019; Kim, Woo & Nam, 2018; O'Connor & Assaker, 2021). For instance, Chen (2016) found that moral norms drive pro-environmental behaviours, such as energy-saving. Scholars have also linked environmentally responsible behaviours with social practices (Kantenbacher et al., 2019). Specifically, research has linked social norms with the willingness to make or reject pro-environmental choices (Keizer & Schultz, 2018). Accordingly, past studies have emphasised that the expression of sustainability-oriented behaviours or the lack thereof depends upon varied social aspects (e.g. Darnton et al., 2011; Spurling et al., 2013). Similarly, past studies have noted that individuals' personal norms impact their pro-environmental behaviours and decisions (Groot et al., 2021; Pearce et al., 2022).

In the current context, an accomplishment, which measures the instrumentality component of expectancy theory, can also be interpreted to reflect the personal norms or obligations that can motivate individuals to do the right thing from a sustainability perspective (Schultz et al., 2016; Joanes, 2019). The preceding discussion leads us to

speculate that making a difference from a social point of view or appearing socially responsible through personal pro-environmental choices is likely to enhance individuals' own efforts to exhibit sustainability-oriented behaviours. Therefore, we contend that the sense of accomplishment that people derive from making sustainability-oriented choices and thereby encouraging others to do the same is likely to positively impact their own pro-environmental behaviours of both low and high effort. The preceding discussion provides us with a basis to propose the following hypothesis:

H3: Accomplishment is positively associated with (a) low-effort pro-environmental behaviour and (b) high-effort pro-environmental behaviour.

3.3. Valence and pro-environmental behaviours

Past studies have conceptualised valence as an affective component of expectancy theory, describing it as a net measure of the difference between the value an individual perceives to derive from an action and the costs incurred to take that action (Weber et al., 2020). Because valence weighs costs and benefits, it must be understood in terms of an individual's willingness to make an economic sacrifice for a cause, a concept well-recognised in the tourism literature (e.g. Kantenbacher et al., 2019; O'Connor & Assaker, 2021; Rahman & Reynolds, 2016). The concept of valence is also grounded strongly in multiple theoretical frameworks, including economic sacrifices theory, which postulates that the willingness to make economic sacrifices for environmental protection drives pro-environmental behaviours (Hedlund, 2011; Kantenbacher et al., 2019). Contending that willingness to make sacrifices should be seen through a broader lens that extends beyond mere economic sacrifice, we employ the construct to capture individuals' willingness to opt for VRT over the traditional—and less environmentally friendly—mode of in-situ tourism. Furthermore, while most prior studies have theorised willingness to sacrifice as an outcome or mediating variable impacted by antecedents such as commitment to the environment and sense of environmental obligation (Coy et al., 2013; Landon et al., 2018; O'Connor & Assaker, 2021), we consider willingness by itself as a force that is likely to increase individuals' commitment to exhibit both low- and high-effort pro-environmental behaviours. Hence, we propose the following hypothesis:

H4: Willingness to sacrifice is positively associated with (a) low-effort pro-environmental behaviour and (b) high-effort pro-environmental behaviour.

3.4. Moderation effect of the number of children and daily green behaviours

In addition to the proposed direct associations presented above, we relied on the prior consumer behaviour and tourist behaviour literature (e.g. Talwar, Kaur, Nunkoo & Dhir, 2022) to contemplate the moderation effect of pertinent intervening variables. To this end, we identified moderating variables that reflect how individual families and their habits may affect the strength of the associations between motivational forces and pro-environmental behaviours. Accordingly, we identified the number of children (households with children versus households without children) as one moderating variable to capture the impact of individuals' family profiles on their pro-environmental choices. Although, to our knowledge, no prior study has investigated the moderation effect of the number of children on the association between motivational forces proposed in the expectancy framework and individuals' pro-environmental behaviours, we contend that it is quite plausible to expect people with children to have a stronger sense of commitment to protecting the environment for future generations than do those without children. Thus, it is pertinent to evaluate the moderation effect of having children versus not having children on the proposed associations. Similarly, we identified daily green behaviours to capture individuals' habituated green behaviour in their daily lives, which may—consciously or instinctively—impact their pro-environmental choices.

Our choice of these moderating variables is not completely devoid of support in the literature. In fact, we extrapolated the potential moderation effect of number of children from the findings of past studies that have confirmed the effect of family profile on the strength of pro-environmental behavioural manifestations (e.g. Kumar, Dhir et al., 2021). Similarly, past studies have confirmed the effect of habitual behaviours on other behaviours—both current and future (e.g. Ajzen, 2002), which led us to consider this possible moderation effect in the present context as well. In addition, recent studies on pro-environmental behaviours have considered the moderation effect of habits and routines, such as planning routines and daily green behaviour, among others (e.g. S. Talwar, Dhir, Scuotto & Kaur, 2021; Liu et al., 2020).

Further, we developed an interest in examining the moderation effect of daily green behaviours after noting a particular subject of academic curiosity: While habits are considered reliable predictors of behaviours (Lenzen et al., 2018), the tourism literature has argued that individuals on touristic ventures might become disconnected from daily life and, consequently, ignore their daily routines (Pritchard & Morgan, 2006; Urry, 1990). We thus wondered whether this same association between habits and behaviours holds in the context of VRT, which is a hybrid kind of activity where individuals remain at home while enjoying touristic travel. This curiosity further compelled us to examine the moderation effect of daily green behaviours on the associations of expectancy, instrumentality and valence with low- and high-effort pro-environmental behaviours. We begin by anticipating a positive moderation effect for both moderation variables. Taking into consideration the preceding argument and existing evidence, we posit as follows:

H5: Number of children (having children versus no children) positively moderates the strength of the associations of (a) goal difficulty, (b) reduced environmental impact of tourism, (c) accomplishment and (d) willingness to sacrifice with low-effort pro-environmental behaviour.

