The role of embodiment and ergonomics in immersive VR tour in creating memorable tourism experiences

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Abstract

Purpose: Given the growth of virtual reality-based tourism experiences in the last five years, this research investigates the impact of VR-based interactions (Ergonomics and Embodiment) on memorable experiences and revisit intention mediated by cognitive and emotional responses.

Design/Methodology/Approach: The study has used an exploratory sequential mixed methodology research design to operationalise this research. Study 1 uses qualitative in-depth interviews to explore the proposed research questions, and Study 2 uses a 3x3 factorial experimental research design to test the proposed hypothetical model with 355 samples.

Findings: The results indicate that embodiment plays a more crucial role than VR ergonomics. Also, the cognitive response in the virtual tour indirectly generates a more memorable experience than the emotional response.

Originality: Very minimal focus was given to understanding the tourists' interaction with technology in VR tours. The concept of ergonomics and embodiment investigated as an experimental variable is a novel approach in technology-based tourism research.

Research Implications:

The research uses the theory of technological mediation as an overarching framework to conceptualise the research. Also, the research has applied the tenets of cognitive embodiment theory, metacognitive theory, and other related theories to develop the arguments. Thus, the results of this research will extend the holistic understanding of these theories.

Practical Implications:

This research will guide VR tourism developers in understanding the requirements and expectations of tourists. It also serves as a manual to understand how tourists process the VR tour psychologically.

Keywords: VR tours; embodiment; ergonomics; memorable experience; revisit intention; psychological response

1. Introduction

Immersive tourism has been in the limelight this decade, especially after introducing technology-related interactions. Immersive tourism is also known for experiential, adventure, cultural, ecotourism, heritage, and culinary tourism (Bec *et al.*, 2019). Immersive tourism can be explained in terms of engagement, experience, interest, and interactivity that tourists show during the whole process of visiting (Fan *et al.*, 2022). However, these experiences are now augmented to a higher level of interaction using various technologies and tools (Flavián *et al.*, 2021a). Advances in technology, such as virtual reality, augmented reality, and mobile apps, enable more immersive and interactive tourism experiences (Orús *et al.*, 2021). From 360-degree videos to the metaverse, the technology has offered different levels of experiences (Flavián *et al.*, 2021b; Koo *et al.*, 2022). The growth of immersive technology in tourism has started receiving attention from academics, subsequently contributing to the tourism industry (Dwivedi et al., 2022). Especially after the impact of COVID-19, technology has played a significant role in tourism (Shareef et al., 2023; Tasnim et al., 2023). Given that technology in

tourism is proliferating and the changes are fast compared to previous decades (Balakrishnan *et al.*, 2021), whether tourists can accommodate these changes long-term needs empirical investigation (Yung *et al.*, 2021). Research has adequately examined revisiting tourists' intentions in different tourism settings. However, knowledge of how these immersive tools can contribute to the continuing intention of this tourism is necessary to understand the long-term prospects of these technologies in the tourism industry.

Immersive technology enhances the tourists' experience (Flavián *et al.*, 2021a). Immersive technology creates a sense of immersion or presence in a simulated or virtual environment (Alyahya and McLean, 2022). The environment can be augmented to any higher level based on the technological intervention present in the process. Notably, immersive tools are necessary to provide meaning to the technology used. For example, a 360-degree video tour can be viewed on a smartphone and connected with virtual reality (VR) glasses/headset. However, the VR glasses fulfil the video's real purpose. Other immersive technologies exist, such as augmented reality (AR), mixed reality (MR), haptic feedback, gesture control, and similar technologies. Of all the technologies now used, since metaverse is in the inception stage, 360-degree videos and VR tours have recently penetrated highly. Research has supported that VR-based tourism can extend a more elevated experience level (Schepers *et al.*, 2022). Unlike other industries where AR and VR are used extensively for customer experience, traditional tourism is more associated with memories that tourists cherish (Orús *et al.*, 2021). So, it is essential to note whether immersive technology can provide a tourism experience. A tourism experience is an affective state that enables tourists to connect during enjoyment. Similarly, as proposed above, the continuing intention is built from a psychological response state. Thus, the interlink between a psychological response perceived from the use of immersive technology in tourism can render a tourism experience and continuing intention. However, no hypotheses support this argument in the present literature. These arguments need empirical investigation to support these views. Especially, most of the models which have worked on technology based immersive tourism has rendered framework based on literature gap. But, the practical problems remain unexplored. Based on the above discussion, the following gaps are proposed: (1) There is a need to investigate the impact of immersive technological interactions on the tourism experience and continuing intention. (2) Given the possibility that psychological responses from immersive technology interactions can alter the experience and continuing intention, the intervening role of the variables should be explored. (3) a robust methodology should be applied to develop a holistic model with both theoretical and practical implications. By

investigating the above gap, this research provides a holistic understanding of virtual tourism and extends the theoretical and practical implications accordingly.

The research aims to investigate the impact of immersive technological interaction on the tourism experience and continuing intention through psychological response conditions. To operationalise the immersive technology interaction, this research proposes using two variables: technology embodiment (Flavián *et al.*, 2021b) and ergonomic intervention (Brown *et al.*, 2021). Notably, technology embodiment and ergonomic intervention can fit inside the holistic idea of the Theory of Technological Mediation (Ihde, 2009), which is used as an overarching theory for this study. Technology embodiment refers to integrating technology into our physical and mental selves to the point where it becomes an extension of our bodies and minds. At the same time, ergonomic intervention refers to modifying the environment to improve outcomes and experiences. Technology embodiment is an extended tenet of Embodied Cognitive Theory (ECT; Wilson, 2002), which connects physical and mental processing from the technology viewpoint. On the other hand, ergonomic intervention in IT can be reframed by an emotional design framework (Norman, 2004) based on the changes in usability and functionality. Based on the gaps and discussion, the following research questions are proposed.

RQ1: How much do the immersive technology interactions impact the tourism experience and continuing intention?

RQ2: What is the intervening role of psychological response in the relationship proposed in RQ1?

The proposed research is explored and empirically concluded using an exploratory sequential mixed research design. Study 1 used an in-depth qualitative study to reiterate the conceptual model based on a structured discussion with the tourists using immersive tools in virtual tourism. The qualitative study has further identified the conditions used to measure the ergonomic intervention and technology embodiment, which is tested in Study 2. Study 2 is operated as a 3 (high to low) x 3 (high to low) factorial experimental design with a survey design focused on VR-based online virtual tours in India as the major stimuli of the study. The results of the two studies are discussed, and conclusions are provided finally.

2. Theoretical Background - Theory of Technology Mediation

Phenomenology is the guiding idea of technological mediation. According to phenomenology, there is always an intentional bond between the subject and the object. Intentionality is a

fundamental tenet of phenomenology, which holds that consciousness is always focused on actual or hypothetical things (Aagaard, 2017). In other words, according to Verbeek (2008), humans constantly view the world via a mediating technology that creates a specific interaction between humans and the outside world. The theory of technology mediation explains how humans perceive, think, and act based on their interactions with the technology (Ihde, 2009). The theory explains that more than a tool, interactions with technology can develop human experiences and behaviour. In other words, the technology interaction augments the interaction between humans and the world. Studies which have used the theory of technology mediation have mainly discussed individual technology interactions with technology and its effect on human experience (Balakrishnan and Dwivedi, 2021), recommendation systems (Li *et al.*, 2021), technology adoption (Dwivedi, Hughes, *et al.*, 2023), and sustainable management (Kumari *et al.*, 2022). Previous research has used technology mediation theory to explain the positive impacts of VR and AR usage among individuals (Flavián et al., 2021a).

While technology mediation theory is acclaimed as a multidisciplinary theory (Ihde, 2009),its branches contributing to tourism and VR-based tourism are yet to be explored. Despite a steady rise in the studies that have used technology assistance in tourism, various dimensions associated with technology interactions are ignored. Technology interactions in the context of VR tourism can vary based on the different elements, including the interactive features in the device, navigation and interaction in the virtual tour of the destination, chats in the virtual tour, and the self-perception interactivity in the tour (Fan *et al.*, 2022). Thus, tourists can adhere to various levels of virtual tourism interactions. However, the basis of technology interactions is subjective to the ergonomic features (Gualtieri *et al.*, 2021) and the embodiment (Flavián *et al.*, 2021a) that an individual feels during VR usage. Ergonomics is concerned with creating and arranging objects, processes, and surroundings that maximise user comfort and system efficiency (Karwowski, 2005). Ergonomics aims to make productive and comfortable interactions between individuals, the environment, and technology (Brown *et al.*, 2021). In the context of virtual tourism, ergonomics describes how virtual surroundings are designed and interacted with to give users a productive and comfortable experience. To maximise user ease and reduce potential difficulty, ergonomics should be considered when it comes to virtual tourism. Ergonomics in virtual tourism can contribute in the following ways; user interface, comfort in viewing, interactivity, accessibility, realism and aesthetics, and iterative convenience. Thus, users tend to connect the virtual tour through ergonomic features, which underline the tenets of technology mediation theory.

