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Digitalization and sustainability: virtual reality tourism in a post pandemic world

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ABSTRACT

The government-imposed COVID-19 pandemic control measures brought the tourism sector to a complete halt. However, virtual reality (VR) tourism offered people a way to escape the isolation. Media reports and research have noted heightened activity in VR tourism, which has been touted as "alternative tourism" and "eco-tourism". However, scholars have yet to determine whether this shift is temporary or will persist after the pandemic is over. Questions also remain regarding the factors driving this behaviour. The present study uses stimulus-organism-response theory (SOR) to propose a sequential mechanism of the interplay of antecedents and outcomes, theorising VR tourism as a sustainable tourism solution long into the future. The model, tested by analysing 359 responses collected from VR users through *Prolific Academic*, confirmed the positive association of the environmental impact of touristic travel and pandemic travel anxiety with eco-guilt; pandemic travel anxiety, moreover, was also associated with attitude towards VR tourism. Furthermore, attitude towards VR tourism was positively associated with willingness to forgo the pleasure of in-situ tourism and post-pandemic VR tourism continuance intentions, with willingness also mediating the association between the other two. Finally, willingness partially mediated the association of attitude and fully mediated the association of eco-guilt with intentions.

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Introduction

Virtual reality (VR) tourism (e.g. M. J. Kim et al., 2020), also called 'VR travel', is a technology-driven mode of travel that provides tourists with virtual experiences through a three-dimensional environment created using computer technology (Guttentag, 2010). VR tourism allows tourists to experience a destination virtually without travelling physically to the place. At the same time, it offers immersive, realistic and authentic sensory participation to travellers (e.g. Gibson & O'Rawe,

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2018; Mura et al., 2017). VR is based on a simulated and interactive environment that is driven by the active involvement of tourists (Lee et al., 2021). It utilises three-dimensional (3D) technology that comprises visual, kinetic and audio to provide tourists with an experience of a real object (Williams & Hobson, 1995). Past literature has discussed VR tourism in detail, delving deeply into the experiences VR offers to distinguish between fully-, semi- and non-immersive VR, as noted by Beck et al. (2019). These VR experiences are delivered through apps and viewed through hardware devices, such as Google Cardboard, Oculus by Facebook or PlayStation by Sony. Some of the tourist experiences that can be provided through VR include interplanetary voyages, fantasy world trips, theme park visits and sporting events (Dewailly, 1999).

Trial experiences of VR have been used as a tool to market tourism-related products and services (Bogicevic et al., 2019; Wei et al., 2019; Yung & Khoo-Lattimore, 2019). Recently, the adoption and use of VR tourism in the tourism and hospitality sector has increased, with many international brands, including Airbnb, Carlson and Hilton, utilising it as a marketing tool (Ting, 2016). Although VR tourism has been successfully employed as a marketing tool, its relevance and usefulness has increased further because of the COVID-19 pandemic (Chinazzi et al., 2020). Sanitary control measures introduced by governments across the world restricted travel and tourism, causing individuals to pursue travel experiences through VR technologies (Rogers, 2020). Scholars project VR tourism in a new light, suggesting that the social distancing requirement to protect oneself from infection has positively influenced the desire for touchless travel since the pandemic's inception (Serra & Leong, 2020). For example, Buglar (2020) found that average monthly searches for "virtual reality tours" rose significantly from 775 searches in February 2020 to 4,561 searches in March 2020 – a staggering 488% increase. The United Kingdom (UK) witnessed a tripling of searches between February and March 2020 while the US witnessed a nearly four times increase during the same period. It remains to be seen, though, whether this surge in the use of VR travel will continue after the pandemic.

Empirical studies examining the effect of the COVID-19 pandemic on VR tourism have recently increased (e.g. Itani & Hollebeek, 2021; T. Yang et al., 2021; Schiopu et al., 2021; El-Said & Aziz, 2021; Y. Li et al., 2021; Sarkady et al., 2021). These studies have largely focussed on VR travel adoption during the pandemic and its effects on well-being. However, few studies have examined tourists' post-pandemic usage intentions towards VR travel. Drawing upon media reports and existing findings, we posit that post-pandemic VR tourism is a phenomenon with various nuances, which must be considered before determining whether it will or will not persist as an ex-situ mode of tourism in the post-pandemic world. We contend that fully comprehending the ways in which individuals respond to VR tourism in the post-pandemic period requires identifying, evaluating and explaining VR tourism's multiple dimensions – beyond the linear lens of COVID-19 related fears.

According to the World Travel and Tourism Council (World Travel and Tourism Council (WTTC),),), 2020), the successful resurgence of tourism in the post-pandemic world requires the alignment of four essential pillars: health, sustainability, security and technology. Therefore, post-pandemic consumer behaviour towards VR tourism should be understood through the prismatic view of sustainability (i.e. the environmental aspect), technology, security and health-related concerns. VR tourism is a technological innovation that addresses travellers' sustainability-related concerns while also alleviating their security – (i.e. safety of life, protection from infection, etc.) and health-related concerns during the COVID-19 pandemic. This is consistent with the extant literature, which has discussed VR tourism as a sustainable mode of tourism (Schiopu et al., 2021; Yung & Khoo-Lattimore, 2019).

Pro-environmental behaviours are critically important for tourism, a sector known for its detrimental effects on the environment (Gossling et al., 2021). This concurs with recent calls to examine tourists' environment-related behaviours during and after the COVID-19 pandemic (Crossley, 2020; Higgins-Desbiolles, 2020). However, existing studies have not delved into the affective and non-economic aspects of tourism during the COVID-19 pandemic, such as changes in tourists' consumption choices or sustainability behaviours as a result of a health crisis (Senbeto & Hon,

2020). This important gap must be urgently addressed because the ongoing pandemic may serve as a final warning for individuals to alter their consumption choices and behave in more environmentally responsible ways (Hall et al., 2020). Recognising the need to better understand consumers' sustainability-oriented behaviours, a recent study (O'Connor & Assaker, 2021) examined the association between individuals' pandemic and travel behaviours. The study confirmed the indirect effect of risk perception regarding COVID-19 on pro-environmental travel behaviour through a willingness to make economic sacrifices for environmental protection, environmental responsibility, environmental moral obligation and environmental concerns. We propose to use this study to discuss and build upon this earlier study's findings by examining individuals' response to VR tourism as a specific pro-environmental travel behaviour that will persist after the pandemic. In essence, we suggest that travellers' post-pandemic behaviour should be examined not only through the lens of pandemic-related anxiety but also from the perspective of environmental sustainability.

We draw upon the stimulus-organism-response theory (SOR; Mehrabian & Russell, 1974) to propose and theorise the antecedents of pro-environmental behaviour, conceptualised as post-pandemic VR tourism continuance intentions. Our choice of SOR is motivated by its use in prior pro-environmental studies (e.g. S. Kumar et al., 2021; Tandon et al., 2021). At the same time, SOR is suitable for our study because it offers a relevant framework for grounding our research objectives. Specifically, we seek to answer three research questions (**RQs**): **RQ1.** How do informational and environmental stimuli drive individuals' pro-environmental internal states in the context of the pandemic? **RQ2.** How do these internal states induce a pro-environmental tourism-related response in individuals impacted by the pandemic? **RQ3.** Do underlying moderating and mediating mechanisms affect the anticipated associations? We posit that informational and environmental stimuli arising from environmental concerns and pandemic-related travel anxiety impact individuals' sustainability-oriented internal states, causing them to develop guilt as well as a pro-sustainability attitude. This further increases individuals' willingness to sacrifice the pleasure they would derive from their in-situ touristic travel and enhances their intentions to exhibit sustainable intentions to use VR tourism in the post-pandemic period. In addition, we examine the mediation and moderation effects to uncover the complex mechanism of the interaction of stimuli, organism and response. The proposed model is tested with data collected from 359 individuals based in the UK.

The unique contributions of our study are as follows: (a) as the first empirical study to propose VR tourism (technology) as a sustainability measure to mitigate the environmental fallout of touristic travel in the post-pandemic world, our work aligns with the four key pillars – health, security, technology and sustainability – the World Travel and Tourism Council (World Travel and Tourism Council (WTTC), 2020) identified while deliberating on the future of the tourism sector in the wake of the pandemic, and (b) it is the first study to examine consumer perceptions regarding VR tourism as a sustainable travel solution in the post-pandemic world, while also taking into account consumers' current vaccination status and travel mode (solo vs group travel). Prior studies have focussed either on the sustainability aspect of VR tourism (e.g. Wiltshier & Clarke, 2017) or the usage aspect (M. J. Kim et al., 2020; M. J. Kim et al., 2020; M. J. Kim & Hall, 2019). None have brought usage, pandemic and sustainability together.

Theoretical background

Covid-19 pandemic and virtual reality tourism

Past studies on VR tourism have largely focussed on the effect of VR tourism on hotels and destinations (e.g. Leung et al., 2020; M. J. Kim et al., 2020), VR features and customer behaviour (e.g. Lee et al., 2021) and VR as a means of tourism marketing (Yung & Khoo-Lattimore, 2019). The extant literature has also examined the role of various components in enhancing VR experiences

and increasing intentions to visit (e.g. M. J. Kim & Hall, 2019; M. J. Kim et al., 2020) as well as technology adoption and the effects of VR on consumer attitude, engagement and experiences (e.g. Beck et al., 2019). In addition, some scholars have explored the design of immersive content and its effect on consumer perceptions and mental imagery (Bogicevic et al., 2019) and on behavioural intentions (e.g. T. Li & Chen, 2019; Wei et al., 2019). The extant VR tourism research has mainly focussed on VR tourism as a way to attract tourists to destinations, motivating scholars to call for additional research to better illuminate the applicability of VR in tourism from a broader perspective (M. J. Kim et al., 2020; M. J. Kim et al., 2020).