H6: Number of children (having children versus no children) positively moderates the strength of the associations of (a) goal difficulty, (b) reduced environmental impact of tourism, (c) accomplishment

and (d) willingness to sacrifice with high-effort pro-environmental behaviour.

H7: Daily green behaviours positively moderate the strength of the associations of (a) goal difficulty, (b) reduced environmental impact of tourism, (c) accomplishment and (d) willingness to sacrifice with low-effort pro-environmental behaviour.

H8: Daily green behaviours positively moderate the strength of the associations of (a) goal difficulty, (b) reduced environmental impact of tourism, (c) accomplishment and (d) willingness to sacrifice with high-effort pro-environmental behaviour.

3.5. Control variables

The current study proposes to test the confounding effect of seven control variables—four demographic profile-related variables: age, gender, household size, educational background and three travel-related variables: preferred travel mode (solo/group), preferred travel type (domestic/international) and VRT experience. Our choice of socio-demographic variables as controls is based on their documented confounding effects on consumer behaviour, including pro-environmental behaviours (Annunziata et al., 2019; Kumar, Talwar et al., 2021; Talwar, Dhir, Scuotto & Kaur, 2021). The choice of these control variables also aligns with previous studies on VRT (e.g. El-Said and Aziz, 2021; Van et al., 2020). We have thus drawn upon past findings that have revealed the influence of travel-related control variables, such as travel mode, on travellers' choices, such as risk-taking (e.g. Steffen et al., 2020; van Genderen et al., 2014).

4. Data and methods

4.1. Instrument development

To test the proposed hypotheses, we collected self-report data based on participants' subjective perceptions. We prepared the questionnaire to collect data by modifying existing pre-validated scales so that they better aligned with the conceptualisation of our study. We followed all procedural steps discussed in recent studies to ensure the face and content validity of the developed questionnaire (e.g. Dhir, Talwar, Kaur et al., 2021). First, we consulted three experts from the areas of sustainability and VRT to evaluate whether the proposed items correctly captured the intended constructs. Based on their feedback, we modified some of the items to make them more representative of the underlying constructs. Thereafter, we pilot-tested the instrument by inviting 14 respondents who represented our target group. The purpose of this test was to assess whether the language of the items was clear, appropriate and easy to understand. The respondents confirmed that most of the items were unambiguous and clearly conveyed the intended meaning. The structured questionnaire thus developed measured each item on a five-point Likert scale, where 1 indicated strongly disagree and 5 indicated strongly agree. The factor loading table presents the items and the sources later in the paper.

4.2. Data collection and study of respondents

We invited the survey participants via the online crowd-sourcing platform, *Prolific Academic*. The survey was open to all adults who were between the ages of 21 and 50, residing in the US and aware of VRT, preferably with a recent experience of it. We identified the US as the geography of interest for the following reasons: (a) VR use is projected to rise considerably in the country, with usage estimates for North America as a whole at nearly 20% by 2025 (Alsop, 2021), (b) Interest in virtual travel has increased exponentially in the US, as evidenced in the quadrupling of Google search volume from March 2019 to March 2020 (Buglar, 2020) and (c) The United Nations Sustainable Development Agenda 2015 mandates that developed nations should work on the sustainability agenda (Belmonte-Ureña et al., 2021), making it

important for scholars and practitioners to understand the sustainability-oriented behaviours of individuals in these countries.

We received 350 valid responses and compensated those respondents per the *Prolific Academic* policy. Because the data included no outliers or missing responses, we proceeded with all 350 responses for our analysis. Table 2 presents the respondents' socio-demographic profile.

4.3. Data analysis

We analysed the collected data using SPSS and AMOS (Version 27). Following the standard approach for covariance-based structural equation modelling (CB-SEM), a popular data analysis method employed by recent studies (e.g. Luqman et al., 2021), we first assessed the fit of the measurement model and evaluated the reliability and validity of the measurement scale. Thereafter, we analysed the structural model and confirmed support for the proposed hypotheses on the basis of the statistical significance of the generated path coefficients (Byrne, 1994).

5. Results

5.1. Preliminary analysis

First, we examined the data for their multivariate characteristics to ascertain their suitability for path analysis using CB-SEM modelling. We thus examined skewness and kurtosis values to ascertain the probability distribution of the data. Both values fell within the prescribed limits, confirming that the data were normally distributed. Next, consistent with recent studies (Talwar, Dhir, Scuotto & Kaur, 2021), we examined

Table 2
Respondents' profile.

Variable	Percentage	Frequency
Gender		
Female	38.6	135
Male	61.4	215
Age group		
21–25 years	7.4	26
26–30 years	31.7	111
31–35 years	29.1	102
36–40 years	18.6	65
41–45 years	9.7	34
46–50 years	3.4	12
Household size		
Live alone	14.9	52
Two members	29.4	102
Three members	21.7	76
Four members	26.6	93
Five members	4.6	16
More than five members	2.9	10
Children		
Don't have children	58.9	206
One child	16	56
Two children	20.3	71
Three children	3.1	11
More than three children	1.7	6
Educational background		
Less than high school	0.3	1
High school	14	49
College	16	56
Bachelor's	38.9	136
Master's	24	84
Doctorate	6.9	24
Virtual reality experience		
No	5.4	19
Yes	94.6	331
Travel mode		
Solo	45.1	158
Group	54.9	192
Travel type		
Domestic	45.4	159
International	54.6	191

the variance inflation factors (VIF) and tolerance values of each construct to check for any multicollinearity issues. All VIF values were less than 4, and all tolerance values exceeded 0.1, thereby confirming the absence of multicollinearity issues.

Subsequently and consistent with recent empirical studies (e.g. Tandon et al., 2021), we examined the data for common method bias (CMB). This was necessary because we measured all of our independent and dependent variables using a single, self-reported instrument. To this end, we employed both ex-ante procedural remedies to prevent CMB at the data collection stage and post-hoc statistical techniques to check for the presence of CMB after collecting the data. First, we followed the non-statistical procedure for data collection recommended by MacKenzie and Podsakoff (2012). We thus ensured that the questionnaire was not so long that it fatigued the respondents, and we kept the language of the items simple, clear and easy to understand. We also did not reveal the actual purpose of the study and presented the survey items in a randomised order. Furthermore, to address the participants' apprehensions about self-disclosure and potential judgement, we guaranteed their full anonymity and confidentiality. We also pre-tested the final questionnaire by soliciting responses from 10 participants who represented the target sample, as discussed by Hulland et al. (2018).

