

Recalibrating Risk Through Immersive Technologies: A Hybrid Systematic Review and Conceptual Framework for Adventure Tourism Decision-Making

Akash Banerjee¹, Dr. Ananya Mitra², Dr. Mukunda B.G³

¹ Research Scholar, Amity Institute of Travel and Tourism, Amity University, Kolkata. India, akashbanerjee6261@gmail.com

² Assistant Professor, Amity Institute of Travel and Tourism, Amity University, Kolkata. India, ananya.ofc@gmail.com

³ Assistant Professor, School of Humanities and Social Sciences, Department of Travel and Tourism Mount Carmel College, Autonomous, Bangalore, India, bgmukunda8@gmail.com

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ABSTRACT

The nature of adventure tourism itself is linked with both uncertainty and a perception of risk, and these contribute greatly to the decisions regarding participation and intentions to buy. Today, perceived risk is mostly conceptualised as a stable phenomenon; however, emerging immersive technologies such as virtual and augmented reality allow tourists to interact with simulated environments before they interact with the real ones. In this study, the researchers explore the reconfiguration of perceived risk and the restructuring of behavioural intentions in an adventure tourism setting due to the use of the immersive technologies. Using a sample of 147 peer-reviewed studies determined from the Scopus database via PRISMA-based screening, 108 bibliographic studies were identified and mapped, and 29 theory-driven thematic studies were undertaken, resulting in a hybrid systematic review. A thematic coding was performed by using iterations of open and axial coding of literature following the TCCM to bring out the concept, which occurred in the literature over and over again, and to indicate conceptual relationships. The results suggest that by cognitively familiarising children with the situation, immersive exposure helps to decrease uncertainty, and by engaging them with the procedures, perceived behavioural control increases. When integrated, the study constructs the Immersive Risk Calibration Model, which considers perceived risk as a mobile cognitive process that is created in an interactive manner before the intention is given. It offers a study theory perspective and extends the knowledge of behaviour decision-making in a high uncertainty tourism environment and in the context of technology mediated cognitive calibration processes.

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Introduction

Adventure tourism is one of the most rapidly developing trends in the tourism sector and is considered a type of tourism that is uncertain, challenging, new and has different levels of perceived risk (Gross & Sand, 2020; Janowski et al., 2020). Adventure tourism is different from regular tourism because it's a first-hand experience of a foreign environment and activity that occasionally involves a few physical, psychological and environmental uncertainties. Therefore, perceived risk in adventure tourism has long been acknowledged as an important factor that affects participation and behavioural intention in this context (Cater, 2006; Fuchs & Reichel, 2011). This has mainly led to the concept that perceived risk is a more enduring cognitive precursor which influences tourists' willingness to engage in adventure activities. Most studies so far have conceptualised perceived risk as a relatively enduring cognitive factor influencing tourists' willingness to engage in adventure activities. Recent research, however, also indicates that risk can be seen as a motivating factor as well, especially when engaging in risky behaviours with greater propensities are higher in sensation-seeking individuals (Kiatkawsin et al. 2021; Akbar 2017). From this duality, the concept of risk in adventure tourism decision making processes appears to be very complex and multidimensional. Although great advances have been made in the research on tourism behaviour, the current theoretical models argue that the perceptions of risk remain constant and occur prior to a decision. Behavioural models like the Theory of Planned Behaviour (TPB) try to comprehend the behavioural intention by examining attitudes, subjective norms and perceived behavioural control, and perceived risk is usually considered as an external factor that affects either of the three factors. These models, while suitable for predicting behavioural intention, have minimal explanatory power when

it comes to the cognitive construction, revision and recalibration of perceptions prior to behavioural involvement. This restriction grows in importance in today's tourist contexts in which technology develops at a fast pace and in which users are constantly interacting with digital screens.

Although virtual reality is a new technology, its development has changed the way that tourists are able to access, interpret, and experience tourism before they travel in reality, especially virtual reality (VR) and augmented reality (AR) technologies. Potential tourists could learn about the environment, procedures, safeguarding measures, and uncertainty-related aspects of adventure, including immersive scenarios in a safe environment. Immersive technologies make it possible to place people into a simulated tourism environment prior to their in-person involvement, providing the possibility of pre-experiential cognitive and emotional interaction. Potential tourists could learn about the environment, procedures, safeguarding measures, and uncertainty-related aspects of adventure, including immersive scenarios in a safe environment. This exposure can have a significant impact on the way people think about uncertainty, risk and capability to undertake high-risk travel experiences. Thus, the perception of risk might not only be shaped as a kind of a priori assessment of cognitive risk, but also be dynamic through technological, experiential engagement.