The onset of the COVID-19 pandemic altered perceptions of VR tourism from a gimmick to a valid form of alternative travel, creating an opportunity for individuals to develop familiarity with the technology as the pandemic spread (Debusmann, 2020). Seizing this opportunity, scholars have initiated investigations into related aspects. These investigations are limited in number but offer interesting insights into consumer perceptions of VR tourism in the context of the COVID-19 pandemic. For instance, Itani and Hollebeek (2021) utilised the protection motivation theory to reveal that self-efficacy, response efficacy and perceived threat severity are associated with visitors' COVID-19-induced social distancing behaviour. Social distancing, in turn, increases the intent to use VR tours and decreases the intent to attend in-person site tours during the pandemic. However, it has no effect on consumers' intent to use VR after the pandemic. Similarly, El-Said and Aziz (2021) used the dual theoretical lens of the protective action decision model and the technology acceptance model (TAM) to examine the drivers of individuals' decisions to use VR tourism as a temporary alternative in times of crises. Their results reveal that intentions to adopt VR tourism are positively driven by the perceived risk associated with COVID-19, the perceived enjoyment, hazard-related attributes and the perceived usefulness of VR tourism. Furthermore, adoption intentions towards VR tourism positively increase the tendency to physically visit a site, and this association is moderated by both the perceived enjoyment and usefulness of VR tourism. In a similar vein, Schiopu et al. (2021) proposed an extended TAM to examine individuals' intentions to use VR tourism during the pandemic. The study confirmed the positive association of perceived ease of use, usefulness and substitutability of VR tourism with intention to use VR tourism. The results also revealed the mediation effect of people's interest in VR tourism. Adding to the studies related to the use of VR tourism during the pandemic, Sarkady et al. (2021) examined the possibility of VR tourism replacing in-situ tourism in the face of the pandemic. The study revealed the positive association between perceived usefulness and behavioural intentions, confirming consumers' intentions to use VR tourism during and after the COVID-19 pandemic.

Van et al. (2020) discussed the role of human–machine interactive technology, which includes VR tourism apps, in reviving the tourism industry after the pandemic. Their findings reveal that tourists' willingness to use these devices in the post-pandemic phase will be driven by perceived value enhancers, empathy and update information sharing. Offering a different perspective, Y. Li et al. (2021) revealed that peripheral, core and pivotal attributes of VR tourism are positively associated with presence during VR experiences, which, in turn, has a positive impact on the perceived value of VR tourism measured through functional and emotional values. These values further associate positively with satisfaction, which eventually has a positive relationship with tourists' subjective well-being during the pandemic. Reinforcing the connection between the use of VR tourism and well-being, T. Yang et al. (2021) examined the ability of VR tourism to mitigate the psychological stress caused by the pandemic. The study confirmed that a sense of presence and telepresence is positively associated with enjoyment of and involvement in VR tours, and these four variables positively impact consumers' satisfaction with VR tour experiences. Ultimately, enjoyment, involvement and satisfaction each exhibit positive associations with stress reduction. Finally, the study confirmed the negative moderation effect of involvement on the association between telepresence and satisfaction.

Stimulus-organism-response (SOR) theory

The SOR theory, proposed by Mehrabian and Russell (1974) and modified by Jacoby (2002), provides a theoretical framework for explicating consumer behaviour. Rooted in environmental psychology, the theory conceptualises a sequential mechanism wherein stimuli (S) drive internal organismic states (O), which, for their part, lead to approach or avoidance responses (R). Jacoby (2002) clarified that the stimulus (S) represents the environment an individual encounters at a given point in time while the organism (O) spans a wide range of aspects, such as attitudes, beliefs, values, motives, personality, knowledge, experiences, feelings, predispositions and cognitions. Vieira (2013) explained that the response (R) represents the desire or willingness to enter or leave a given environment – that is, to exhibit approach or avoidance behaviour.

The sequential mechanism of SOR operates when a stimulus in the environment induces internal psychological processes to elicit a behavioural response (Mehrabian & Russell, 1974). The theory offers a suitable base for our conceptualisations in the present study for the following reasons. First, researchers have applied it in a variety of settings to explicate consumer behaviour, particularly pro-environmental behaviours (e.g. S. Kumar et al., 2021; Tandon et al., 2021) as well as virtual travel-related behaviours (e.g. M. J. Kim et al., 2020; M. J. Kim et al., 2020; Yeh et al., 2017) and in-situ travel-related behaviours (e.g. Chang et al., 2014; Jani & Han, 2015). Because we are conceptualising a conjunction between the pandemic, VR tourism and pro-environmental behaviour, the choice of SOR is pertinent. Second, consumers' psychological processes are complex, and the sequential mechanism offered by SOR is quite versatile in capturing these complexities through a spectrum of internal states ranging from the affective to the cognitive and through varied responses spanning acceptance, attachment or avoidance. Third, the model is flexible and can be extended to better reflect the study context within the broader SOR framework. For instance, Yeh et al. (2017) extended it to incorporate attention, interest, desire and action as an expression of tourists' responses.

Extending stimulus-organism-response (SOR) theory to the present context

To operationalise the conceptual model, we identified the SOR variables through an extensive review of the literature. First, we identified the environmental impact of travel on the environment as an informational cue based on studies that have discussed environmental concerns related to travel (Gossling et al., 2021; Mkono & Hughes, 2020; O'Connor & Assaker, 2021; Toivonen, 2020). Similarly, we accounted for the effect of COVID-19 on travel-related behaviours by identifying pandemic-related anxiety as an environmental cue, consistent with recent studies (O'Connor & Assaker, 2021; Schiopu et al., 2021).

With regard to the organism, we drew upon the travel-related literature, in general, to propose eco-guilt as one of the organismic states, representing the affective aspect of the organism, as discussed by Bigne et al. (2020). The prior pro-environmental literature has discussed eco-guilt extensively (Andersson, 2019; Bruhn, 2018; Mkono & Hughes, 2020), theorising it to capture the '*green guilt*' that is triggered by travel-related and pandemic-related environmental concerns. Next, drawing upon the prior literature positing VR tourism as a more sustainable form of tourism (Beck et al., 2019; Wiltshier & Clarke, 2017; Yung & Khoo-Lattimore, 2019), we propose attitude towards VR tourism as another internal state triggered by the stimuli. This conceptualisation also aligns with recent studies underscoring the need to better understand consumer perceptions of ex-situ tourism (Bec et al., 2021). Furthermore, we theorise attitude towards VR tourism to be the cognitive aspect of an organism, which M. J. Kim et al. (2020) describe as beliefs and attributions based on the benefits, value and usefulness of products/services.

Finally, we theorise response through two variables. The first of these variables proposes post-pandemic VR tourism intentions to measure the depth of sustainability-oriented behaviour.

Theorising intentions as a response is consistent with prior studies (e.g. J. Kim & Lennon, 2013; An et al., 2021). In addition, noting that readiness to make a sacrifice for the greater good is an essential part of pro-environmental behaviours, we propose a new construct – "willingness to forgo the pleasure of in-situ tourism" – by extrapolating the idea of economic sacrifice, which is well-documented in the context of travel and tourism (e.g. Kantenbacher et al., 2019; O'Connor & Assaker, 2021; Rahman & Reynolds, 2016).

Research model and hypotheses development

Our proposed research model theorises the environmental impact of travel (EIT) and pandemic travel anxiety (PTA) as the stimuli associated with the organismic states of attitude towards VR tourism (AVT) and eco-guilt (EGT), which eventually drive response in the form of willingness to forgo the pleasure of in-situ tourism (WFP) and post-pandemic VR tourism continuance intentions (PVI). In addition, we examine the mediation effect of WFP on the association of AVT and EGT with PVI to better comprehend the mechanism of their interaction. At the same, we acknowledge the existence of individual differences among consumers by examining the moderation effect of travel mode (solo versus group travel) and COVID-19 vaccination status (no vaccination/single shot/fully vaccinated). Finally, we control the model to uncover the potential confounding effects of age, gender, educational background and household size. The operational descriptions of the study variables appear in Table 1, and the research model is presented in Figure 1.