Technology embodiment refers to blending technology and what it is incorporated into, whether physical things, systems, or the human body (Zhang *et al.*, 2022). In virtual tourism, "Embodiment" refers to the experience of using technology to be present and involved in a virtual setting. It entails establishing a sense of intimacy between the user and the virtual environment they are investigating. In virtual tourism, embodiment is essential to delivering a fully immersive and fulfilling experience. In other words, embodiment allows the users to connect the real selves in the virtual space. Various embodiment strategies are used in virtual tourism such as; third person technology navigations, avatar creations. Haptic and audio integration, natural and dynamic interactions, narrative feature, and realistic communications. These strategies provide a better experience and allow users to connect with the virtual world, which is eventually an underlying principle of technology mediation theory.

So, ergonomics intervention and technology embodiment are essential to interactions that can shape tourist behaviour. Literature on technology interactions has supported that interaction's mode and generate different psychological responses (Hu *et al.*, 2020). These psychological responses form a basis for processing the information or stimuli to arrive at a decision or desired outcome (Li *et al.*, 2021). So, the interaction with VR devices during virtual tours can generate a psychological response, leading to tourist behaviour (Wu and Lai, 2021). Most of the studies have supported that a positive psychological response can result in a fruitful experience in tourism (He *et al.*, 2023). The same can be applied in this context to VR tours. Besides, literature has also confirmed that such psychological response can instil a long-term association with technology (Daassi and Debbabi, 2021), tourism (Lei *et al.*, 2021), and destination (Lee *et al.*, 2023). Thus, Figure 1 shows the conceptual model developed based on the research question and the theoretical discussion above.

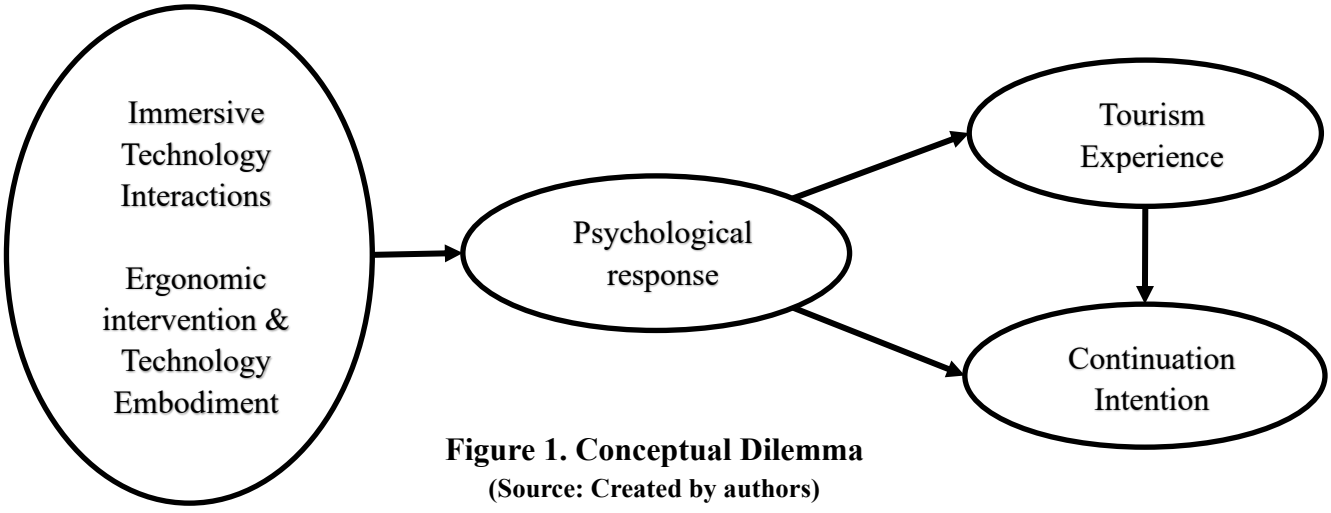

Figure 1. Conceptual Dilemma
(Source: Created by authors)

3. Research Design

This research followed an exploratory sequential mixed method design developed as two different studies. An exploratory sequential mixed-methods approach was employed in order to comprehend and validate the interventions and outcomes of Immersive Technology Interactions (Creswell and Creswell, 2017). With this strategy, researchers can use a qualitative method to first investigate a concept that hasn't received much attention. Subsequently, in order to explore the generalisation of qualitative findings from a sample population, researchers employ a quantitative strategy guided by the qualitative investigation (Creswell and Creswell, 2017). Semi-structured interviews were used as the first method of data collection in order to obtain concepts related to Immersive Technology Interactions because there is a lack of study on this topic. Study 1 uses a qualitative methodology to further explore the conceptual model provided in Figure 1 and develop it as a hypothetical model. Study 2 discusses the hypothetical arguments and performs a factorial experimental design (3x3) to analyse the proposed hypothetical model in Figure 2. The discussions and conclusions are consolidated based on the insights from Study 1 and Study 2.

4. Study 1 (Thematic Exploration)

4.1. Study Design

A qualitative interview was conducted with 28 tourists who have used VR-based tourism previously. Also, they were requested to participate in a virtual tour offered by an agent from India who is engaged in VR immersive experience service. The VR agent's facilities were used to create an immersive VR tour for the tourists. Following a 20-minute virtual tour, an in-depth interview is conducted with each participant of Study 1. The interview with the tourists extended up to 17 minutes on average for a participant. The interviews were designed to elaborate the inherent understanding of the conceptual model proposed in Figure 1, and the interview questions were designed accordingly to reflect on the purpose of the study. All the tourists who participated in the in-depth interview had good knowledge about the growing technology in tourism.

4.1.1. Sampling and Operationalisation

The tourists who participated in Study 1 had at least once experienced the VR tourism experience and some to a maximum of 6 times (mean = 2.71; Std. Dev = 1.13). Fifteen of those who participated in the interview were female, and Thirteen were male. The interviews with

these customers lasted between 13 and 32 minutes (mean = 17 minutes; Std. Dev. = 4.11). The tourists were selected based on a snowball sampling method identified through various online and offline sources representative of the targeted sample. After selecting participants, a structured interview was conducted with a self-developed questionnaire vetted by four experts from academics and industry. The refined questionnaire was used to interact during the interview process. Appendix A provides the list of questions asked during the interview process and Appendix B shows the participants list.

4.1.2. Data Analysis

The study followed a five-step process to evaluate the data verbatim provided by the participants (Braun and Clarke, 2019; Dwivedi, Balakrishnan, *et al.*, 2023; McCrudden and McTigue, 2019). As a first step, the recorded interview transcripts were read thoroughly to ascertain that the data and discussion holistically represented the exploration of the conceptual model. In the second step, the interview transcripts were generated as closed phrases, which fall into the study's conceptualisation. For example: "I tend to get immersed in the VR tourism" (P21), "The comfort that I get through the VR device helps me to focus on my journey resulting in better memorable experience" (P16), "I get more emotional during my journey and I can feel myself being in the location" (P8), and "My experience with this VR transition is very fruitful, I wish to experience this again soon with another location" (P11). In the third step, open codes derived from the phrases were systematically combined to develop an axial coding system. For example, P21's statement above was coded as "VR Immersion", P16's statement as "Memorable Experience", and P8's statement as "Emotional Response". Following the principles of selective coding, the axial coding labels were further grouped into categories during the fourth stage based on thematic congruence. For example, The codes "Emotional feel" and "Emotional transition" are grouped under "Emotional Response". Finally, as a fifth step, the derived labels and codes fit into the conceptual model in Figure 1 to derive an extended hypothetical model. NVIVO and GEPHI 0.10 were used to understand the codes and to visualise the relationship pattern.

4.2. Results of Study 1

The qualitative analysis explored the inherent topics and concepts branching out from the conceptual model in Figure 1. The concepts (i) technology embodiment, (ii) ergonomics, (iii) psychological response, (iv) experience, and (v) continuing intention are explored further to

discover the underlying topics present within the system. The following sections will explain the qualitative exploration of the concepts.