Next, we used two post-hoc techniques—Harman's single-factor test and the CFA marker technique—to determine whether any CMB-related issues persisted in the collected data. The test results revealed that a single factor explained only 42.55% of the total variance. This value—well below the recommended cut-off of 50% (Dhir, Talwar, Sadiq et al., 2021)—indicated that CMB was not an issue in the collected data. We also used the CFA marker technique with 'blue attitude,' a commonly used marker variable (Simmering et al., 2015). The analysis, which produced values in line with recommended value ($r < 0.06$), revealed that this variable had no significant correlation with the other variables under study and thus confirmed the absence of CMB (Chin et al., 2013).

5.2. Measurement model, validity and reliability

As the first step of data analysis, we conducted a confirmatory factor analysis (CFA) to test the quality of the measures used to collect the data. To this end, we assessed the measurement model by examining the model fit indices and the reliability and validity statistics. The goodness-of-fit indices were consistent with the recommended values and thus indicated an acceptable model fit (Hair et al., 2020). Specifically, the values were as follows: chi-square/degree of freedom ($\chi^2/df = 1.86$), comparative fit index ($CFI = 0.96$), Tucker–Lewis index ($TLI = 0.96$) and root mean square error of approximation ($RMSEA = 0.05$).

Although we had adapted the survey items from pre-validated scales, we nevertheless confirmed the instrument's validity and reliability with the following measures. First, we examined all items' factor loadings to confirm that they were consistent with the recommended values (see Table 3). Next, we examined the composite reliability (CR) and average variance extracted (AVE) values. The CR values ranged from 0.88 to 0.95 and thus exceeded the recommended cut-off of 0.7, while the AVE values ranged from 0.59 to 0.73 and thus exceeded the recommended cut-off of 0.5 (Carmines & Zeller, 1979; Fornell & Larcker, 1981). Thereafter, we assessed the instrument's discriminant validity through various measures employed in prior studies (e.g. Talwar, Dhir, Kaur & Mäntymäki, 2020). We thus ensured that (a) the square root of the AVE exceeded the correlations among the respective constructs and (b) the inter-correlation between any two constructs was less than the required cut-off. In addition, we conducted an HTMT analysis, which indicated that the inter-construct correlations fell below the recommended threshold of 0.85 (Henseler et al., 2015). Tables 4–5 report the specific values.

5.3. Control variables

We controlled the proposed model for the confounding effects of

Table 3
Measurement items and loadings.

Study measures	Measurement items	CFA	SEM
Goal difficulty (GD)	I believe it does not require much time to learn how to use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.79	0.79
	I believe it is not difficult to learn how to use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.76	0.76
	I believe it does not require much effort to learn how to use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.84	0.84
	I believe it is easy to learn to use VR tourism as a way of enjoying touristic travel in an environmentally -friendly way.	0.82	0.81
Reduction in the environmental impact of tourism (REI)	I can effectively use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.64	0.64
	I believe my use of VR tourism will reduce the ecological footprint of my touristic travel.	0.84	0.84
	I believe my use of VR tourism will protect the environment from the negative impact of tourism.	0.84	0.84
	I believe my use of VR tourism will reduce emissions caused by my touristic travel.	0.89	0.89
	I believe my use of VR tourism will reduce the sustainability issues arising from tourist services offered at a tourist destination.	0.88	0.88
	I believe my use of VR tourism will protect the natural environment at a tourist destination.	0.86	0.86
	I believe the use of VR tourism can reduce waste produced at a tourist destination.	0.77	0.77
	I believe by using VR tourism to enjoy touristic travel in an environmentally-friendly way, I can encourage my friends and peers to do the same.	0.93	0.93
Accomplishment (AC)	I believe by using VR tourism to enjoy touristic travel in an environmentally-friendly way, I can encourage my family to do the same.	0.87	0.87
	I believe by using VR tourism to enjoy touristic travel in an environmentally-friendly way, I can encourage my social circle to do the same.	0.92	0.92
	I believe by using VR tourism to enjoy touristic travel in an environmentally-friendly way, I can encourage my social circle to do the same.	0.92	0.92
Willingness to sacrifice (WS)	I believe forgoing the enjoyment of real-time travel and instead using VR tourism as a way of enjoying touristic travel in an environmentally-friendly way is acceptable because it will protect the environment.	0.84	0.84
	I believe forgoing the enjoyment of real-time travel and using VR tourism instead is acceptable because it will support sustainability initiatives.	0.86	0.86
	I believe forgoing the enjoyment of real-time travel and using VR tourism instead is acceptable because it will reduce pollution.	0.89	0.89
	I believe forgoing the enjoyment of real-time travel and using VR tourism instead is acceptable because it will help in reducing the spread of viral infections.	0.74	0.74
		0.80	0.80

Table 3 (continued)