Stimuli-organism

Environmental impact of touristic travel, attitude towards VR tourism and eco-guilt

Tourism has contributed to the economic growth of many destinations (Bhutto et al., 2021; Gossling et al., 2021). However, the adverse environmental impact of travel and tourism has not gone unnoticed (F. L. Han & Li, 2019; Farooq et al., 2021). Research has, in particular, emphasised the role of travel in increasing pollution through CO_2 emissions (e.g. Gossling et al., 2021). The ongoing debate about the effect of tourism on the environment has increased public awareness of the problem (Campos-Soria et al., 2018), which, in turn, has encouraged consumers to make more eco-friendly decisions (A. Kumar et al., 2021). In this regard, prior studies have revealed that individuals' pro-environmental behaviours are driven by their awareness of the consequences of their actions that cause environmental deterioration; this awareness, in turn, initiates a response that drives them to make commensurate decisions to protect the environment (H. Han et al., 2015; Shin et al., 2018). In the present context, we argue that individuals' heightened awareness of the environmental impact of touristic travel stimulates them to think in pro-environmental ways, and this pro-environmental approach may be felt more keenly due to various reports showing that restricted travel during the pandemic substantially reduced gas emissions (Rume & Islam, 2020). Thus, we posit that individuals' awareness of the negative impact of travel on the environment, coupled with informational cues from the prevailing context of the COVID-19 pandemic, causes consumers to become positively disposed towards VR tourism, which does not require any physical travel. In other words, as the pandemic weighs on their minds, consumers' concern for environmental degradation due to the impact of their touristic travel should cause them to perceive VR tourism favourably as a viable, pro-environmental substitute for in-situ tourism. Hence, we propose the following hypothesis:

> **H1a.** Consumers' concern about the environmental impact of travel is positively associated with their attitude towards VR tourism.

In addition to causing consumers to develop a favourable attitude towards pro-environmental behaviours (S. Kumar et al., 2021; Tandon et al., 2021), consumers' awareness of the adverse environmental impact of their actions has been found to trigger a sense of guilt. This sense of

Table 1. Variable descriptions.

Variable	Operational description
Environmental impact of touristic travel (EIT)	EIT represents individuals' concerns and worries associated with the adverse impact of their touristic travel on the environment in terms of waste generated, emissions and global warming. Broadly, it spans the concern individuals have about the ecological footprint of their touristic travel and the negative effect it has on sustainability goals.
Pandemic travel anxiety (PTA)	PTA is an expression of the anxiety, worry and fear that individuals have about undertaking touristic travel due to the COVID-19 pandemic. These fears and anxieties are related to crowded destinations, modes of travel, the need for precautionary measures before travelling, the need to avoid people while travelling, safety and risk to life.
Attitude towards VR tourism (AVT)	AVT represents individuals' favourable cognitive assessment of VR tourism in terms of its ability to protect the environment at tourist destinations and its ability to protect them against exposure to and the spread of COVID-19 infection by helping them to maintain social distance. Individuals also perceive VR tourism as a mode of touristic travel that protects them from being stranded at a tourist destination due to COVID-19 related lockdowns.
Eco-guilt (EGT)	EGT captures the guilt that individuals harbour regarding the negative impact of their touristic travel. This affective internal state, which arises despite the pleasure and enjoyment individuals derive from travel, stems primarily from their assessment of the adverse impact that their touristic travel has in general and, in particular, on the environment in terms of pollution and sustainability issues. EGT also represents the remorse and mortification travellers experience when they engage in less environmentally friendly behaviour for touristic pleasure.
Willingness to forgo pleasure of in-situ tourism (WFP)	WFP extrapolates the well-researched concept of an individual's willingness to make *economic* sacrifices to the concept of an individual's willingness to make *hedonic* sacrifices for the sake of the environment. It is operationalised as the willingness of individuals to forgo the enjoyment of touristic travel and instead undertake VR tourism to protect the environment, support sustainability initiatives and reduce pollution. In sum, it represents the willingness to sacrifice self-interest when faced with environmental dilemmas.
Post-pandemic VR tourism continuance intentions (PVI)	PVI refers to the intent and willingness of individuals to continue undertaking VR tourism even after they have been fully vaccinated against COVID-19 and even after the COVID-19 pandemic is over.
Mediators	Willingness to forgo the pleasure of in-situ tourism.
Moderators	(a) Travel mode is measured as a dichotomous categorical variable, which consists of two groups: solo or group traveller.(b) COVID-19 vaccination status is measured as a categoricalvariable with three levels: no vaccination/single shot/ fully vaccinated.
Controls	Age, gender, educational background and household size.Age, educational background and household size are measured as ordinal variables and coded using sequential numbers. Gender is measured as a binary variable and coded (0, 1)

guilt has been termed "eco-guilt" in the environmental context, and it is a well-examined variable in the pro-environmental literature (e.g. Bruhn, 2018; Mkono & Hughes, 2020). Eco-guilt captures consumers' affective reaction to their awareness of the environmental fallout of their consumption decisions. Prior studies have discussed the flight shaming movement, which evoked guilt among air travellers by highlighting the adverse environmental effects of this form of travel (e.g. Andersson, 2019). Furthermore, scholars have noted that to experience a sense of guilt, consumers' must not only develop a fear of the outcome but also accept responsibility for their actions (e.g. Fredericks, 2014). Based on the above discussion, we speculate that the stimulus arising from the transgressive impact of their touristic travel on the environment causes consumers to develop eco-guilt, particularly in the milieu of the COVID-19 pandemic, as scholars highlight efforts to encourage sustainable human interactions with nature to mitigate the threat of future pandemics and ensure that ecosystems do not suffer (Yin et al., 2021). Hence, we posit the following hypothesis:

H1b. Consumers' concern about the environmental impact of travel is positively associated with their eco-guilt.

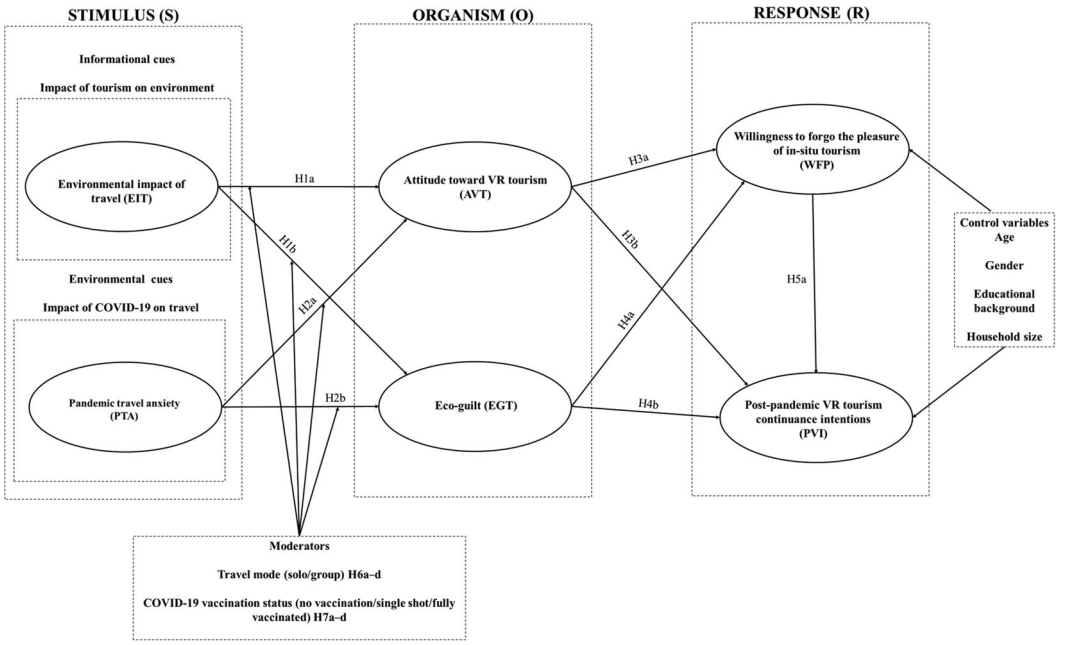

Figure 1. Proposed research model.

Pandemic travel anxiety, attitude towards VR tourism and eco-guilt

Although people generally enjoy travelling and exploring, scholars have noted that risks, particularly health risks, such as pandemics, take priority over their wandering instincts (e.g. Novelli et al., 2018; Zenker & Kock, 2020). For instance, Joo et al. (2019) revealed the adverse impact of SARS in 2003 and MERS in 2015 on demand for travel. Widmar et al. (2017) noted a similarly adverse impact in the case of ZIKV outbreak in 2015–16. More recently, the tourism sector has felt the effects of the COVID-19 pandemic – but on a much larger scale causing extensive losses (Itani & Hollebeek, 2021).

The pandemic has also caused changes in consumers' touristic behaviour by depriving them of the choice to travel to popular destinations (Zenker & Kock, 2020). In fact, social distancing, which is considered an effective COVID-19 prevention measure, has posed a challenge to tourism in its present form (Baum & Hai, 2020). Zenker et al. (2021) systematically captured the anxiety and fear that individuals developed towards travelling during the pandemic through a pandemic anxiety travel scale. Moreover, scholars have noted that COVID-19 pandemic-related anxiety towards tourism has led individuals to seek safer, technology-driven avenues for diversion; in this context, VR tourism has emerged as a solution (Nanni & Ulqinaku, 2021; Schiopu et al., 2021). In addition, some scholars have asserted that the pandemic has revealed the link between environmental change and the spread of infectious diseases, thereby underscoring the importance of prioritising sustainable behaviours over short-term economic agendas (Armstrong et al., 2020; Barouki et al., 2021; Shakil et al., 2020).