4.2.1. Ergonomic intervention

The ergonomic intervention concept is explored to understand the topics present in it. Most tourists could understand the meaning of ergonomics in terms of comfort and design in which the VR is physically operated. The tourists associated the ergonomic characteristics with the VR and other devices associated with the virtual tour. While various labels were determined during the discussion, such as posture, movements, noise, painlessness, and structure, most participants were more concerned about design, comfort, and usefulness, as given in Table 1. An exemplary statement reflecting ergonomic intervention is given below.

> *P5 stated: "While using the VR devices, I feel the comfort is paramount to feel the tour."*
>
> *P13 stated: "The design and use of the VR headset should be helpful to gain fuller experience."*

So, the ergonomic intervention is mainly associated with design, comfort, and usefulness, as given in Table 1.

Table 1: The categories and codes for the Study 1 (n=28) (Source: Created by authors)

Technology Interaction	**n**	**Psychological Response**	**n**	**Experience and Intentions**	**N**
Ergonomic Intervention		***Cognitive Response***		***Experience***	
Design (+)	12	Learn (+)	16	Memorable (+)	21
Comfort (+)	10	Think (+)	12	Technology experience (+)	14
Usefulness (+)	9	Evaluate (+)	12	VR Experience (+)	11
		Rational imagination (+)	8	Enjoyable Experience (+)	10
Technology Embodiment		***Emotional Response***		***Intentions***	
Body Identity (+)	11	Feel (+)	18	Revisit Intentions (+)	19
Ownership (+)	11	Emotional Connect (+)	14	Continuation Intentions (+)	14
Control (+)	8	Excited (+)	9	Word of Mouth Intentions (+)	11
Agency (+)	8				

4.2.2. Technology embodiment

Technology embodiment explored various labels of tourists' perception of how they connect their physical being in the virtual world. The labels associated with technology embodiment include ownership, agency (movement), control, body identity, body feel, physical rejuvenation, and physical touch. However, the concepts of ownership, agency, control, and

body identity were mentioned by most of the tourists. An exemplary statement reflecting technology embodiment is given below.

> *P7 stated: "I would like to have ownership (body) during my journey of virtual tours."*
>
> *P12 stated: "It is important to me to have control in my virtual tour; also, my movements should be decided by me."*

Thus, tourists mostly see technology embodied through the eyes of ownership, agency, control, and body identity.

4.2.3. Psychological response

Tourists responded to various psychological responses as an outcome of the ergonomic and embodiment, such as learning, thinking, evaluating, happiness, feeling, emotional, thoughts, hope, self-esteem, sensations, unsecured, delight, and confidence. However, the responses such as learn, think, evaluate, feel, emotional, and rational thinking were found to be more repeated among the tourists. Thus, the responses are classified as cognitive and emotional based on the tourists' identified labels. The labels learn, think, evaluate, and rational response are categorised as cognitive and feeling, emotional, and excited as emotional responses. An exemplary statement reflecting cognitive and emotional responses is given below.

> *P11 stated, "I feel happy being on this virtual tour. Of course, it taught much about the destination and the technology."*
>
> *P17 stated, "I can evaluate my experience in this VR tour."*

4.2.4. Tourism Experience

Eight labels were identified while processing the content of the tourists in the context of tourism experience, including memorable, technology experience, VR experience, enjoyable, new experience, emotional experience, fun and experience, and interactive experience. Memorable experiences, technology experiences, VR experiences, and enjoyable experiences were found to be refereed by most of the tourists. Most of the tourists insisted that the virtual tour was memorable.

> *P18 stated, "My experience with this VR tour is memorable, and I would like to cherish the memories for a long time."*
>
> *P26 stated, "My journey in this VR tourism is such a memorable experience."*

4.2.5. Continuing Intention

Most of the responses associated with continuing intention are concerned with revisit intention. Some tourists also associated the context of continuing intention with VR technology and word-of-mouth intentions.

> *P1 stated, "I would like to revisit this destination through this VR tour; this was a memorable experience."*
>
> *P19 stated, "I learned a lot from this tour, and I wish to revisit the destination in future."*

Based on the labels and associated, a thematic diagram is derived as given in Figure 2. In which it provides a larger perspective of how the labels are connected. Thus, deriving from the qualitative analysis of Study 1 and Appendix C's thematic diagram, this study proposes the hypothetical model (Figure 2) that can be investigated in Study 2. Appendix C shows hat memorable experience is the strongest node which is connected through other nodes such as; comfort, VR experience, emotional connection, control, think and evaluate, and feel. When these nodes are connected with the conceptual dilemma provided in Figure 1, it fits with the framework, showing that both cognitive and affective response leads to memorable experience, thus leading to an outcome. Also, the conditions of ergonomic intervention and technology embodiment can be decided based on the output shown in Appendix C

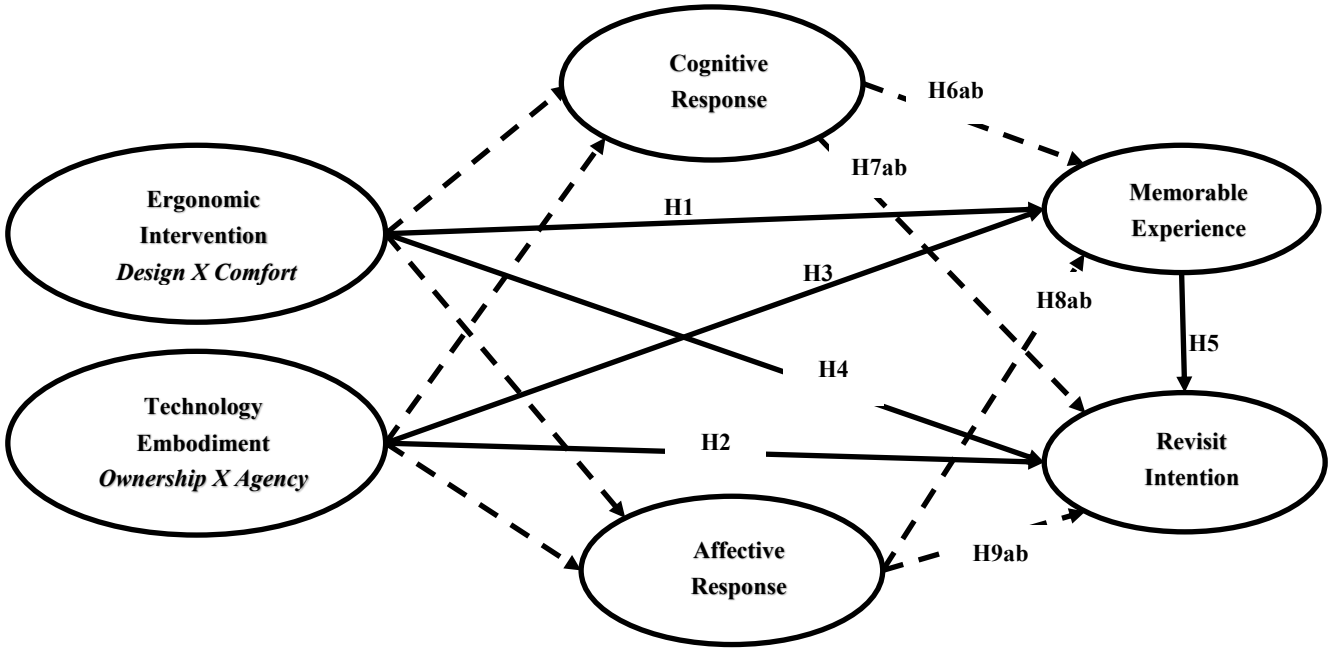

Figure 2. Hypothetical model of the study

(Source: Created by authors)

5. Study 2

Study 2 is organised in the following pattern: first, the hypotheses are proposed, followed by the methodology and results section.

5.1. Model and Hypothesis Development

5.1.1. Ergonomic Intervention

Ergonomics in the context of VR refers to the VR system's design and comfort, which optimises better interaction and usability (Ottogalli *et al.*, 2021). Ergonomic intervention in VR tourism aims to provide better comfort and usability to improve the experience (Brown *et al.*, 2021). While experiencing VR-based tourism, tourists process information more consciously than physically visiting the destination (Seçilmiş *et al.*, 2022). Previous research has also supported the idea that the signs and functions of VR devices can enhance the experience (Flavián *et al.*, 2021a). As positioned above, ergonomic intervention can help tourists mediate their presence in the technological medium, thus leading to a memorable experience. The comfort and design of the VR devices can augment the tourists' virtual tours to be remembered as a memorable experience.