Study measures	Measurement items	CFA	SEM
Low-effort pro-environmental behaviour (LP)	I believe forgoing the enjoyment of real-time travel and using VR tourism instead is acceptable because it will support destinations closed due to environmental reasons.		
	I believe forgoing the enjoyment of real-time travel and using VR tourism instead is acceptable because it will minimise transportation-related greenhouse gas emissions.	0.86	0.86
	I am willing to use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.83	0.83
	I will expend effort to use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.84	0.84
	I am willing to support the use of VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.84	0.84
	I am willing to learn more about VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.77	0.77
	I am willing to frequently use VR tourism to enjoy touristic travel in an environmentally-friendly way.	0.87	0.87
	I am willing to use VR tourism the next time I want to enjoy touristic travel in an environmentally-friendly way.	0.88	0.88
	I am willing to use VR tourism in the near future when I want to enjoy touristic travel in an environmentally-friendly way.	0.92	0.92
	I am willing to use VR tourism whenever I get an opportunity to enjoy touristic travel in an environmentally-friendly way.	0.86	0.86
High-effort pro-environmental behaviour (HP)	I will pay for a subscription to VR tourism apps to enjoy touristic travel in an environmentally-friendly way.	0.74	0.74
	I will write blogs/posts/vlogs to make VR tourism popular to enjoy tourist travel in an environmentally-friendly way.	0.84	0.85
	I will write online reviews on various sites/apps to inform others about VR tourism as a way to enjoy touristic travel in an environmentally-friendly way.	0.86	0.86
Daily green behaviours (DGs)	I will volunteer my time to participate in projects to promote VR tourism as a way to enjoy touristic travel in an environmentally-friendly way.	0.85	0.85
	I always participate in green (environment-related) activities.		Moderator
	I talk with friends about problems related to the environment.		
	I prefer renewable energy sources in my daily life.		
	I consciously try to save water and electricity in my home.		
	I always recycle waste in my home.		

seven control variables on the two outcome variables. The results indicated that none of the four socio-demographic variables—age, gender, household size and educational background—or the three travel-related variables—preferred travel mode (solo/group), preferred travel type (domestic/international) and VRT experience—had any controlling effect on low- or high-effort pro-environmental behaviours.

Table 4
Reliability and validity statistics.

	CR	AVE	MSV	ASV	HP	GD	REI	AC	WS	LP
HP	0.89	0.68	0.39	0.23	0.83					
GD	0.88	0.60	0.16	0.08	0.16	0.77				
REI	0.94	0.72	0.47	0.22	0.36	0.27	0.85			
AC	0.93	0.82	0.46	0.30	0.62	0.28	0.47	0.91		
WS	0.93	0.69	0.47	0.32	0.49	0.29	0.68	0.59	0.83	
LP	0.96	0.73	0.47	0.34	0.62	0.39	0.48	0.68	0.69	0.85

Table 5
HTMT analysis.

	GD	REI	AC	WS	LP	HP
GD						
REI	0.285					
AC	0.310	0.472				
WS	0.312	0.692	0.595			
LP	0.432	0.482	0.689	0.689		
HP	0.174	0.365	0.640	0.504	0.630	

5.4. Structural model

Path analysis of the structural model returned an acceptable model fit, with the recommended indices conforming to the required values (Hair et al., 2020). Specifically, the values were as follows: chi-square/degree of freedom ($\chi^2/df = 1.67$), comparative fit index (CFI = 0.96), Tucker–Lewis index (TLI = 0.95) and root mean square error of approximation (RMSEA = 0.04).

After confirming the goodness-of-fit, we examined the path coefficients to test the associations between the four motivational forces and the two pro-environmental behaviours through eight hypotheses proposing direct effects. The results supported H1a ($\beta = 0.16, p < .001$) but not H1b ($\beta = -0.02, p > .05$). Statistical analysis also failed to yield support for either H2a ($\beta = -0.02, p > .05$) or H2b ($\beta = -0.03, p > .05$). However, H3 (a–b) and H4 (a–b) received statistical support (H3a: $\beta =$

0.39, $p < .001$; H3b: $\beta = 0.50, p < .001$; H4a: $\beta = 0.42, p < .001$; H4b: $\beta = 0.23, p < .01$). Overall, the model explained 63.8% of the variance in low-effort pro-environmental behaviour and 44.8% of the variance in high-effort pro-environmental behaviour. Fig. 2 presents the standardised path coefficients for all the proposed associations.

5.5. Moderation analysis

We tested the proposed moderation hypotheses (H5a–d, H6a–d, H7a–d and H8a–d) by running Model 1 in PROCESS macro with 5000 times bootstrapping. The results, presented in Table 6 and Figs. 3–7, revealed a positive moderation effect for both variables—number of children and daily green behaviours—on the associations of reduced environmental impact of tourism and accomplishment with high-effort pro-environmental behaviour. Thus, H6b–c and H8b–c received support. In addition, number of children also positively moderated the association between reduced environmental impact of tourism and low-effort pro-environmental behaviour, offering support for H5b. The results did not support the other moderation hypotheses (H5a; 5c–d; H6a, d; H7a–d and H8a, d).

6. Discussion

The current study aimed to examine the relationship between motivational forces and pro-environmental behaviours via two research questions. The underlying variables were grounded in the theoretical