Based on the preceding discussion, we contend that travel-related anxiety will stimulate individuals to develop affective and cognitive awareness of their environmental responsibility. We speculate that these internal states may also be motivated by recent calls in various forums for individuals to alter their travel-related behaviours towards more sustainability-oriented alternatives (Higgins-Desbiolles, 2020; Prideaux et al., 2020). Furthermore, we speculate that recent discussion underscoring VR tourism as a sustainable tourism solution (e.g. Chen, 2020; Schiopu et al., 2021) would impinge on the minds of consumers, causing them to see sustainability, VR tourism and COVID-19 safety in conjunction. On the other hand, VR can contribute to sustainability because it constitutes a low cost and environmentally friendly mode of travel (Chen, 2020;

Schiopu et al., 2021; Wiltshier & Clarke, 2017) Thus, even in the absence of a priori evidence, we posit that pandemic travel anxiety drives a favourable attitude towards VR tourism. At the same time, upon experiencing pandemic-related anxiety, individuals may develop eco-guilt as they contemplate their contribution to environmental degradation and the potential of their actions to expose others to the COVID-19 virus. Thus, we propose the following hypotheses:

H2a. Consumers' pandemic travel anxiety is positively associated with their attitude towards VR tourism.

H2b. Consumers' pandemic travel anxiety is positively associated with their eco-guilt.

Organism-response

The association between attitude and identified behavioural responses is well-documented in the seminal literature. For example, the tripartite model of attitude proposed by Rosenberg and Hovland (1960) posits that a stronger attitude is likely to produce a positive reaction. Pro-environmental research has likewise confirmed this association. Past studies have revealed that individuals' attitudes in the context of the environment are a potential driver of their pro-environmental response (X. Liu et al., 2012). For instance, Ahamad and Ariffin (2018) contended that attitude towards the consumption of environmentally friendly products positively drives consumers' sustainable behaviours. Similarly, scholars have examined this association in the case of sustainable travel (Taube et al., 2018) and energy-saving (Starke et al., 2020) behaviours. While acknowledging the lack of any a priori evidence in the immediate context of VR tourism, we draw upon this extended literature to assert that driven by their environmental concerns, consumers' stronger attitudes towards VR tourism are likely to positively impact their pro-environmental responses exhibited via their willingness to forgo the pleasure of in-situ tourism and their post-pandemic VR tourism continuance intentions. Notably, the willingness to make sacrifices is a well-researched pro-environmental response in travel and tourism settings (e.g. Kantenbacher et al., 2019; Rahman & Reynolds, 2016). Similarly, future intentions represent a key behavioural response examined in the same settings (Chaulagain et al., 2019; Zhai et al., 2020). Hence, we propose the following hypotheses:

H3a. Consumers' attitude towards VR tourism is positively associated with their willingness to forgo the pleasure of in-situ tourism (WFP).

H3b. Consumers' attitude towards VR tourism is positively associated with their post-pandemic VR tourism continuance intentions.

Guilt represents the negative affective outcome when an individual feels responsible for an adverse event or impact (Antonetti & Maklan, 2014). This feeling of remorse an individual may experience in a given situation (H. Han et al., 2017) is, in environmental and sustainability contexts, termed "eco-guilt" (Fredericks, 2014). Although guilt is examined less frequently than attitude, scholars consider it to be an essential precursor of pro-environmental behavioural responses (e.g. Bissing-Olson et al., 2016). In fact, it serves significantly to explicate sustainable decisions (Onwezen et al., 2014). Scholars have empirically examined the concept of guilt to explain a variety of pro-environmental behaviours (Klöckner, 2013; H. Han, 2021), including green travel choices (Mkono & Hughes, 2020) and the consumption of environmentally friendly products (McCarthy et al., 2020). This existing evidence provides an adequate basis to anticipate that eco-guilt, in the current context, will also have a positive effect on consumers' pro-environmental responses in the form of their willingness to forgo the pleasure of in-situ tourism and their post-pandemic VR tourism continuance intentions. Hence, we hypothesise as follows:

H4a. Consumers' eco-guilt is positively associated with their willingness to forgo the pleasure of in-situ tourism (WFP).

H4b. Consumers' eco-guilt is positively associated with their post-pandemic VR tourism continuance intentions.

Willingness to forgo the pleasure of in-situ tourism and post-pandemic VR tourism continuance intentions

The extant literature has discussed consumers' willingness to make economic sacrifices as a driver of their intentions to engage in pro-environmental behaviour (e.g. Kantenbacher et al., 2019). The idea of economic sacrifice includes a willingness to pay a higher price for environmental benefits (Hedlund, 2011). For instance, O'Connor and Assaker (2021) found a positive association between willingness to make economic sacrifices for environmental protection and pro-environmental travel behaviour. Similarly, Winter et al. (2021) revealed a positive association between consumers' willingness to pay for sustainability and their pro-environmental intentions. Similar results have been reported in various pro-environmental contexts, such as eco-friendly apparel, where A. Kumar, Prakash and G. Kumar et al. (2021) revealed a positive association between willingness to pay and intentions. Substantial support for the association between economic sacrifice and intentions to indulge in pro-environmental behaviour in varying contexts and our extrapolation of economic sacrifice to capture the sacrifice of pleasure derived from in-situ travel (explained in preceding parts of this study) give us sufficient reason to speculate the existence of a similar relationship in the present context. In other words, we expect that consumers' willingness to forgo the pleasure of in-situ tourism will be related to their post-pandemic VR tourism continuance intentions. Hence, we posit the following hypothesis:

H5a. Consumers' willingness to forgo the pleasure of in-situ tourism is positively associated with their post-pandemic VR tourism continuance intentions.

Given the complexity of consumer behaviour, we are further motivated to explore whether consumers' willingness to forgo the pleasure of in-situ tourism also serves as a mechanism or channel for the effect of their organismic states (willingness to forgo the pleasure of in-situ tourism and eco-guilt) on their post-pandemic VR tourism continuance intentions. Our motivation for examining the mediation effect of willingness is based on the following three reasons. First, examining the mediation effect of the variables of interest enables us to better understand the relationships among the identified variables and illuminate the process involved in eliciting positive outcomes, such as pro-environmental intentions in the present context, Second, efforts to examine the mediation effect of the identified variables are quite prevalent in tourism and pro-environmental research. For instance, Han et al. (2019a) examined the mediation effect of personal norms on the association between social norms and the intention to select eco-friendly travel options. Similarly, Farooq et al. (2021) examined the mediation effect of green self-efficacy on the association between green human resource management and green creativity. Third and more specifically, willingness has been examined as a mediator of the associations between environmental concern and sustainable behaviour (Thieme et al., 2015) and between perception of climate change and intention to take action (Winter et al., 2021), among others. The mediating role of willingness to make economic sacrifices to protect the environment has also been confirmed in the context of outcomes such as pro-environmental travel behaviour (O'Connor & Assaker, 2021), intention to endorse environmental programmes proposed by colleges (Coy et al., 2013) and intention to engage in various types of eco-friendly activities while travelling (Landon et al., 2018). Hence, we hypothesise as follows:

H5b. Consumers' willingness to forgo the pleasure of in-situ tourism mediates the association between their attitude towards VR tourism and their post-pandemic VR tourism continuance intentions.

H5c. Consumers' willingness to forgo the pleasure of in-situ tourism mediates the association between their eco-guilt and their post-pandemic VR tourism continuance intentions.

Moderation effect

We propose to examine the moderation effect of two variables: travel mode (solo vs group travel) and COVID-19 vaccination status (no vaccination/single shot/fully vaccinated). The choice

of the two moderators is driven by their relevance to the COVID-19 context. Prior studies have noted the significant impact of travel mode on traveller preferences (S. Liu et al., 2013; Steffen et al., 2020). Research – such as van Genderen et al. (2014) study of travel to destinations with a high-risk of hepatitis B infection – has also shown that solo travellers exhibit greater risk-taking ability. Therefore, we anticipate that travel mode is likely to affect the strength of the association between stimuli and internal states. While we anticipate this effect to differ for the two modes, in the absence of a priori evidence, we do not venture to anticipate the direction of the effect.

We selected the second moderator, vaccination status, to capture whether vaccination status alters consumers' perception of risk, thereby altering the strength of the association between stimuli and internal states. Although no prior study has used this variable as a moderator or even as a control, we are motivated to examine the moderation effect of vaccination status based on debates in various forums regarding the effect of vaccines on the control of COVID-10 infections and continuing calls even for fully vaccinated individuals to maintain all preventive measures against infection (CDC, 2021). Again, we do not speculate on the direction but do anticipate differences in the strength of the association between the stimuli and internal states due to the moderation effect of respondents' vaccination status. Hence, we propose the following hypotheses:

H6a–b. Travel mode (solo vs group travel) moderates the association between consumers' concern about the environmental impact of travel and (a) their attitude towards VR tourism and (b) their eco-guilt.

H6c–d. Travel mode (solo vs. group travel) moderates the association between consumers' pandemic travel anxiety and (c) their attitude towards VR tourism and (d) their eco-guilt.

H7a–b. COVID-19 vaccination status (no vaccination/single shot/fully vaccinated) moderates the association between consumers' concern about the environmental impact of travel and (a) their attitude towards VR tourism and (b) their eco-guilt.

H7c–d. COVID-19 vaccination status (no vaccination/single shot/fully vaccinated) moderates the association between consumers' pandemic travel anxiety and (c) their attitude towards VR tourism and (d) their eco-guilt.