> *Hypothesis 1: The ergonomic intervention is significantly related to a memorable experience*

Studies have supported that the infrastructure and functional designs in the destination will build a positive intention for tourists to revisit the destination (Isa *et al.*, 2019). Thus, the gratifications received through such functional or psychological benefits have a long-term effect (Kumar and Dhir, 2020). In virtual tourism, these structural gratifications are primarily associated with the VR devices through which the tourists experience their journey. The use of ergonomic concepts into VR technology and virtual tours can enhance tourists' comfort, enjoyment, and sense of fulfilment, leading to a better memorable experience. Thus, the design and comfort felt during virtual tourism can form a long-term association with the destination and develop positive intentions to revisit the destination. The following hypothesis is proposed based on the above discussion.

> *Hypothesis 2: The ergonomic intervention is significantly related to a positive relationship to revisiting intention*

5.1.2. Technology Embodiment

Technology embodiment is a concept that integrates technology with the physical entity of the users (Zhang *et al.*, 2022). In other words, technology embodiment refers to when an individual sees the technology as an extension of their physical body (Scavarelli *et al.*, 2021). Tourists using VR devices may replicate their physical presence in the virtual world, which in turn can provide a memorable experience. In virtual tours, tourists can have a memorable experience based on their perceived sensation in the destination journey (Dubosc *et al.*, 2021). Previous research has strongly supported that technology and the physical embodiment of the technology can build positive experiences (Chylinski *et al.*, 2020). This research extends this discussion in VR-based tourism, stating that the perceived embodied structure will develop memorable experiences with the tourists.

> *Hypothesis 3: The technology embodiment is significantly related to memorable experiences.*

Embodiments can develop personalisation in VR-based tourism, creating a real-life feel (Flavián *et al.*, 2021a). Studies have supported that creating personalisation in the technology medium can develop positive intentions to continue with the technology (Balakrishnan *et al.*, 2021). In VR-based tourism, tourists can feel their physical existence through the reality devices (Alyahya and McLean, 2022), which can subsequently develop more intention to revisit the destination. Studies have supported that when individuals feel their own body is connected in a virtual space (Flavián *et al.*, 2021b), they tend to create a level of satisfaction with the systems in which the interaction occurs. In virtual tourism, the tourists will be more associative with their physical connection with the destination, which can result in better satisfaction (Reer *et al.*, 2022), thus resulting in an intention to revisit the destination (McLean and Barhorst, 2022).

> *Hypothesis 4: The technology embodiment is significantly related to revisiting the intention*

5.1.3. Memorable experience to revisiting intention

Memorable experiences about the destination are developed when a tourist is emotionally connected with the destination (Kim, 2014). Thus, a memorable experience in the virtual tours will build a positive revisit intention. Previous studies have supported the idea that aemorable experience is significantly associated with the revisit intention (Rasoolimanesh *et al.*, 2021).

Using virtual tours to create unique experiences improves visitors' first impressions of a place and influences their desire to return in the future. Virtual tours mediate through multiple technologies like VR, 360-degree technology, and other immersive mediums to augment their experience, thus creating a prospective intention to revisit. Based on this discussion, this research posits that memorable experiences can positively build the intention to revisit virtual destinations.

Hypothesis 5: Memorable experience is significantly related to revisiting intention.

5.1.4. Cognitive and Emotional Response

In VR tourism, cognitive response or evaluation can be seen as how tourists can process the information rationally, which helps in behavioural formation (Michael *et al.*, 2019). When tourists process information, they tend to augment the information better, which can help them build a better experience. Metacognition theory (Schraw and Moshman, 1995) states that the cognitive aspects that an individual processes will allow them to build a better experience. In the case of VR tourism, the cognitive response will help the tourists process the ergonomic positioning from a rational point of view, thus building a memorable experience. The following hypothesis is proposed based on the above discussion.

Hypothesis 6a: Cognitive response significantly mediates the relationship of the ergonomic intervention to a memorable experience.

Similarly, the cognitive response can positively mediate the path between technology embodiment and memorable experience. People who interact with technology develop cognitive responses, including opinions, judgments, and views generated through embodied interaction (Flavián *et al.*, 2021a). This could include the technology's uniqueness, simplicity of use, information gleaned, and an overall augmented experience. Thus, VR tours with cognitive response can positively mediate the relationship between technology embodiment and memorable experiences.

Hypothesis 6b: Cognitive response significantly mediates the relationship of the technology embodiment to a memorable experience.

Similar to the previous hypotheses, previous research has supported that cognitive elements will have a better memory, resulting in the continuation of the goods or services (Li *et al.*, 2010). In the VR tourism context, ergonomics and embodiment give various points to detail,

which is necessary for tourists to pay attention to detail. So, the cognitive response gained from VR usage in terms of ergonomics and embodiment can improve the relationship between ergonomics and embodiment to revisit intention. Metacognition theory supports the idea that cognitive responsesnd experiences make individuals derive a long-term association with the event (Tsai *et al.*, 2018).

Designing and implementing easily accessible and user-friendly components can build revisit intention. This could include safety precautions, well-thought-out areas, ergonomic seating, and other elements meant to improve visitors' general comfort and ease of travel. Thus, when tourists can decode the ergonomic interactions through the cognitive route, they can develop positive revisit intentions. The following hypothesis is provided based on this discussion.

> *Hypothesis 7a: Cognitive response significantly mediates the relationship of the ergonomic intervention to revisit intention.*

Similarly, VR travellers may have a positive opinion of the technology embodiment if they receive processable cognitive responses. They might consider the technology and experience unique, interesting, and worthwhile. Positive cognitive assessment is important because it affects how travelers interpret and assess their entire motivation to revisit.

> *Hypothesis 7b: Cognitive response significantly mediates the relationship of the technology embodiment to revisit intention.*

An emotional way of interaction with technologyas been addressed in previous research (McDaniel and Drouin, 2019). Studies in tourism research have supported that tourists tend to have emotional feelings about their technology interactions (Jiang *et al.*, 2020), specific to VR devices (Flavián *et al.*, 2021a). Viewing this from the Affective Disposition Theory (Zillmann and Bryant, 1975), tourists can get emotionally attached to VR tourism experiences, leading to a memorable experience overall.

Positive emotional reactions serve as a transitional stage, influencing visitors' perceptions of the ergonomic aspects. This emphasises how crucial it is to create ergonomic interventions that promote good emotional reactions and physical comfort to give the tourists a memorable experience. Thus, when interacting in virtual tourism, tourists can feel emotionally connected with the bodily journey and feel the ergonomic design, resulting in a better memorable experience. The following hypothesis is proposed based on the above discussion.

Hypothesis 8a: Emotional response significantly mediates the relationship of the ergonomic intervention to the memorable experience.

Both ergonomic feel and embodied emotions can augment the experience in a better way. As mentioned above, emotional responses act as an intermediary to trigger positive responses from the tourists based on the technological features that they use. So, the designing and the embodied presence in the virtual world, when transmitted through emotional response, can create a better memorable experience. This emphasises the importance of developing technological embodiments that arouse favourable emotions and improve the memorable experience.

Hypothesis 8b: Emotional response significantly mediates the relationship of the technology embodiment to the memorable experience.

Similar to hypotheses 8a and 8b, studies using the Affective Disposition Theory have stated that emotional connection with technology can develop a solid continuation intention (Whittaker et al., 2021). In the case of virtual tourism, the emotional flow associated with the ergonomics of the device and the feel of the embodiment can develop a positive continuation intention. Previous research has found that emotional responses can significantly augment the relationship associated with a destination's revisit intention (Zhang *et al.*, 2018). So, tourists who connect emotionally with the destination, technology, or both can get positive intentions to revisit.

A positive feel of the VR devices and the bodily feel in virtual tourism can help generate revising intentions. The ergonomic features and the technology underlining the same can generate positive response on revisit intention. The following hypothesis is proposed based on the above discussion.

Hypothesis 9a: Emotional response significantly mediates the relationship of the ergonomic intervention to revisit intention.

Positive emotional reactions to technological embodiment lead to increased satisfaction, influencing the establishment's intention to revisit. Travelers with emotionally fulfilling and rich experiences are more likely to say they plan to return to the location. In the context of VR tourism, emotionally connected embodied interventions can positively influence the relationship of technology embodiment to revisit intention. The following hypothesis is proposed based on the above discussion.

Hypothesis 9b: Emotional response significantly mediates the relationship of the technology embodiment to revisit intention.