EXPECTANCY THEORY

MOTIVATIONAL FORCES

OUTCOMES

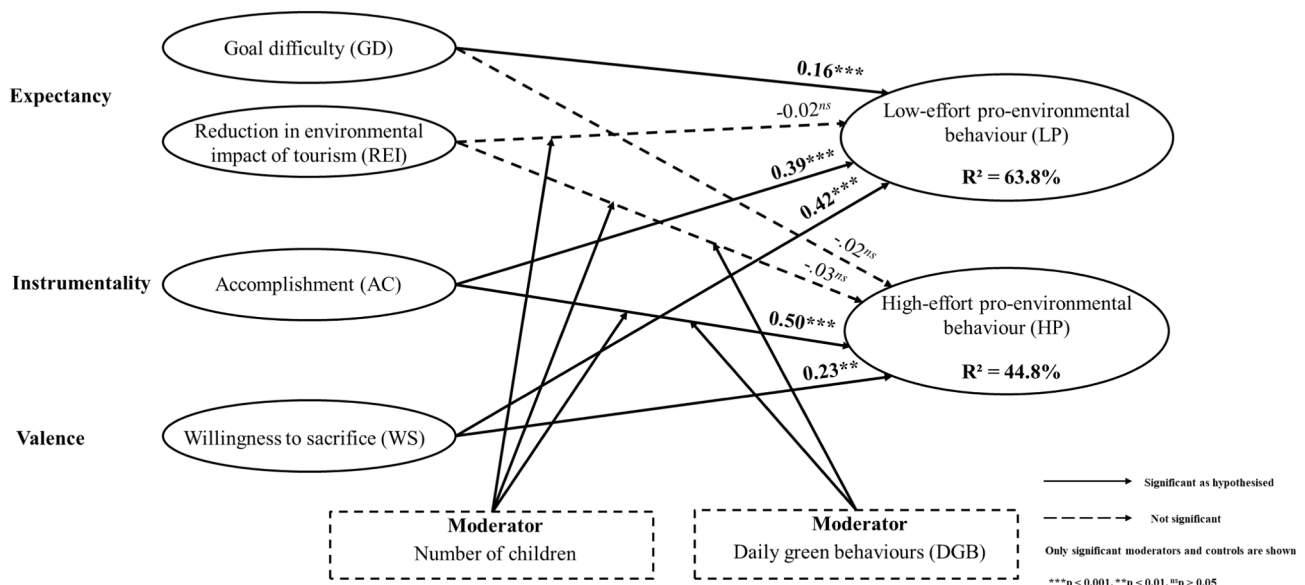


Fig. 2. Research model with path coefficients.

Table 6
Results of moderation analysis.

	β	t	p	LLCI	ULCI	Moderation?
Number of children						
GD → LP	0.01	0.09	0.93	-0.2552	0.2793	No
EI → LP	0.20	2.12	0.03	0.0149	0.3882	Yes
AC → LP	-0.04	-0.60	0.55	-0.1922	0.1024	No
WS → LP	0.04	0.47	0.64	-0.1155	0.1883	No
GD → HP	-0.15	-0.83	0.41	-0.4951	0.2012	No
EI → HP	0.27	2.24	0.03	0.0337	0.5129	Yes
AC → HP	0.23	2.32	0.02	0.0344	0.4183	Yes
WS → HP	0.16	1.48	0.14	-0.0528	0.3768	No
Daily green behaviours						
GD → LP	-0.01	-0.19	0.85	-0.1511	0.1243	No
EI → LP	0.01	0.18	0.86	-0.0805	0.0969	No
AC → LP	-0.02	-0.54	0.59	-0.0968	0.0551	No
WS → LP	0.03	0.74	0.46	-0.0476	0.1046	No
GD → HP	0.09	0.92	0.36	-0.0988	0.2717	No
EI → HP	0.11	1.74	0.08	-0.0137	0.2246	Yes
AC → HP	0.09	1.67	0.10	-0.0157	0.1916	Yes
WS → HP	0.09	1.58	0.12	-0.0222	0.2033	No

edifice of expectancy theory (Vroom, 1964). We addressed RQ1, which inquired into the associations between the four motivational forces and the two levels of pro-environmental behaviours by proposing goal difficulty and reduction in the environmental impact of tourism as expectancy-related motivational forces, accomplishment as an instrumentality-related motivational force, willingness to sacrifice as a valence-related motivational force and low- and high-effort pro-environmental behaviours as outcome variables. H_{a-b} examined the associations between goal difficulty and low- and high-effort pro-environmental behaviours while H_{2a-b} examined the association between reduction in the environmental impact of tourism and low- and high-effort pro-environmental behaviours. The results support only the positive association of goal difficulty with low-effort pro-environmental behaviour. This indicates that individuals who believe it is easy to learn and effectively use VR tourism—i.e. that it does not require much time or effort—are more willing to support and use it frequently. Because these associations have not been examined in any context before, however, we have no specific a priori evidence on which to draw for comparisons. Nevertheless, our results are consistent with our expectations based on the prior extended literature (e.g. Chiang & Jang, 2008; tom Dieck et al., 2018).

In contrast, our study indicates the absence of an association between

goal difficulty and high-effort pro-environmental behaviours. The results also fail to support associations between reduction in the environmental impact of tourism and either of the pro-environmental behaviours. These results run counter to our overarching expectations based on prior findings (e.g. Kamal et al., 2020; Shin et al., 2018). While it is rather difficult to explain, the timing of the study, the sample profile or the specific geographic context may have produced this deviation. If so, these are important aspects that require further clarification so that managers’ decisions in different geographies with different target segments are informed by reliable and specific research inputs. We, therefore, suggest that future researchers retest these associations empirically, targeting different cultural contexts and varied demographic profiles within each context.

Our results support a positive association between accomplishment and both degrees of pro-environmental behaviours proposed in H_{3a-b}. These outcomes align with those of past studies in various contexts (e.g. Han, Yu et al., 2019; Kim et al., 2018; O’Connor & Assaker, 2021). The results indicate that individuals who believe they can—through their own example—encourage their family, friends, peers and social circle to use VRT to enjoy touristic travel in an environmentally friendly way will tend not only to use VRT frequently but also to spend time, money and effort to support and promote its use. In addition, our results reveal positive associations between willingness to sacrifice and both degrees of pro-environmental behaviours, as proposed in H_{4a-b}. These outcomes are consistent with our expectations based on the extrapolation of the extended literature regarding expectancy theory and pro-environmental behaviours (e.g. Weber et al., 2020; Kantenbacher et al., 2019). Statistical support for these two hypotheses suggests that individuals who believe that VRT will protect the environment, support sustainability initiatives, reduce pollution, control the spread of viral infections, advance sustainability initiatives and minimise transportation-related greenhouse gas emissions will be willing to forgo the pleasure of in-situ tourism and expend significant effort and resources on VRT.

To respond to RQ2, we tested the moderation effects of number of children (households with children versus households without children; H_{5a-d}, H_{6a-d}) and daily green behaviours (H_{7a-d}, H_{8a-d}) on the positive associations between the motivational forces and the two degrees of pro-environmental behaviours. Ultimately, our results support only some of the proposed moderation effects we had anticipated based on the prior pro-environmental consumption literature (e.g. Kumar, Dhir et al., 2021; S. Talwar, Dhir, Scuotto & Kaur, 2021; Liu et al., 2020).