Control variables

The respondents' socio-demographic profile may exert confounding effects on the outcome variables. Therefore, the present study utilises age, gender, educational background and household size as control variables. The choice of these variables is consistent with prior studies on VR tourism, technology usage and pro-environmental behaviours. For instance, El-Said and Aziz (2021) controlled for the confounding effects of age, gender and previous experience with virtual tours (VTs) on the intention to adopt VTs. However, none of these variables had any significant effect. Similarly, Van et al. (2020) used gender, age and education as control variables in their study on consumers' willingness to use human–machine interactive technologies, including VR. T. Li and Chen (2019) employed gender, age, educational background, working years, travel experience, monthly income and travel frequency as control variables in their study on the inhibiting effect of VR tourism on in-situ travel intention. In a study based on online-to-offline (O2O) services, S. Talwar et al. (2021) controlled for the effects of gender, age, household size and educational background on trust and valence of recommendation intentions towards food delivery apps. Household size has also been found to have a key influence on pro-environmental decisions (Annunziata et al., 2019; Kumar et al., 2021).

Data and methods

Measurement scale

We developed the questionnaire for this study by adapting pre-validated scales from the tourism and consumer behaviour literature. The study variables were operationalised as follows: EIT was

operationalised through a six-item scale from Toivonen (2020), PTA was operationalised through a six-item scale adapted from Zenker et al. (2021), AVT was operationalised through a five-item scale from Toivonen (2020) and Tussyadiah et al. (2018), EGT was operationalised through a six-item scale adapted from Mkono and Hughes (2020), WFP was operationalised through a three-item scale from O'Connor and Assaker (2021) and PVI was operationalised through a six-item scale adapted from Chaulagain et al. (2019) and Zhai et al. (2020). All scales measured responses on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Table 1 presents the items and their loadings.

We also sought feedback from two tourism professors and one VR consumer insights specialist to ensure the content validity of the developed/adapted items. These experts reviewed the instrument and offered suggestions for slight modifications in the language of the items. To ensure content validity, we also pre-tested this survey with five academic researchers experienced in developing psychometric scales. We revised the instrument based on the input received and pilot tested it with 15 representatives of the target group to ensure the instrument's face validity. Subsequently, we again made minor changes to ensure that all items were worded in simple, unambiguous and easy to understand language.

Data collection

The final instrument was used to collect data from the target respondents through the online facility of *Prolific Academic,* a platform employed by many recent studies (e.g. Bhutto et al., 2021). The survey was administered in April 2021, and 359 complete responses were retained after rejecting ten insincere responses. The researchers explained the purpose of the study to the survey respondents and remunerated them for their participation according to the guidelines established by the platform. The respondents were, moreover, assured of the complete anonymity and confidentiality of their responses. The study participants were also apprised of the sustainability aspects of VR tourism to ensure that they understood the study context better. Two attention check questions were included to ensure the participants' complete attention. The screening criteria for participant recruitment were as follows: (a) prior VR use experience in any context, (b) age between 18 to 50 years and (c) residence in the UK. Individuals aged between 18 to 50 years were selected as respondents to ensure representation of VR users and tourists across age groups. The UK was identified as the geographical area of interest for two key reasons: (a) the UK market has exhibited a noticeable increase in VR tourism since March 2020 (Buglar, 2020), and (b) in a departure from its past approach, the United Nations Sustainable Development Agenda 2015 seeks commensurate actions not only from developing countries but from developed countries as well (Belmonte-Ureña et al., 2021). For these reasons, we sought to examine the sustainability/pro-environmental behaviours of consumers from a developed country. Table 2 presents the respondents' socio-demographic details.

Method

Consistent with recent studies (M. Talwar et al., 2020), we utilised the popular two-step approach of covariance-based structural equation modelling in AMOS 27 to analyse the collected data. In the first step, we conducted a confirmatory factor analysis (CFA) to generate reliability and validity statistics for the study constructs. Thereafter, we performed a path analysis of the structural model to test the hypothesised associations. We also performed mediation and moderation analyses in PROCESS macro for SPSS. Before undertaking the two-step analysis, we screened the data for various characteristics that confirmed their suitability for the chosen method.

Table 2. Socio-demographic profile of respondents.

Variable	Percentage	Frequency
Gender		
Female	32.9	118
Male	67.1	241
Age group		
Below 20 years	0.3	1
21–25 years	7.2	26
26–30 years	24.8	89
31–35 years	32.3	116
36–40 years	20.6	74
41–45 years	8.6	31
46–50 years	6.1	22
Household size		
Live alone	16.2	58
2 members	30.1	108
3 members	24.5	88
4 members	19.5	70
5 members	7.8	28
More than 5 members	1.9	7
Children		
Don't have children	57.7	207
1 child	17.8	64
2 children	16.7	60
3 children	7.2	26
More than 3 children	0.6	2
Educational background		
High school	13.1	47
College	15.6	56
Professional degree	4.2	15
Bachelor's	42.1	151
Master's	20.3	73
Doctorate	4.7	17
Tourism destination preference		
Domestic	48.2	173
International	51.8	186
Travel mode		
Solo	39.8	143
Group	60.2	216
COVID-19 infection status		
Infected	88.6	318
Not infected	11.4	41
COVID-19 vaccination status		
Not vaccinated	46.2	166
Taken one shot	25.3	91
Fully vaccinated	28.4	102

Results

Preliminary analysis

Following the approach of recent studies (M. Talwar et al., 2020), we ascertained the data's suitability for analysis by screening for characteristics and issues such as normality and multicollinearity. First, to confirm normalcy, we examined skewness and kurtosis values. These values were within the recommended limits for all variables, indicating that the data followed a Gaussian distribution. Next, we assessed the variance inflation factor (VIF) to examine collinearity. All values were less than 5, indicating the absence of multicollinearity issues in the data, as discussed in recent studies (M. Talwar et al., 2020). Descriptive statistics for all study variables were also generated, as reported in Table 3.

In addition, we performed a test to ensure that common method bias (CMB) did not affect our results. First, we took all procedural precautions in the questionnaire design. Second, after data collection, we performed the Harman single factor test through exploratory factor analysis

Table 3. Descriptive statistics.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1 **Age**	4.16	1.28	1											
2 **Gender**	1.33	0.47	0.02	1										
3 **Household size**	2.79	1.26	0.11*	0.01	1									
4 **Educational background**	3.55	1.43	0.04	0.00	−0.01	1								
5 **Travel mode**	1.60	0.49	−0.08	0.12*	−0.16**	0.01	1							
6 **Vaccination status**	1.82	0.85	−0.01	0.00	−0.04	0.11*	0.05	1						
7 **EIT**	3.14	1.18	0.03	0.09	0.04	0.08	−0.07	0.10	1					
8 **PTA**	3.82	1.13	0.05	0.03	0.06	0.07	0.01	0.15**	0.30**	1				
9 **AVT**	3.56	1.14	0.05	0.07	0.07	0.02	−0.02	−0.09	0.26**	0.50**	1			
10 **EGT**	2.53	1.16	−0.03	0.08	0.10*	−0.01	0.04	0.12*	0.74**	0.36**	0.35**	1		
11 **WFP**	2.99	1.29	0.00	−0.01	0.16**	0.00	−0.07	−0.10	0.49**	0.34**	0.60**	0.55**	1	
12 **PVI**	2.86	1.18	0.17**	−0.03	0.13*	0.04	−0.01	−0.14**	0.33**	0.32**	0.59**	0.41**	0.71**	1

Environmental impact of touristic travel (EIT), Pandemic travel anxiety (PTA), Attitude towards VR tourism (AVT), Eco-guilt (EGT),.
Willingness to forgo the pleasure of in-situ tourism (WFP), Post-pandemic VR tourism continuance intentions (PVI).

(Podsakoff et al., 2003); the results indicated that the single-factor model explained much less than the required threshold of 50% of the observed variance, thus confirming the absence of CMB. However, we also applied the marker factor method by examining the time respondents took to complete the survey, which is theoretically unrelated to the other factors. Because the addition of this variable did not significantly impact the results, we concluded that CMB was not an issue.

Measurement model

The measurement model returned a good model fit ($\chi 2/df = 2.5$, *CFI* =.95. *TLI* =.94, *RMSEA* =.07; *GFI* = .91, *p-value* = .000; *p-close* = .00), as recommended by Hair et al. (2020). All items also loaded appropriately (above 0.7), as presented in Table 4. In addition, we evaluated the validity and reliability statistics, presented in Table 5, based on Fornell and Larcker (1981) recommendations. Internal consistency and convergent validity were established for all constructs based on the following statistics: (a) average variance extracted (AVE) > 0.5, (b) composite reliability (CR) > 0.7 and (c) Cronbach's alpha > 0.7. Next, we established discriminant validity by confirming that the square roots of all constructs' AVEs exceeded the corresponding correlations. In addition, following Hair et al. (2020) recommendation, we conducted a heterotrait-monotrait ration (HTMT) analysis to assess the robustness of the discriminant validity. The results reported in Table 6 indicate that all HTMT values were below the required cut-off value of 0.90.

Control variables

The results confirm two statistically significant confounding effects – one for household size on willingness ($ß = 0.10$, $p < .01$) and another for age on intentions ($ß = 0.16$, $p < .001$).