5.2. Method

5.2.1. Study Design and Experiment Conditions

A 3x3 factorial experimental design is used to test the proposed hypotheses. The 3x3 design indicates conditions for ergonomic intervention and technology embodiment. Ergonomic intervention is measured as three conditions (high design and control (3), medium design and control (2), and low design and control (1)), and technology embodiment is also measured with three conditions (high ownership and agency (3), medium ownership and agency (2), and low ownership and agency (1)). Table 2 provides the details of the six experimental conditions. The study was operationalised with the help of a VR-based agency that provides 20-minute VR-based virtual tours to more than 50 tourist locations. To reduce the control bias, a single destination is choosen for all the participants. 400 tourists from India expressed their willingness to participate in the virtual tour and completed a survey questionnaire afterwards. All 388 tourists participated in the experiment, but 355 eligible data points were finalised based on the eligible responses. The 355 tourists were found to be almost equally distributed across the nine blocks (3x3) based on the factorial design. Each block had a minimum of 38 tourists and a maximum of 42 tourists. The sample consisted of 51.83% male and 48.17% female; 51.3% of the sample is educated to graduation level, and 48.7% is educated to post-graduate level. The same is diversely spread across age groups, with 43.9% of the sample belonging to the age bracket of 19 to 30 years, 25.4% belonging to 31 to 40 years, and 30.7% belonging to above 40 years.

5.2.2. Experiment Procedures and Manipulation Validations

A third-party VR-based agency is chosen. The agency helps people to engage with VR devices to have an experience in terms of games, tourism, movies, and cartoons. The agency is operational in five locations in India. They facilitate the virtual tour on the computer and in the mobile phone with different customised settings in terms of seating, standing, and other comfort levels with VR devices. The experiment procedures were operationalised in the following manner: The tourists were asked to experience the VR tour of the selected location. Following their journey to the destination, the tourists were asked to fill out a questionnaire providing feedback about their VR experience. The experiment conditions are chosen based on the insights provided in Study 1. The conditions for ergonomic intervention were chosen based

on the interactions with the tourists, suggesting that comfort and control were the main variables to describe the ergonomic intervention. Similarly, the conditions for technology embodiment are chosen based on Study 2. The 3x3 experiment conditions are manipulated into nine blocks. The conditions were validated through pilot testing to check whether the conditions explained the variance as coded.

5.2.3. Experiment Validations

The experiment conditions are pretested using 30 samples. The conditions given in Table 2 are placed in the experiment, and two questions were asked to the pilot sample: It was a great experience and memorable (5 –strongly agree to 1 – strongly disagree). I would be happy to take another tour of this VR-based tourism now or in the future (5 –strongly agree to 1 – strongly disagree). The questions were tested with different conditions for ergonomic intervention and technology embodiment. In ergonomic intervention, the conditions were tested with 15 samples in a random order, in which the five samples were placed in each condition. Following the experiment, two questions were asked to test the variance present in the experimental conditions. The ANOVA results demonstrated that the experience in VR tourism differs across the conditions ($F = 22.750$; $df = 2,12$; $p<0.05$) and future behavioural intentions ($F = 17.750$; $df = 2,12$; $p<0.05$) for ergonomic intervention. Also, the results showed significant differences among the conditions for technology embodiment for the variables: experience ($F = 7.740$; $df = 2,12$; $p<0.05$) and future behavioural intentions ($F = 8.600$; $df = 2,12$; $p<0.05$).

Table 2: Conditions of the two experimental variables (Source: Created by authors)

Ergonomic Intervention (Design and Comfort)	
Low (coded as 1)	Tourists can use a mobile or computer device without a VR headset where the design and comfort of using the system are minimal.
Medium (coded as 2)	Tourists can use a computer with a VR headset defined with moderate comfort and medium control over the VR headset. However, the destination and the other variables about Technology Embodiment are the same.
High (coded as 3)	Tourists can use a mobile phone with a VR headset defined with high comfort and high control over the VR headset. However, the destination and the other variables of Technology Embodiment are the same.
Technology Embodiment (Ownership and Agency)	
Low (coded as 1)	The tourists were able to see the tour in a first-person view. The tourists will be able to see the places in a 360-degree view. But the ownership towards the body or any visible body movements will not be visual in the tour.

Medium (coded as 2)	The tourists could see an Avatar or Hand in a third-person view. The tourists will be able to see the places in a 360-degree view. The ownership of the body is visible in the tour, but any body movements will not be visible. Thus, ownership of the body is present in the journey.
High (coded as 3)	The tourists were able to see an Avatar or Hand as a third-person view, the tourists will be able to see the places in 360-degree view. The ownership of the body is visible in the tour, also the movements of the body and the hand movements is visible. Thus the ownership of the body and the agency of movements is present.

5.2.4. Questionnaire and Measurement

The study used established scales from previous studies. The scales were reworded to fit in with the context of the study. The questionnaire was evaluated by five academic experts and five industry practitioners involved in technology-based tourism. The questionnaire had three parts: (1) Explanation part of the questionnaire, (2) item scales, and (3) the socio-demographic information. The scale for cognitive and emotional response is derived from (Fu and Kim, 2019), memorable experience from Rivera et al. (2015), and revisit intention from Zhang et al. (2018). All items are measured on a five-point Likert scale, with five representing strongly agree and one representing strongly disagree. The measurement items for the constructs are provided in the Appendix D. The experimental variables, ergonomic intervention, and technology embodiment are coded as dummy variables, in which the higher experimental condition is coded as 3, medium condition as 2, and lower condition is coded as 2. The details of the conditions are given in Table 2.

5.2.5. Analysis

The study used two-step structural equation modelling to test the proposed hypotheses and model (Hair et al., 2010). Previous research has used structural equation modelling techniques to test the relationship integrated with different experimental conditions. In the first step, the confirmatory factor analysis (measurement model) is employed to test the reliability, content validity, convergent validity, and discriminant validity requirements. Next to the confirmatory factor analysis, the hypotheses were tested using co-variance-based structural equation modelling using SmartPLS 4.0. The total, direct, and indirect effects were also tested to understand the mediation effect in the model for the proposed hypotheses. The Common Method Bias (CMB) requirements were also tested to understand whether the data is free from any internal biases.

5.3. Results

5.3.1. Measurement Model and Common Method Bias

As shown in Table 3, the factor loadings of each item to the corresponding constructs are found to be above 0.60, thus satisfying the content validity requirements (Nunnally, 1978; Portney and Watkins, 2000). Table 3 shows construct reliability to be above 0.750, confirming the reliability requirements. Average Variance Extracted (AVE) values are above 0.50, which confirms the convergent validity requirements (Fornell and Larcker, 1981). Table 4 shows the inter-correlation values between the constructs and squared root of AVE values in the diagonals of the table. Table 4 shows that the cross-correlation loadings for each construct is less than its diagonal value, confirming the discriminant validity requirements (Fornell and Larcker, 1981). The confirmatory factor analysis model fits well (Iacobucci, 2010). Overall, the measurement model indicates an overall fit with satisfying the reliability and validity requirements (Bagozzi *et al.*, 1991), paving a path to conduct the structural equational model (SEM) analysis. Before proceeding to SEM, CMB analysis (Podsakoff *et al.*, 2003) is tested to check whether the data was internal bias-free. Podsakoff et al. (2003) supported CMB analysis for survey-based research using the Common Latent Factor (CLF) method. The CLF method separates the true relationships between the variables from the method-related variance. This enables to obtain precise and unbiased estimates of the relationships. The standardised regression comparison between the CLF and Non-CLF model will provide a thorough understanding of the CLF. The difference in standardised regression weights between the CLF and Non-CLF models was considerably below 0.05 during the CLF analysis. The conclusion that "the CLF model is well in control" (MacKenzie and Podsakoff, 2012) indicates that Common Method Bias is unlikely to affect the items and assessment.