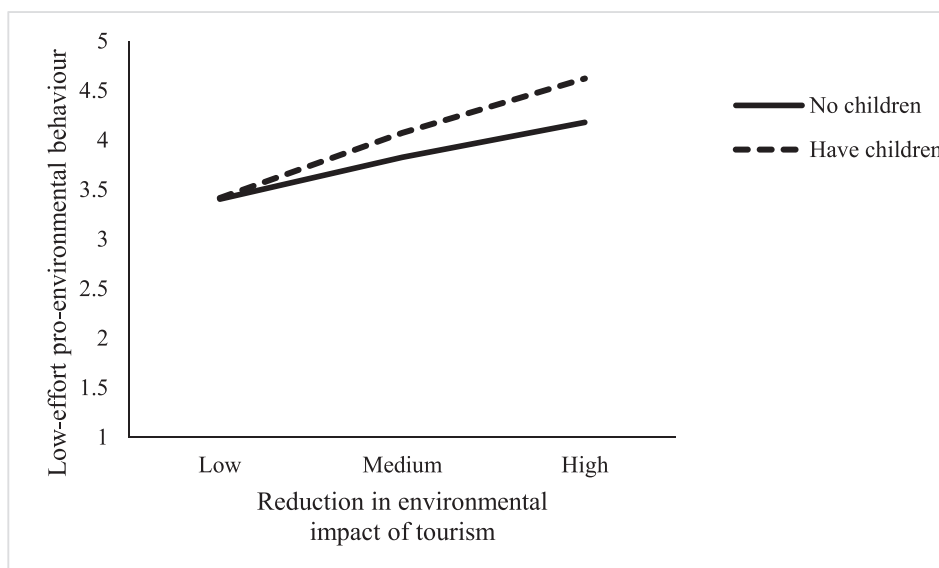


Fig. 3. Moderation effect of the number of children.



Fig. 4. Moderation effect of the number of children.

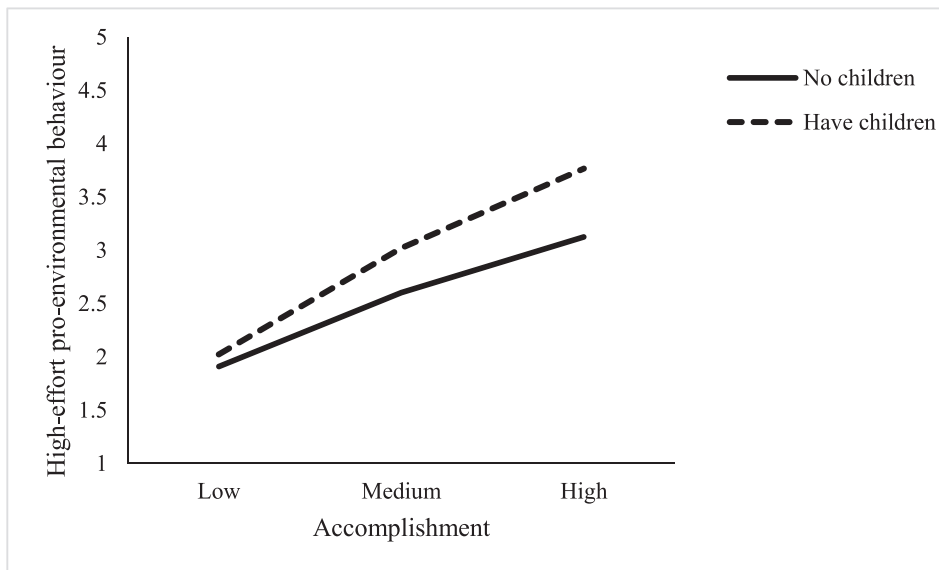


Fig. 5. Moderation effect of the number of children.

According to our findings, number of children positively moderates the associations between reduced environmental impact of tourism and both low- and high-effort pro-environmental behaviour. These findings support **H5b** and **H6b**. Number of children also moderates the association between accomplishment and high-effort pro-environmental behaviour, indicating support for **H6c**. These results, which also appear in Figs. 3–5, indicate that individuals without children are less likely to exhibit low-effort pro-environmental behaviour than are individuals with children. Irrespective of whether they have children, moreover, individuals who expect a greater reduction in the environmental impact of tourism are more likely to exhibit low-effort pro-environmental behaviour than are those who expected a lower reduction in the environmental impact. We observed similar outcomes in the case of high-effort pro-environmental behaviours. More specifically, individuals without children are less likely to exhibit high-effort pro-environmental behaviour than are those with children regardless of their expectations regarding the extent of reduction in the environmental impact of tourism or their sense of accomplishment. In fact, individuals who

expect a lower level of reduction in environmental impact and a lower sense of accomplishment are less likely to exhibit high-effort pro-environmental behaviour than are those with more positive perceptions about the two variables.

Next, the results of the moderation analysis indicate that green behaviours positively moderate the associations of reduced environmental impact of tourism and accomplishment with high-effort pro-environmental behaviour. These results, which support **H8b–c** and appear in Figs. 6–7, imply that individuals who exhibit lower levels of daily green behaviours are also less likely to exhibit high-effort pro-environmental behaviour than are those who exhibit higher levels of daily green behaviours regardless of their perceptions regarding the extent of reduction in the environmental impact of tourism or their sense of accomplishment. In other words, individuals who expect a greater reduction in the environmental impact of tourism and a stronger sense of accomplishment are more likely to exhibit high-effort pro-environmental behaviour than are those with lower perceptions of the two.