Hypotheses testing

The structural model also returned a good fit ($\chi 2/df = 2.3$, *CFI* =.94. *TLI* =.94, *RMSEA* =.06; *GFI* = .90, *p-value* = .000; *p-close* = .02). The variance explained – 29.3% for attitude, 62.2% for eco-guilt, 50.5% for willingness and 58.4% for intentions – indicates the good explanatory power of the model. The results of testing the direct paths of the hypotheses, presented in Figure 2, confirmed support for the positive association of environmental impact with eco-guilt (H1b; $ß = 0.74$, $p < .001$) and pandemic anxiety with attitude (H2a; $ß = 0.50$, $p < .001$) and eco-guilt (H2b;

Table 4. Factor loadings.

Study measures (Reference)	Measurement items	CFA	SEM
Environmental impact of touristic travel (EIT)	EIT 1: I am concerned about global warming due to my touristic travel.	.81	.81
	EIT 2: I am concerned about my own ecological footprint due to my touristic travel.	.82	.82
	EIT 3: I am worried about the negative impact of touristic travel on the environment.	.87	.87
	EIT 4: I am worried about the impact of emissions caused by my touristic travel.	.91	.91
	EIT 5: I am concerned about the negative effect of touristic travel on sustainability goals.	.89	.89
	EIT 6: I am worried about the waste generated due to touristic travel.	.86	.86
Pandemic travel anxiety (PTA)	PTA 1: I am anxious about touristic travelling to crowded destinations due to the COVID-19 pandemic.	.91	.91
	PTA 2: The COVID-19 pandemic makes me worry a lot about my normal ways of touristic travelling.	.90	.90
	PTA 3: The COVID-19 pandemic makes me think a lot about taking precautionary measures before touristic travelling.	.86	.86
	PTA 4: Avoiding people when I undertake touristic travel is frequently on my mind due to the COVID-19 pandemic.	.87	.87
	PTA 5: I am afraid to risk my life when I undertake touristic travel because of the COVID-19 pandemic.	.82	.82
	PTA 6: I do not feel safe undertaking touristic travel due to the COVID-19 pandemic.	.80	.80
Attitude towards VR tourism (AVT)	AVT 1: VR tourism is essential since it helps protect the environment at tourist destinations.	.79	.79
	AVT 2: VR tourism is essential since it protects me from exposure to COVID-19 infection.	.92	.92
	AVT 3: VR tourism is essential since it helps me reduce the spread of COVID-19 infection.	.91	.91
	AVT 4: VR tourism is essential since it helps me maintain social distance.	.92	.92
	AVT 5: VR tourism is essential since it protects me from getting stuck at a tourist destination due to COVID-19 related lockdowns.	.85	.85
Eco-guilt (EGT)	EGT 1: I feel guilty about undertaking touristic travel despite its pleasure and enjoyment.	.79	.79
	EGT 2: I feel guilty about undertaking touristic travel since it causes so much pollution	.93	.93
	EGT 3: I feel guilty about the sustainability issues associated with my behaviour during touristic travel.	.93	.93
	EGT 4: I feel guilty about my less environmentally friendly ways while enjoying a tourist destination.	.93	.93
	EGT 5: I feel guilty about the generally negative impact of travelling for tourism.	.88	.88
	EGT 6: I feel guilty about behaving in non-green ways for touristic pleasure, given the public discourse in that regard in recent years.	.91	.91
Willingness to forgo the pleasure of in-situ tourism (WFP)	WFP 1: I am willing to forgo the enjoyment of touristic travel and instead undertake VR tourism to protect the environment.	.95	.95
	WFP 2: I am willing to forgo the enjoyment of touristic travel and instead undertake VR tourism to support sustainability initiatives.	.96	.96
	WFP 3: I am willing to forgo the enjoyment of touristic travel and instead undertake VR tourism to reduce pollution.	.95	.95
Post-pandemic VR tourism continuance intentions (PVI)	PVI 1: I will undertake VR tourism even after I am fully vaccinated against COVID-19.	.90	.90
	PVI 2: I will undertake VR tourism even after the COVID-19 pandemic is over.	.95	.95
	PVI 3: I will frequently undertake VR tourism even after the COVID-19 pandemic is over.	.86	.86
	PVI 4: I am willing to undertake VR tourism even after the COVID-19 pandemic is over.	.84	.84
	PVI 5: If I feel like travelling for tourism purposes after the COVID-19 pandemic, I will first think of undertaking VR tourism.	.75	.75
	PVI 6: I want to undertake VR tourism after the COVID-19 pandemic is over.	.88	.88

Table 5. Validity, reliability and Cronbach's alpha.

	α	CR	AVE	MSV	ASV	PVI	EIT	PTA	AVT	EGT	WFP
PVI	0.95	0.95	0.75	0.53	0.25	**0.87**					
EIT	0.95	0.95	0.74	0.61	0.23	0.33	**0.86**				
PTA	0.94	0.94	0.74	0.29	0.15	0.31	0.33	**0.86**			
AVT	0.94	0.94	0.77	0.36	0.23	0.58	0.25	0.54	**0.88**		
EGT	0.96	0.96	0.80	0.61	0.27	0.41	0.78	0.36	0.34	**0.90**	
WFP	0.97	0.97	0.91	0.53	0.32	0.73	0.50	0.35	0.60	0.56	**0.96**

Environmental impact of touristic travel (EIT), Pandemic travel anxiety (PTA), Attitude towards VR tourism (AVT), Eco-guilt (EGT).
Willingness to forgo the pleasure of in-situ tourism (WFP), Post-pandemic VR tourism continuance intentions (PVI).
The bold-faced values represent the square root of AVE.

Table 6. HTMT analysis.

	EIT	PTA	AVT	EGT	WFP	PVI
EIT						
PTA	0.32					
AVT	0.28	0.53				
EGT	0.78	0.38	0.37			
WFP	0.51	0.36	0.63	0.57		
PVI	0.35	0.34	0.63	0.43	0.74	

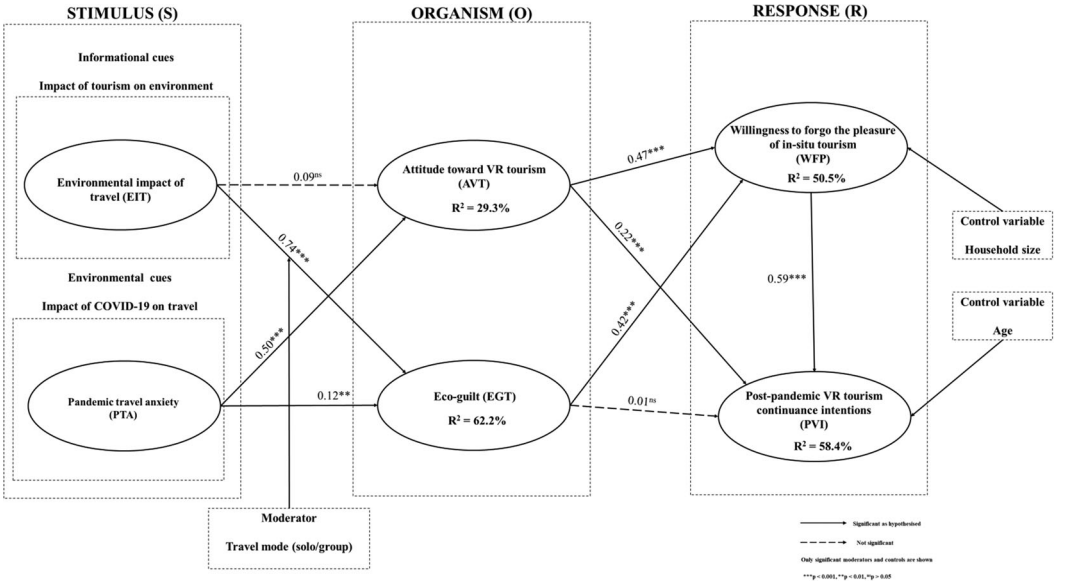

Figure 2. Results of hypotheses testing.

ß = 0.12, p <.01). However, the results did not support the association between environmental impact and attitude (H1a; ß = 0.09, p >.05). While attitude was positively associated with willingness (H3a; ß = 0.47, p <.001) and intentions (H3b; ß = 0.22, p <.001), eco-guilt was positively associated with willingness (H4a; ß = 0.42, p <.001) but not with intentions (H4b; ß = 0.01, p >.05). Finally, willingness also exhibited a positive association with intentions (H5a; ß = 0.59, p <.001).

Mediation analysis

We employed Model 4 in PROCESS macro to examine the mediation effect of willingness on the association of attitude (H5b) and eco-guilt (H5c) with intentions. The results of the analysis,

Table 7. Results of mediation analysis.

AVT → WFP → PVI						
	β	*se*	*t*	*p*	LLCI	ULCI
AVT → WFP	.67	.05	14.01	.00	.5791	.7682
AVT → PVI	.27	.05	5.87	.00	.1794	.3600
WFP → PVI	.51	.04	12.59	.00	.4310	.5906
Total effect of AVT → PVI	.61	.04	13.87	.00	.5268	.7009
EGT → WFP → PVI						
	β	*se*	*t*	*p*	LLCI	ULCI
EGT → WFP	.61	.05	12.34	.00	.5109	.7045
EGT → PVI	.03	.05	.60	.55	-.0618	.1164
WFP → PVI	.64	.04	15.68	.00	.5592	.7196
Total effect of EGT → PVI	.42	.05	8.45	.00	.3190	.5127

Table 8. Indirect effects between dependent and independent variable.