Table 3: Results of Measurement Model (CFA) (Source: Created by authors)

Construct	Items	Mean	Std. Dev	Factor Loadings	CR	AVE
Cognitive Response	CR1	3.372	1.0240	0.820***	0.892	0.579
	CR2	3.417	1.1551	0.836***		
	CR3	3.254	0.9760	0.807***		
	CR4	3.211	1.0530	0.796***		
	CR5	3.158	1.1310	0.728***		
	CR6	3.344	0.9970	0.739***		
Emotional Response	AR1	3.369	1.0585	0.859***	0.918	0.737
	AR2	3.589	1.1050	0.868***		

	AR3	3.380	1.0625	0.834***		
	AR4	3.487	1.0745	0.873***		
Memorable Experience	ME1	3.332	1.0151	0.806***	0.860	0.673
	ME2	3.389	1.0474	0.816***		
	ME3	3.301	1.0178	0.838***		
Revisit Intention	RI1	3.383	1.1323	0.791***	0.836	0.630
	RI2	3.439	1.0859	0.798***		
	RI3	3.296	1.1764	0.793***		
Note 1: CA represents "Composite Reliability"; AVE represents "Average Variance Extracted"; CFA Fit indices: ϰ2/df = 1.95; GFI = 0.936, CFI = 0.972 (Good fit>0.9); RMSEA=0.041 (Good fit <0.06). Note 2: ***denotes p<0.001						

5.3.2. Structural Model

Hypothesis 1 to 5 investigated the relationships proposed in Figure 2. The proposed model is investigated as two models (i.e.) model 1 with no effect of mediating variables in the direct relationships and model 2 with the effect of mediating variables in the direct relationships. All five hypotheses investigated in Model 1 are significant, of which the relationship between ergonomic intervention to memorable experience (β = 0.343) is the highest. Hypotheses 3, 4, and 5 also showed a highly significant relationship between technology embodiment to a memorable experience (β = 0.323), technology embodiment to a revisit intention (β = 0.283), and memorable experience to revisit intention (β = 0.333) respectively. Hypothesis 2 showed the relationship between ergonomic intervention and revisit intention that showed a weak coefficient (β = 0.140) compared to other paths. However, a significant relationship. The results of model 2 showed that after the mediating variables (cognitive response and emotional response) were introduced in the model, the direct effects of all the paths declined. Of which, the relationship between ergonomic intervention and revisit intention is insignificant (β = 0.057). The remaining four hypotheses were found to be significant but failed to exhibit a very strong direct effect. The coefficients of the model 2 exhibit the strength of the mediating variable. Table 5 shows results of the proposed hypotheses.

Table 4: Discriminant validity and descriptive statistics of measures (Source: Created by authors)

	Cognitive Response	Emotional Response	Memorable Experience	Revisit Intention
Cognitive Response	***0.766***			
Emotional Response	0.665	***0.796***		
Memorable Experience	0.179	0.036	***0.962***	
Revisit Intention	0.106	-0.066	0.764	***0.952***
The diagonals value represents √AVE; and the off-diagonal values represent inter-construct correlations for respective variables.				

Table 6 shows the eight hypotheses' total, direct, and indirect effects (H6a, H6b, H7a, H7b, H8a, H8b, H9a, H9b). Hypotheses 6a, 6b, 7a, and 7b investigated the indirect effect of cognitive response in the relationship of ergonomic intervention to a memorable experience, technology embodiment to a memorable experience, ergonomic intervention to revisit intention, and technology embodiment to revisit intention, respectively. The cognitive response is a significant mediator of all these four relationships. Also, since the direct effects are already significant, the cognitive response partially mediates H6a, H6b, and hypotheses H7b. However, H7a exhibited an insignificant direct effect. Thus, the path is fully mediated by the cognitive response. Hypotheses 8a, 8b, 9a, and 9b investigated the indirect effect of emotional response in the relationship of ergonomic intervention to a memorable experience, technology embodiment to a memorable experience, ergonomic intervention to revisit intention, and technology embodiment to revisit intention, respectively. Hypotheses 8a and 8b were significantly mediated by an emotional response. At the same time, the impact of emotional response was insignificant for the relationship's existence in Hypotheses 9a and 9b.

Table 5: Standardised estimates of the proposed model (Source: Created by authors)

Hypotheses	Endogenous Variable	Exogenous Variable	Model 1		Model 2	
			Standardised Coefficients	T values	Standardised Coefficients	T values
Hypothesis 1	Memorable Experience	Ergonomic Intervention	0.343	6.420^{***}	0.195	3.004^{***}
Hypothesis 2	Revisit Intention		0.150	2.497^{***}	0.057	1.061^{ns}
Hypothesis 3	Memorable Experience	Technology Embodiment	0.324	6.037^{***}	0.214	3.850^{***}
Hypothesis 4	Revisit Intention		0.303	5.041^{***}	0.147	2.778^{***}
Hypothesis 5	Memorable Experience	Revisit Intention	0.357	5.081^{***}	0.193	2.990^{***}

Notes: *** represent values significant at 99% confidence level. Model fit indices (model 1): $\chi 2$ /df = 2.52; GFI =0.971; NFI = 0.962; CFI = 0.976; RMSEA = 0.041. Model 1 represents the values without mediating paths (Appendix E), Model 2 represents the values with mediating paths (Appendix F). Source: Created by authors

6. Discussion

This research has used an exploratory sequential mixed method design to explore and investigate the proposed research questions. This enables a robust methodology to bridge a gap between the practical problem with theoretical integration. The design is structured as two studies in which study 1 explores the conceptual theme to develop it as a hypothetical model using 28 in-depth interviews with tourists. Study 2 empirically investigates the proposed model with 355 tourists using a 3x3 factorial experimental design. The study proposed five hypotheses to investigate the direct relationships and eight to investigate the indirect effect of cognitive

and emotional responses. The following section of discussions are structured in the following manner. First, the results of study 1 and study 2 are discussed, and then the theoretical and practical contributions are briefly explained.

Previous research has ascertained that ergonomics and embodiment are perceived through the comfort (Mansfield *et al.*, 2020) and the ownership (Roth and Latoschik, 2020) associated with the technology, respectively. The results of Study 1 confirm the same. However, further research also extends the context of comfort to design, control, and ownership of the agency. Studies that have studied immersive technology and its role in tourism (Atzeni *et al.*, 2022) have strongly denote that cognitive and emotional connection with immersive tourism will lead to a more decisive outcome. This research confirms and extends the results by discovering that cognitive and emotional responses are two crucial psychological aspects of VR-based tourism. While many experience facets are possible within the VR tourism channels, study 1 strongly recommended that memorable experience is crucial. Previous research has supported that memorable tourism can build long-term outcomes in tourism. Study 1 supports such a view by qualitatively confirming that memorable experiences can lead to revisiting intention.

Table 6: The results of total, direct, and indirect effects in the model (Source: Created by authors)

Effects		**Effects of EI on ME (H6a)**	**Effects of TE on ME (H6b)**	**Effects of EI on RI (H7a)**	**Effects of TE on RI (H7b)**
Mediating effects of Cognitive Response	Total Effects (std. dev, lower bound, upper bound)	0.344^{***} (0.055, 0.235, 0.450)	0.324^{**} (0.049, 0.216, 0.413)	0.259^{***} (0.049, 0.151, 0.342)	0.395^{***} (0.045, 0.307, 0.476)
	Direct effect (std. dev, lower bound, upper bound)	0.195^{***} (0.065, 0.065, 0.316)	0.214^{***} (0.056, 0.092, 0.322)	0.057^{ns} (0.053, -0.161, 0.149)	0.147^{***} (0.053, 0.033, 0.242)
	Indirect effect (std. dev, lower bound, upper bound)	0.118^{**} (0.031, 0.059, 0.178)	0.083^{***} (0.026, 0.039, 0.142)	0.182^{***} (0.036, 0.118, 0.252)	0.129^{***} (0.028, 0.078, 0.185)
Effects		**Effects of EI on ME (H8a)**	**Effects of TE on ME (H8b)**	**Effects of EI on RI (H9a)**	**Effects of TE on RI (H9b)**
Mediating effects of Emotional Response	Total Effects (std. dev, lower bound, upper bound)	0.344^{***} (0.055, 0.235, 0.450)	0.324^{**} (0.049, 0.216, 0.413)	0.259^{***} (0.049, 0.151, 0.342)	0.395^{***} (0.045, 0.307, 0.476)
	Direct effect (std. dev, lower bound, upper bound)	0.195^{***} (0.065, 0.065, 0.316)	0.214^{***} (0.056, 0.092, 0.322)	0.057^{ns} (0.053, -0.161, 0.149)	0.147^{***} (0.053, 0.033, 0.242)
	Indirect effect (std. dev, lower bound, upper bound)	0.032^{ns} (0.02, -0.003, 0.074)	0.027^{ns} (0.017, -0.002, 0.061)	0.068^{***} (0.021, 0.033, 0.117)	0.057^{***} (0.021, 0.023, 0.117)

All the estimates are standardised and *** denotes values significant at 99 % level and ^{ns} denotes values not significant: n=355, bootstrap iterations=5000. (Bias corrected method). Notes: EI denotes Ergonomic Intervention; TE denotes Technology Embodiment; ME denotes Memorable Experience; RI denotes Revisit Intention

Study 2 investigated hypotheses 1 to 5 as direct relationships in model 1 and with holistic mediation effect in model 2. In model 1, ergonomic intervention is found to significantly impact memorable experience (H1) and revisit intention (H2). Previous research has confirmed that ergonomic features create a positive experience (Brown et al., 2021), but this research has extended this understanding to memorable experiences. Also, previous research has supported that ergonomic features tend to create solid behavioural intention with the technology (Pal *et al.*, 2022), but there is no research to support the relationship between ergonomics and revisit intention. Guler et al. (2021) supported e idea that ergonomics can create a long-term impact on users. Thus, through this finding the study has filled the gap and extended the theoretical foundation associated with this result. Hypothesis 2 supports the same. While hypothesis 1 has a similar result in model 2, hypothesis 2 is insignificant.