Our results fail to support the other moderation hypotheses (**H5a**,

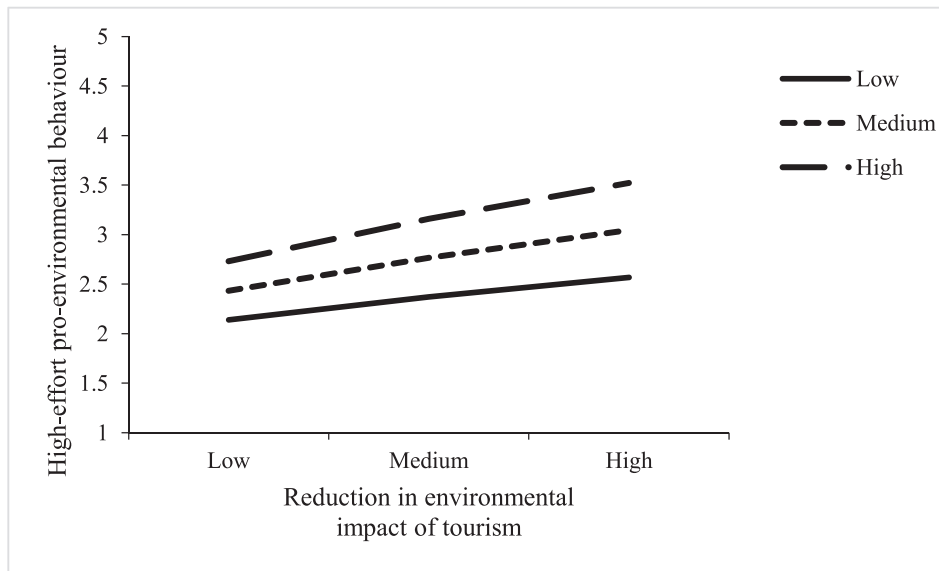


Fig. 6. Moderation effect of daily green behaviours.

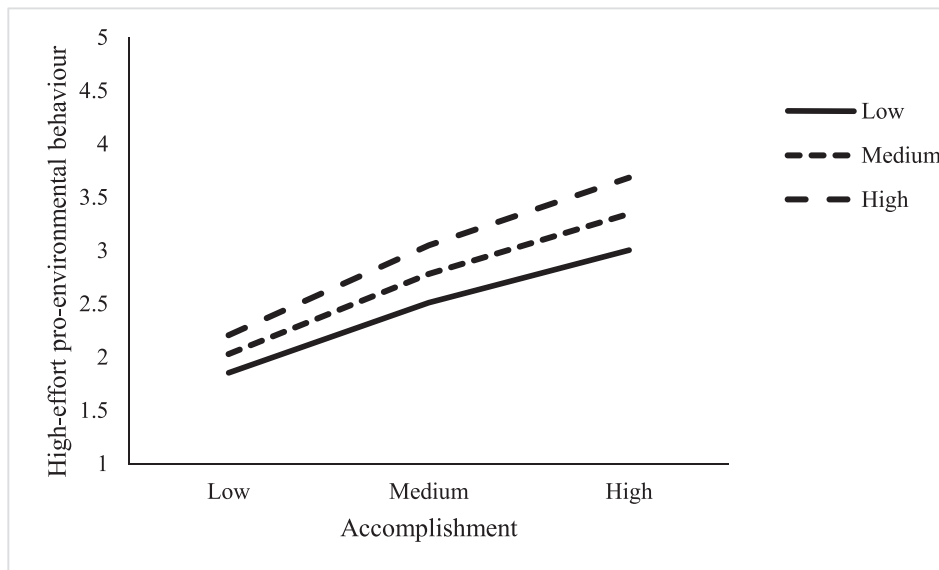


Fig. 7. Moderation effect of daily green behaviours.

c–d, H6a,d, H7a–d and H8a,d). This is a rather confounding outcome because all motivational forces are related to environmental effects, and the selected moderators should have played some role in the associations between these motivational forces and the proposed pro-environmental outcomes. We speculate that the size or profile of our sample may have produced these statistically insignificant outcomes and recommend testing these moderation effects with a larger sample. We further recommend that future researchers conduct qualitative studies to better understand the factors that may weaken or strengthen the associations between individuals’ motivations and their behaviours regarding the use of VRT as a sustainability-oriented tourism alternative.

7. Implications, limitations and future research areas

The results of our study offer several key theoretical and managerial implications, which we discuss below.

7.1. Theoretical implications

The four key theoretical implications of our study are as follows. First, our study answers the call for research into the ways in which digital technology can be leveraged to support and advance the sustainability agenda across various sectors, including tourism, which is among the most significant contributors to environmental issues (e.g. Gössling, 2020; Talwar, Kaur, Nunkoo & Dhir, 2022). Through our investigation of the drivers of tourists’ pro-environmental behaviours, we also illuminate behaviours on the demand side. This is an important contribution because this area of research has, thus far, remained deficient (Campos-Soria et al., 2018) despite substantial evidence indicating that a sustainability orientation is not merely the responsibility of the supply side (the sector and associated stakeholders) but also of the demand side (individuals as tourists; Lee & Moscardo, 2005). In particular, a limited number of studies have examined the use of VRT in this context (e.g. Schioppa et al., 2021) while overlooking emphatic calls for closer analysis of sustainability-oriented behaviours in the tourism sector (e.g.

Gössling et al., 2021; Higgins-Desbiolles, 2020).

Second, our study is the first to examine the factors that impact varying degrees of voluntary behaviour in the tourism sector, which our study captures through low- and high-effort pro-environmental behaviour. Because behaving pro-environmentally is, beyond a certain point, a personal choice that legal statutes cannot dictate, efforts to draw attention to the motivations that drive such choices are quite useful—not only in suggesting viable practical solutions but also in laying the foundation for ongoing research that can support the industry well into the future. Specifically, our study identifies contemporary and contextual variables, such as goal difficulty, accomplishment and willingness to sacrifice, as practical reasons tourists may (or may not) make a sustainability-oriented choice that is as unconventional as selecting an innovative ex-situ tourism solution (i.e. VRT) rather than a traditional in-situ option.