	Effect	se	LLCI	ULCI
AVT → WFP → PVI	.34	.04	.2751	.4208
EGT → WFP → PVI	.39	.04	.3043	.4830

Table 9. Results of moderation analysis.

Travel mode								
	β	*t*	*p*	LLCI	ULCI	$R^2\Delta$	*p*	Moderation?
EIT → AVT	.06	.58	.56	−.1387	.2548	.0004	.710	No
EIT → EGT	.13	1.82	.07	−.0105	.2650	.091	.041	Yes
PTA → AVT	−.08	−.86	.39	−.2724	.1064	.001	.732	No
PTA → EGT	−.06	−.53	.60	−.2641	.1522	.000	.633	No
Vaccination status								
	B	*t*	*p*	LLCI	ULCI	$R^2\Delta$	$R^2\Delta$ *p*	Moderation?
EIT → AVT	−.05	−.91	.36	−.1707	.0624	.001	.541	No
EIT → EGT	.02	.55	.58	−.0599	.1064	.000	.924	No
PTA → AVT	.00	.05	.96	−.1069	.1122	.004	.214	No
PTA → EGT	−.08	−1.36	.18	−.2060	.0377	.000	.544	No

presented in Tables 7–8, revealed the partial mediation effect of willingness on the association between attitude and intentions and the full mediation effect of willingness on the association between eco-guilt and intentions.

Moderation analysis

We utilised Model 1 in PROCESS macro with a bootstrapping effect of 5,000 times to perform the moderation analysis. The results, presented in Table 9 and Figure 3, supported only one moderation hypothesis (H6b), indicating that travel mode (solo vs group travel) positively moderated the association between environmental impact and eco-guilt.

In the context of conditional indirect effect, we followed Edwards and Lambert (2007) approach to clarify the form of interaction and plotted the first-stage moderation effect of travel mode on the association of environmental impact of travel and pandemic travel anxiety with attitude towards VR tourism and eco-guilt for high and low values (-1 standard deviation [SD], mean and +1 SD) of travel mode. We only found the interaction effect of travel mode between the environmental impact of travel and eco-guilt (H5a).

The moderation analysis revealed that the interaction between the environmental impact of travel and travel mode was positively associated with eco-guilt ($\beta = .08$, $SE = .05$, $p > .01$). The

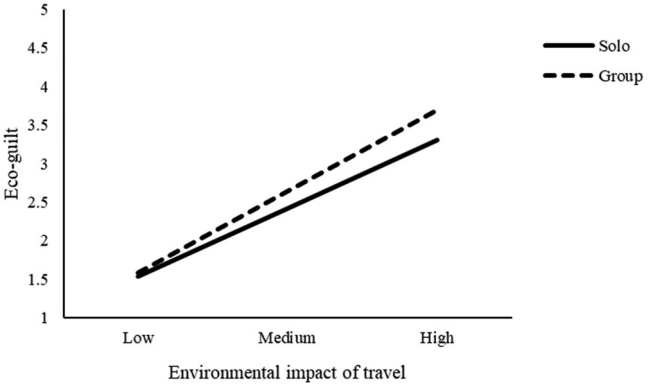

Figure 3. Moderation effect of travel mode (Solo versus group).

interaction is plotted at +1/-1 SD from the mean of travel mode. Simple slope test exhibited that the positive influence of the environmental impact of travel on eco-guilt was significant when travel mode was high ($\beta = .20$, I = .05, $p < .05$) while insignificant when travel mode was low ($\beta = .05$, $SE = 05$, $p > .05$).

In contrast, vaccination status had no significant moderation effect. Thus, H6a, H7c–d, and H7a–d were not supported.

Discussion

We posited that in the context of the COVID-19 pandemic, informational cues based on the adverse environmental outcome of touristic travel and environmental cues arising from individuals' pandemic-related travel anxiety would act as stimuli, fostering a favourable attitude towards VR tourism as well as heightening tourists' sense of eco-guilt. Using the SOR model as our theoretical framework, we further proposed that the organismic states of favourable attitude and eco-guilt would initiate a pro-environmental response in the form of individuals' willingness to sacrifice their hedonic pleasure from in-situ travel to protect the environment and continue to use VR tourism as a sustainable travel option even after the pandemic is over.

To respond to **RQ1**, we proposed a positive association between the environmental impact of touristic travel and pandemic travel anxiety (the two stimuli) with attitude towards VR tourism and eco-guilt (the two organismic states). Consistent with our anticipation based on the existing literature (e.g. Andersson, 2019; Chen, 2020; Nanni & Ulqinaku, 2021), the results indicated support for the associations of environmental impact with eco-guilt and of pandemic anxiety with both attitude and eco-guilt. This implies that environmental impact represented by individuals' concerns regarding the sustainability, waste generation, global warming, emissions and ecological footprint of their touristic travel are positively associated with their sense of guilt about these adverse outcomes. Similarly, our results imply that pandemic anxiety – represented by the anxiousness, stress and worry that individuals experience upon contemplating safety measures and risks associated with touristic travel during the pandemic – is associated with a positive attitude towards VR tourism. In this study, attitude towards VR indicates that VR is an essential and effective way of protecting the environment at tourist destinations, reducing the spread of and exposure to COVID-19 infection, averting the risk of becoming stranded at a tourist destination during lockdowns and adhering to pandemic control measures, such as social distancing. At the same time, pandemic anxiety also exacerbates consumers' sense of eco-guilt based on environmental sustainability concerns, leading them to feel remorseful about the pollution generated by their touristic travel and the environmental degradation caused by their non-green behaviour at tourist destinations.

Inconsistent with our proposition based on prior findings (e.g. H. Han et al., 2019b; Rume & Islam, 2020), however, we found no association between environmental impact and attitude. This result is surprising because environmental concern should, theoretically, enhance individuals' attitudes towards a sustainable solution that simultaneously offers safety in the context of a pandemic. One possible reason for this unanticipated finding could be that the milieu remains in flux as the pandemic continues to unfold. Therefore, we suggest further qualitative and quantitative examinations of the proposed association.

Next, to address **RQ2**, we proposed individual associations of the two organismic states with a willingness to forgo the pleasure of in-situ tourism and post-pandemic VR tourism continuance intentions. As anticipated based on prior evidence (Ahamad & Ariffin, 2018; Kantenbacher et al., 2019; Taube et al., 2018; Zhai et al., 2020), our results revealed support for a positive association of attitude with willingness and intentions. This implies that consumers' favourable attitude towards VR tourism as an environmentally sustainable and pandemic-wise viable option of touristic travel positively associates with their willingness to sacrifice the enjoyment of in-situ touristic travel and opt instead for VR tourism to protect the environment and support sustainability initiatives. At the same time, a favourable attitude is positively associated with consumers' intentions to undertake VR tourism even after the threat of a pandemic declines as a result of full vaccination or is completely eliminated with the end of the pandemic.

As expected based on the extant literature (e.g. Bissing-Olson et al., 2016; McCarthy et al., 2020; Mkono & Hughes, 2020), we found statistical support for a positive association between eco-guilt and willingness. This implies that the feeling of guilt – capturing consumers' remorse about the anti-environmental sustainability outcomes of their touristic travel – positively associates with their willingness to sacrifice the pleasure they derive from being physically present at a tourist destination and, instead, opt for VR tourism as an opportunity to reduce the adverse environmental impact of their travel. In contrast, our results did not reveal any significant association between eco-guilt and intentions, indicating the possibility of the existence of some intervening mechanism between the two, as explained in our response to RQ3. To elaborate, our results indicate the possible existence of a mediation effect, which we found through the mediation analysis discussed below. Additionally, we examined and found support for the positive association between willingness and intentions, as expected based on previous studies (O'Connor & Assaker, 2021; Winter et al., 2021). This result indicates that a greater willingness to sacrifice the hedonic pleasure of in-situ travel is positively associated with consumers' intentions to continue using VR tourism even after the pandemic is over.

Finally, we addressed **RQ3** in two ways. First, we examined the mediation effect of willingness on the association of both attitude and eco-guilt with intentions. The results confirmed partial mediation in the first case and full mediation in the second case, highlighting that the organism–response interaction entails multiple nuances and mechanisms that extend beyond simple direct associations. This implies that tourists' willingness to sacrifice is a key pro-environmental response in the present context because it is not only directly and positively associated with pro-environmental future intentions but also serves as an intervening variable on the associations of attitude and eco-guilt with intentions. The revelation of this mediation effect also supports previous studies underscoring the importance of examining mediating mechanisms to explain pro-environmental behaviours in the tourism sector (Farooq et al., 2021; Han et al., 2019a).

Second, we examined the moderation effect of travel mode and vaccination status on the stimuli–organism interaction. Only travel mode (solo vs group travel) has a positive moderation effect on the association between environmental impact and eco-guilt. The positive moderation effect of travel mode indicates that the eco-guilt associated with the environmental impact of touristic travel is greater for group than for solo travel, and the difference is greater for a higher rather than lower level of environmental impact. The positive moderation effect confirms prior findings, which have revealed significant differences in the preferences and risk-taking abilities of

solo versus group travellers (Steffen et al., 2020; van Genderen et al., 2014). It should be noted, however, that a limited number of studies have examined these differences, and no previous studies have examined the moderating role of solo versus group travel.