When progressed through cognitive and emotional response, hypothesis 2 has become insignificant. Hypothesis 3 and 4 are found to be significantly accepted in both models 1 and 2. Technology embodiment is positively related to memorable experiences and revisit intention. Technology research using technology embodiment has found that it can increase the perceived experience (Flavián *et al.*, 2021c), but this research has extended the same in the context of memorable experiences. (Orús et al. (2021) found that technology embodiment can develop positive intentions to use the technology again. This research has moved ahead and has contributed to the theoretical foundation associated with the technology embodiment and experience.

Nevertheless, in the context of tourism, this research has extended the results that embodiment can also develop positive revisit intentions. This result also confirms the view that the perceived self in technology can increase the likelihood of more extended association with the technology. Hypothesis 5 supports that memorable experiences can develop positive revisit intentions in both model 1 and model 2. Previous research has supported the proposition that the tourism destination experience can develop revisit intentions. Also, literature in VR technology usage has supported that technology experience can develop continuing intentions (Flavián *et al.*, 2021c). So, looking at this literature, the results of Hypothesis 5 look meaningful.

Hypotheses 6a and 6b explain that cognitive response can indirectly affect the relationship of ergonomic intervention and technology embodiment to memorable experience. Cognitive processing also makes technology immersion possible (Parong and Mayer, 2021). Such

processing can augment the perceived experience. Similar results are found in Hypotheses 6a and 6b. However, this research has also extended the proposition of cognitive response as a mediator. Also, most research has supported that cognitive processing can have long-term behavioural intentions (Balakrishnan and Dwivedi, 2021). Hypotheses 7a and 7b support this proposition when the path of ergonomic intervention and technology embodiment to revisit intention is significantly mediated by cognitive response. Besides cognitive response, most research has supported that emotional response can develop continuing intentions through bonding (Nikhashemi *et al.*, 2021). Hypotheses 9a and 9b support the view that emotional response can drive a positive relationship between ergonomic intervention and technology embodiment to revisit intention. However, surprisingly, emotional response fails to create any indirect effect in the relationship between ergonomic intervention and technology embodiment to memorable experiences. Previous research has found that emotions can vary across technology and its usage (Nikhashemi *et al.*, 2021). So, VR is more driven through a metacognitive route of technology geared to better experience (Chylinski *et al.*, 2020). Thus, the results of 8a and 8b are possible.

6.1. Theoretical Contribution

Discussion from the study presents new ideas that can provide valuable insights into various theories and enhance existing knowledge in key theoretical areas. (1) This research has extended the existing knowledge available concerning the theory of technological mediation; (2) This research has explored the technicality of ergonomics and embodiment, thus contributing to that literature accordingly; (3) This research has identified two psychological responses in the context of VR tourism, thus adding knowledge to the psychological literature in the context of technology-based tourism. (4) Apart from the overarching theory, this research has also used other theoretical lenses to position its arguments, including Embodied Cognitive Theory (Wilson, 2002), Affective Disposition Theory (Whittaker *et al.*, 2021), and Metacognitive Theory (Schraw and Moshman, 1995). (5) Also, this research extends the relationship of experience to continuation behaviour in the context of memorable tourism to revisit intention in the context of VR-based tourism

Research that has applied the Theory of Technological Mediation is minimal, primarily since the theory is not used much in human-technology interactions. However, the nature of the theory demands its use in this context. This research has introduced embodiment and ergonomics as interactive element in the context of VR-based tourism, which is further

supported through the lens of the theory of technological mediation. Thus, rather than seeing the theory of technological mediation as a conceptual framework, this research has increased its scope, allowing the theory to be seen as an empirical model. Besides, by integrating the psychological and behavioural outcome into the interactive element, this research has brought a new meaning to the theory of technological mediation. Also, by integrating technology embodiment and ergonomic intervention in a single model, this research has extended a holistic meaning to the research available in VR-based tourism. Most of the research has embodiment from a device setting rather than devising a proper mechanism to define embodiment. This research has described the body-ownership and agency through a comprehensive qualitative study before proposing the same in the experiment. Also, this study follows a similar mechanism to define ergonomic embodiment. Thus, the knowledge of embodied cognitive theory and ergonomic theory gets extended through the results of study 1 and study 2.

The psychological response connecting cognitive embodiment theory and ergonomic theory remained unexplored. These research results have established a comprehensive bridge to show how psychological response can act as a potential mediator in the relationship of ergonomics and embodiment to experience and revisit intention. This research has added value to cognitive and emotional theories in psychological research, especially by discovering the role of cognitive and emotional responses from Study 1. As mentioned above, this research has also added valuable knowledge to the various theoretical tenets, including cognitive embodiment theory, metacognitive theory, and affective disposition theory. The psychological responses and the behavioural outcome of VR-based usage are well documented in this research through the lens of the theories mentioned above, thus extending its branches in the context of technology-based interaction. Finally, most of the research has explored the relationship of experience to continuation intention in various contexts, and this research has extended this line of literature by extending it to memorable experiences to revisit intention.

6.2. Practical Implications

The study provides valuable implications to VR developers and marketers to design the VR journey to optimise the best tourist experience. (1) To develop the VR tour with an integrated embodied feature to enable more interaction in the tour, (2) More learning and thinking features for the tourists instead of only developing to create an emotional feel, (3) An ergonomic design developed with more comfort in the gadgets.

As mentioned above, the VR tour developer or manager should try to create a metaverse-like structure in the VR tour where the tourists can feel their ownership of the body in the virtual space. Developing such engaged interaction will yield a more memorable experience among the tourists. VR developers can use more interactive technology to develop more valuable interactions. The comfort and control of the VR devices in terms of ergonomics are regarded as equally important by tourists. So rather than piling up with multiple technology devices. VR developers and marketers should provide better comfort to tourists during the tour with minimal VR devices or gadgets. A mobile phone-based virtual tour with an organised application structure can also manage these issues to generate a better experience. Likewise, the VR tourist agents, developers and marketers should create or augment the exploration so that the VR tour provides more learning and allows tourists to process the information cognitively rather than emotionally. Such a mechanism can create a memorable experience and a long-term association with the virtual tour.

7. Conclusions, limitations, and future research directions

This research followed an exploratory sequential mixed research design method to explore the conceptual model provided in Figure 1 using Study 1. Study 2 employs a 3x3 factorial experimental design to test the proposed hypothetical model in Figure 2. The study results imply that a VR tour with embodied ownership features with high comfort, which also allows tourists to learn on tour, can develop positive, memorable experiences and revisit intention. This research has reiterated the conceptual model to the hypothetical model using in-depth interviews with the tourists (study 1); the developed model is robust enough to fit in the context of theoretical relevance and industry trends. The study used a single destination to experiment with the variables, mainly to control the destination bias in the response. Future research can test a similar model with multiple destinations, and the same can be controlled in the analysis. Future research can also focus on investigating (1) the role of embodiment and self-concept in a well-developed interactive metaverse tourism, (2) the role of ergonomics may differ based on the choice of the tourists' comfort. Thus, different ergonomic settings can be tested to understand their interactive differences, (3) other detailed psychological responses such as learning competence, information awareness, and cognitive processing can also be used in the model, (4) this research has focussed on a memorable experience, future research can look into the holistic aspect of experience (cognitive, affective, and conative) to understand the interaction-psychological-experience relationship among the tourists.

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Appendix A: Indicative Questions during the interview process (Study 1)

Source: Created by authors

How many times have you experienced VR-based tourism?

What ergonomic patterns do you think play a role in creating experience?

In what way do you think the use of VR device make it easy for you?

How do you feel connected physically in the virtual tour?

In what way do you feel that your body is connected during the virtual tour?