Third, our study extends expectancy theory to model digitally-driven, sustainability-oriented/pro-environmental behaviours in the tourism sector—an endeavour that, to our knowledge, prior studies have not undertaken. Because the literature has derived robust insights on choice behaviour from expectancy theory (e.g. Abrate et al., 2021), our study strengthens the theoretical foundations of the area. Furthermore, scholars have argued that efforts to motivate pro-environmental behaviour are crucial for creating sustainable communities and monitoring the impact of human activities today on ecosystems in the future (Wheaton et al., 2016). Therefore, insights based on the forces motivating pro-environmental behaviours are valuable for sustaining such behaviours. In this regard, our study contributes to a better theoretical understanding of the area by elucidating the factors that might cause people not only to utilise VRT frequently but also to increase their commitment to expend effort and resources to support and promote its use.

Finally, by contemplating the moderation effects of two less explored but relevant variables—number of children and daily green behaviours, our study adds an interesting dimension to the literature on VRT as an unconventional but attractive sustainability-oriented innovation. While past studies have examined family size, habits and routines as important intervening variables influencing individuals' pro-environmental choices (e.g. Kumar, Dhir et al., 2021; Talwar, Dhir, Scuotto & Kaur, 2021; Liu et al., 2020), the literature regarding VRT has yet to consider these variables' moderation effects. Although our results support the moderation effects of these two variables on only some of the hypothesised associations, these findings help to advance research regarding ways to strengthen digitally-driven, sustainability-oriented behaviours.

7.2. Managerial implications

Our findings also offer four useful and actionable insights for practice. First, our findings reinforce the notion that digitalisation and sustainability indeed represent a synergy that can enable various stakeholders to combat the mounting pressure to reduce tourism's detrimental effects (both through travel and at destinations) on the environment and resources. Our position aligns with the increasing demand for various sectors to deploy technological innovations that offer sustainability-oriented solutions (e.g. Schiavone, 2020). We thus recommend increased investment—at both public and private sector levels—in R&D activity focused on improving the VRT experience. In fact, the resulting innovations are likely to reinforce the positive mindset of current users towards VRT and position VRT as a preferred solution for a wider range of individuals seeking leisure in tourism.

Second, our results reveal that consumer awareness of and preference to use VRT as a viable, sustainable tourism alternative have increased substantially, especially during and after the COVID-19 pandemic (Debusmann, 2020). For managers, these positive trends suggest VRT as an extremely effective—and, indeed, tangible and visible—way in which to pursue their green/sustainability agendas. With scholars highlighting the frequent accusations of 'greenwashing' lodged

against the corporate sector (e.g. Dhir, Talwar, Sadiq et al., 2021; Arun et al., 2021), we offer managers a win-win solution by presenting VRT as a sustainable tourism alternative that consumers find increasingly acceptable. This implies that devoting increased investment and manpower towards promoting VRT as a key service can allow managers, on the one hand, to increase revenues and, on the other, to enhance their firms' image by highlighting their efforts to pursue sustainable solutions.

Third, our findings can help relevant stakeholders to identify ways to increase consumer engagement and commitment to expend greater effort on pro-environmental behaviours in the context of VRT. Simply put, our results reveal that 'just being good' does not motivate people to engage in pro-environmental behaviours. More specifically, using VRT to reduce the environmental impact of their own touristic activities does not positively associate with individuals' low- or high-effort pro-environmental behaviour. In other words, the expectation that individuals will be able to reduce the environmental impact of their activities does not serve as a motivational force from a sustainability perspective. However, when an element of accomplishment based on being *perceived* as 'doing the right thing' by one's family, friends, peers and social circle enters the picture, people tend to make an additional effort to engage in pro-environmental behaviours. In fact, our study confirms the positive associations between accomplishment and both degrees of pro-environmental behaviour. We present similar findings in the case of willingness to sacrifice by forgoing the enjoyment of real-time travel and using VRT to protect the environment. With prior studies confirming the social aspect and orientation towards the greater good in various environmental contexts (e.g. Joanes, 2019; O'Connor & Assaker, 2021), we suggest that practitioners use these two aspects in various awareness, informational and marketing communications to nudge individuals in the right direction.

Finally, our findings confirm the positive moderation effects of having children and habituated green behaviours on the associations between the studied motivational forces and low- and high-effort pro-environmental behaviours. This implies that inculcating family values and green habits at an early age might prove to be quite beneficial not only by increasing people's commitment to use VRT as a sustainability-oriented solution but also by making it their instinctive choice since habits are known to impact behaviours (Lenzen et al., 2018).

7.3. Limitations and future research areas

Despite its notable contributions to research and practice, the present study suffers from certain limitations related to its method and scope. First, from a methodological perspective, the study relied on data collected through a self-report, one-wave cross-sectional survey from only one geographical location, i.e. the US. Consequently, the generalisability of our research outcomes may be limited, and issues associated with cross-sectional studies may have impacted our results. We did, however, employ several procedural remedies to mitigate potential data-related issues, as discussed in the preceding parts. With regard to a single geography, we contend that our choice of the US context is relevant because the country's developed economy is acknowledged as a pioneer in technological innovations and a leader for sustainability-oriented behaviours across the world. Future scholars can test our model by collecting data via longitudinal research designs and also by focusing on other geographies where VRT use has diffused.

Regarding scope, we adhered to certain conceptual boundaries to keep the study manageable. Thus, we examined only limited aspects of expectancy theory. Future research should consider additional constructs relevant to the theory, such as perceived value (Kim & Yun, 2019) and green self-efficacy (Chen, Chang & Lin, 2014). Furthermore, we recommend that future studies incorporate variables such as threat perception, frequency of VRT use, active vs passive usage and number of years of VRT usage experience to account for their moderating or confounding effects on the hypothesised associations and outcome

variables.

CRedit authorship contribution statement

Shalini Talwar: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Data curation, Conceptualization. **Puneet Kaur:** Writing – review & editing, Writing – original draft, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Octavio Escobar:** Validation, Supervision, Methodology, Investigation, Data curation, Conceptualization. **Sai LAN:** Writing – review & editing, Supervision, Project administration, Methodology.

Declaration of Competing Interest

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

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