In contrast and rather surprisingly, we did not find any moderation effect for individuals' vaccination status on the above-indicated associations. A potential reason for this could be that vaccination remains a rather recent phenomenon in the UK, which might limit the visibility of differences between those who are vaccinated (one shot or both shots) and those who are not. We suggest that future studies continue to test this variable for its moderation effect so that we may trace the evolving trajectory of vaccination perceptions over time.

The study results make noteworthy contributions to both theory and practice, as discussed below.

Theoretical implications

This study has three key implications for theory. First, by examining pro-environmental behaviours motivated by environmental concerns and pandemic anxiety, it responds to calls for further research on VR tourism and altered tourist behaviour in the pandemic context (e.g. Crossley, 2020; Higgins-Desbiolles, 2020). We thus build upon the findings of our discussant study (O'Connor & Assaker, 2021) in two ways: (a) by proposing VR tourism as a specific pro-environmental travel behaviour and (b) by using the novel theoretical lens of SOR theory as an alternative to the norm activation model and economic sacrifices theory used by O'Connor and Assaker (2021) to elucidate the sequential nature of associations flowing from informational and environmental cues to cognitive and affective states, which, in turn, associate with responses in the form of willingness and intentions to behave in pro-environmental ways. In addition, we augment the limited literature (e.g. Itani & Hollebeek, 2021; Sarkady et al., 2021) by focussing on intentions towards VR tourism usage in the post-pandemic period.

Second, as the first study of its kind to propose and empirically examine the full spectrum of tourist behaviour, our work contributes towards advancing research in the area by taking environmental and pandemic concerns as the starting point, which culminate in consumers' willingness and intentions to exhibit pro-environmental behaviour. In our quest to better explicate the potential effects of the pandemic, which, fuelled by a very public debate on the link between the pandemic and environmental issues (Barouki et al., 2021; Shakil et al., 2020), has likely altered consumers' behaviour by heightening their sense of environmental responsibility, we proposed three new variables – willingness to forgo the pleasure of in-situ tourism, post-pandemic VR tourism continuance intentions and vaccination status, which capture the pandemic, environmental and VR tourism context in a novel way. The relationships we proposed and confirmed highlight the mechanism by which concern for the environment and pandemic anxiety arouse, on the one hand, a positive attitude towards VR and, on the other hand, a feeling of guilt, which, together, translate into a willingness to make personal sacrifices for the greater good and intentions to exhibit pro-environmental behaviour even after the pandemic is over. Our contribution is further enhanced by the fact that we have not only proposed new variables but also theorised new associations, which despite being conceptually sound, have remained hitherto unexplored. These proposed associations better illuminate the pathways of consumers'/tourists' thought processes, thereby providing useful insights that may not only advance research but also inform practice.

Third, by utilising SOR as our conceptual framework, we contribute to theoretical advancement in the area of consumer behaviour towards VR tourism. Despite the framework's unique ability to explain the sequential mechanism by which stimuli in the prevailing environment trigger pro-environmental responses, scholars have not fully exploited SOR's potential in the VR tourism context. We remedy this gap by activating SOR in the environmental sustainability

context. Our choice is quite pertinent because previous studies have already successfully employed SOR in varied pro-environmental contexts (e.g. Tandon et al., 2021). Furthermore, by extending SOR to explore VR tourism in the context of COVID-19 and environmental sustainability concerns, we broaden the applicability of SOR, which has, thus far, largely been used to explicate the ways in which VR tourism can be used to increase in-situ travel intentions (e.g. M. J. Kim et al., 2020).

Practical implications

This study offers four practical implications for concerned stakeholders. First, the study posits and confirms the role of VR tourism, or ex-situ tourism, in promoting environmental sustainability in the tourism sector. Our findings also reveal that consumers exhibit an awareness of this and are ready to sacrifice the hedonic pleasure and enjoyment offered by in-situ tourism. In fact, the respondents in our study express intentions to continue using VR tourism to fulfil their travel lust even after the pandemic is over. This finding implies that governments and travel associations should work to capitalise on these continuance intentions towards VR tourism. Of course, these efforts also require acknowledging the fact that the revenues generated by in-situ travel exceed those generated by ex-situ travel. We suggest one way to achieve the necessary balance between environmental and economic concerns: closing heritage and cultural sites, which are crumbling under the pressure of over-tourism (Frey & Briviba, 2021), to in-situ tourist visits and increasing funding to various establishments to develop unique VR experiences for which prospective virtual tourists could pay separately. Such a solution might be more viable to implement now because, in the wake of the COVID-19 pandemic, many people employed in the tourism sector at these locations have likely found alternative employment.

Second, our results, which find support in the recent literature (Chen, 2020; Schiopu et al., 2021), confirm VR tourism to be a viable, sustainable tourism option, which is rapidly gaining ground amongst consumers. Our finding that consumers are willing to use VR tourism not only as an alternative *during* the pandemic but also as a first choice *following* the pandemic serves as a signal for concerned service providers to increase consumer engagement efforts and thereby ensure that consumers' post-pandemic VR tourism intentions translate into actual behaviour. One step in this direction is to enhance the VR experience to a level where virtual tourists derive such great satisfaction that their loyalty, continuance intentions and behaviours persist long into the future. To this end, we suggest that VR app developers increase their focus on creating worthwhile, unique, varied, authentic and immersive experiences backed by gamification and pleasure (M. J. Kim et al., 2020; Tussyadiah et al., 2018). The pleasure derived from a seamless VR experience would most definitely highlight VR tourism's potential as not merely an environmentally sustainable and cost-effective solution but a coveted opportunity to anticipate and actively seek.

Third, our results indicate that pandemic-related travel fears drive both positive attitudes towards VR tourism and eco-guilt. This implies that at least as long as the pandemic persists – even after vaccinations (vaccination status had no negative moderating effect on the associations), consumers may not exhibit in-situ tourism intentions. Thus, we suggest that many sites and destinations reconsider their plans to reopen soon, which might compound their losses. We recommend, instead, that these destinations focus on developing symbiotic and commercially viable relationships with VR app providers. For example, mixed reality tourism packages, which support the co-existence of virtual and real worlds (Bec et al., 2021), can be developed to manage tourist load, avoid booking mix-ups and protect the ecological balance at environmentally sensitive destinations. Such efforts are particularly important because recent studies have noted that recovering the losses due to the pandemic may take years, depending upon tangible factors, such as infrastructure, and intangible factors, such psychological biases (Rosselló et al.,

2020). For instance, Gudmundsson et al. (2020) estimated that the number of passengers using air transport is likely to reach pre-COVID-19 levels in approximately 2.4 years, with more pessimistic estimates reaching as long as 6 years.

Finally, by sparking interest in VR tourism, the situational exigency created by the pandemic presents an opportunity for VR tourism firms to increase the base of their users who will remain loyal even after the pandemic is over. Because the pandemic has transformed VR tourism from a mere gimmick to a viable form of alternative travel (Debusmann, 2020), we suggest that managers capitalise on this opportunity by aggressively marketing VR tourism to the relevant target segments, such as those who cannot afford in-situ travel, those who are physically unable to travel or those who are disproportionately driven by concerns regarding their eco-footprints (Fennell, 2021). To achieve these objectives, marketing communications must be planned accordingly to clearly underscore the equality, accessibility and ecological advantages of VR tourism as well as the richness of experiences it offers. Thus, even if able-bodied tourists or those who cannot resist the urge to undertake in-situ travel return to their old ways after the pandemic, VR firms would have a stable user base upon which to sustain their commercial success.

Limitations and scope for future research

The novel contributions of this study must be viewed in the context of certain inevitable methodological and conceptual constraints, which, in turn, pave the way for future research. At the methodological level, we collected our data through a self-report questionnaire, which respondents completed at a particular point in time. For this reason, various issues, such as social desirability bias and fatigue, could have impacted the results. However, we did utilise procedural precautions, such as ensuring anonymity, allowing adequate time for responses, preforming manipulation checks and reverse coding certain items, to avoid response biases. Second, no known sampling frame estimates the total number of VR users in the UK. While this limited our sampling approach, our data collection procedure through *Prolific Academic* ensured random sampling by opening the survey to all respondents who met the screening criteria. Third, the data were collected from a single geographical area, creating the usual challenges to the findings' generalisability. Future researchers can apply our model in different countries to evaluate the robustness of our findings and strengthen the literature around this crucial topic.

At the conceptual level, we have – to keep the scope of our study manageable – theorised only a limited number of associations between a similarly limited number of variables. For instance, environmental concerns due to tourism can be measured in terms of impacts at the destination (Xu et al., 2020) and the impact of travel. Similarly, pandemic-related stimuli can be measured through risk perception (Dryhurst et al., 2020) and perceived severity (Laato et al., 2020). In addition, fear of social media shaming (Grant, 2021; Jackson, 2021) and flight shaming (Andersson, 2019) can be included to capture tourists' internal states. Finally, future research can consider the moderation effects of the Big Five personality factors (Yoo & Gretzel, 2011) and technological innovativeness (Thakur et al., 2016) to better understand the effects of individual differences on consumers' attitudes and intentions towards VR tourism.

Disclosure statement

No potential conflict of interest was reported by the authors.

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