How do you think and apply your cognitive reflections during the virtual tour?

How do you feel while on your virtual tour?

Do you feel emotional during a virtual tour?

How would you state the experience in the virtual tour?

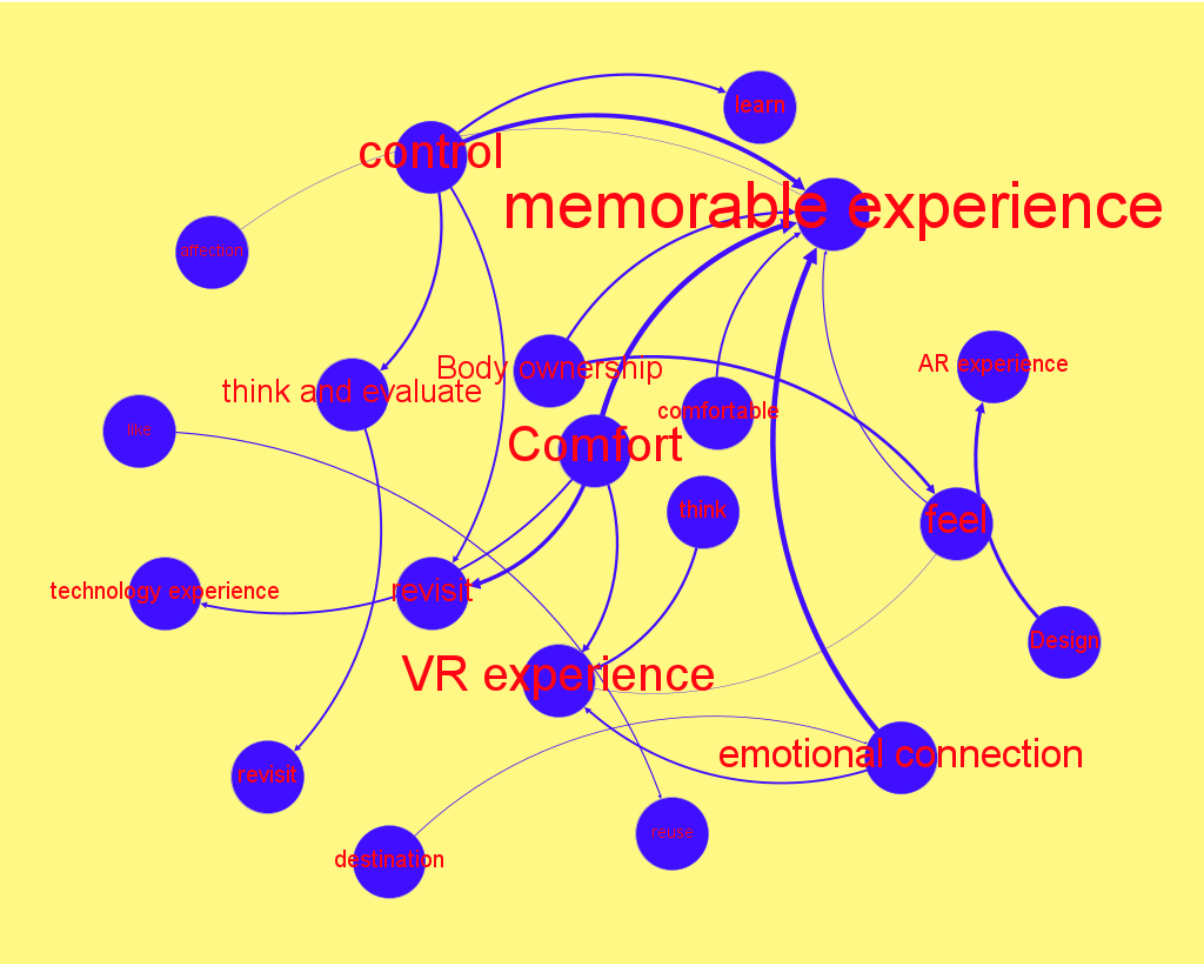
Would you like to continue using VR-based tourism?

Appendix B: Study 1 participants profile (Source: Source: Participants profile and table formated by authors)

Participant Code	Gender	Age Bracket	Level of Education	Number of times VR is used (n)	Interview duration (in minutes)
P1	Female	18-25	Bachelors	3	14
P2	Female	26-35	Masters	4	15
P3	Male	Above 45	Masters	2	15
P4	Female	18-25	Bachelors	2	14
P5	Male	26-35	Masters	3	13
P6	Female	18-25	Bachelors	6	32
P7	Female	36-45	Masters	5	23
P8	Female	18-25	Bachelors	4	22
P9	Male	18-25	Bachelors	2	15
P10	Female	26-35	Bachelors	3	14
P11	Male	36-45	Masters	3	16
P12	Male	Above 45	Masters	2	15
P13	Female	26-35	Masters	1	14
P14	Male	36-45	Masters	1	13
P15	Female	Above 45	PhD	2	17
P16	Male	18-25	Masters	3	17
P17	Female	26-35	Masters	4	25
P18	Male	26-35	Masters	3	17
P19	Female	36-45	PhD	2	15
P20	Male	Above 45	PhD	2	16
P21	Female	Above 45	Masters	2	15
P22	Female	26-35	PhD	1	15
P23	Female	26-35	Masters	3	16
P24	Male	18-25	Masters	3	14
P25	Female	18-25	Masters	3	19
P26	Male	36-45	PhD	2	17
P27	Male	18-25	Masters	3	20
P28	Male	26-35	PhD	2	18

Appendix C: Thematic analysis

Source: Created by authors



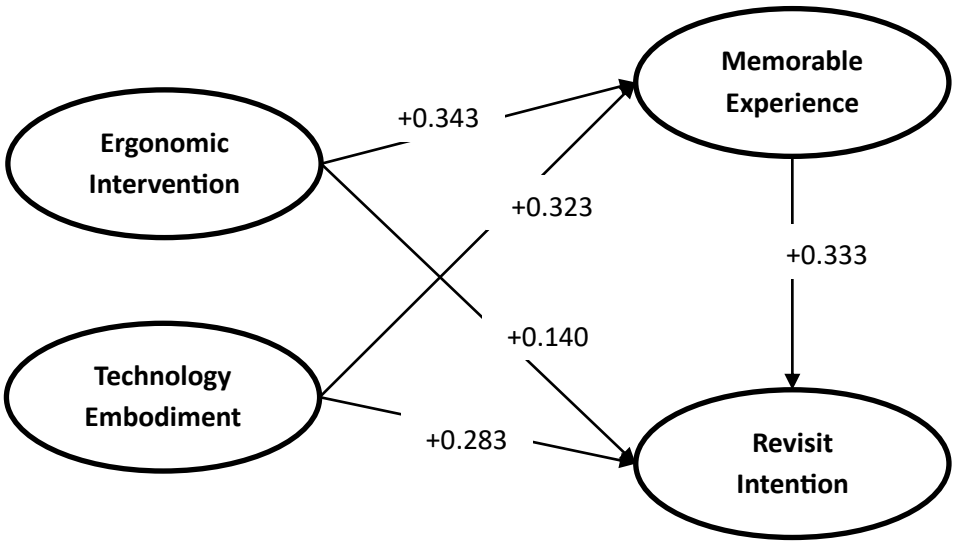
Appendix D: Items of the construct used in the study 2.

Affective Response (Source: Adapted from Fu and Kim, 2019 and rephrased by authors)
My travel in the virtual tour is comfortable
My travel in the virtual tour is good
My travel in the virtual tour is likable
My travel in the virtual tour is enjoyable
Cognitive Response (Source: Adapted from Fu and Kim, 2019 and rephrased by authors)
My travel in the virtual tour is beneficial
My travel in the virtual tour is a wise choice
My travel in the virtual tour is useful
My travel in the virtual tour is valuable
My travel in the virtual tour is positive
My travel in the virtual tour is original
Memorable Experience (Source: Adapted from Rivera et al., 2015 and rephrased by authors)
I won't forget my experience from the virtual tour
I will remember many positive experience about the virtual tour
I will have wonderful memories about this virtual tour
Revisit Intention (Source: Adapted from Zhang et al., 2018 and rephrased by authors)
I tend to use the virtual tour again to visit the destination
I'd love to come again to use virtual tour again
I think I will come back to use the virtual tour in near future

All items measured in Five Point Scale; 5 – Strongly Agree to 1 – Strongly Disagree

Appendix E: Results of the Model 1

Source: Created by authors



Appendix F: Results of the Model 2

Source: Created by authors