Current literature on the use of immersive technologies in the tourism sector has been mainly concerned with the enhancement of experiences, engagement, destination marketing and the adoption of technology (Guttentag, 2010; Jung et al., 2016). Meanwhile, adventure tourism and behavioural studies have both adopted a relatively static concept of perceived risk as a determinant of behavioural intention (Fuchs & Reichel, 2011). While they have grown in independence, a diminished conceptual

connection can be seen between the concepts of immersive exposure, risk recalibration and behavioural decision-making in adventure tourism settings. More attention, in particular, needs to be paid to the understanding of the impact of the immersive technologies on the cognitive formation of the perceived risk before the appearance of the behavioural intention. This disintegration hinders existing theoretical elucidation of the technology-mediated decision-making process in high-uncertainty businesses of this kind. It limits current theory on the technology-mediated decision-making process in high-uncertainty tourism settings.

The use of immersive technologies in tourism grows, further emphasising the need to rethink the traditional behavioural assumption. Immersive simulation environments don't just provide informational support and promotional engagement; they also help to make sense of the uncertain enactment (cognitive familiarisation) before they are enacted. Especially exposure to simulated environments could lessen the uncertainty related to the processes, as well as boost perceived behavioural control because of familiarity and confidence. These processes show a higher possibility that immersive technologies are not only used as tools to improve the experience, but that they could be used as a mediator of the cognitive processes that would actively work in changing the behavioural determinants. Therefore, in this review we concentrate on the following questions regarding the research:

RQ1: What has been the way in which risk has been perceived in the literature in the context of adventure tourism?

RQ2: What is the impact of immersion technologies on perceptive and action-related aspects of tourism?

RQ3: What are the explanations in the literature for the relationship between immersive exposure, perceived risk recalibration, and behavioural intent?

In order to answer these questions, this study can be considered a hybrid systematic review as it adheres to the PRISMA framework for screening but also aims for a bibliometric mapping and theory-informed thematic synthesis approach to study the relationship between the three concepts of immersive technologies, perceived risk and behavioural intention in the context of adventure tourism. The review centres on perceived risk as a dynamic process that alters cognitive appraisal of the risk and the perceived behavioural control prior to the development of behaviour intention, instead of being an a priori attribute. The study links together recurrent conceptual relationships across the literature that have been identified and results in the inception of the Immersive Risk Calibration Model. The proposed framework offers an alternative rethinking of perceived risk as a mobile construct in cognition and learning processes created during an immersive interaction process instead of an initial and fixed determinant of behaviour. The study contributes to the tourism theory by introducing the behavioural decision-making models to technology mediated cognitive calibration processes in high-uncertainty tourism.

2. Methodology

2.1. Review design and protocol:

This research combines PRISMA screening, bibliometric mapping and theory-driven thematic synthesis because PRISMA set out the screening for systematic review, and more than half a dozen authors adopted the PRISMA guidelines, yet bibliometric mapping was used to map the research and picture the relationship between the variables, and thematic synthesis was used to arrive at theoretical answers to the research question. The study's goals were to systematically map various existing scholarship and to synthesise diverse conceptual lineages and designate a theoretically grounded structure that can explain the recalibration processes of risk utilising the technology. This motivated the choice of the hybrid review design, which aims at both identifying the existing scholarship as well as identifying the structure, or architecture, that could explain the recalibration of technology-

mediated risk. This methodology employed is based on the following aspects which are different from traditional review articles: it enables structured identification, screening, classification and interpretation of literature, and it also enables integration of concepts in the building of a theory. Review protocol was developed before data extraction, this would enhance methodological transparency, consistency in analysis and replicability.

This study is conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) tool to direct the identification, screening, eligibility screening and inclusion process. Given that PRISMA was well known and used to increase transparency and methodological rigour in systematic reviews that span disciplines, it was deemed suitable.

- 1) The research is specifically focused on research literature in the following area: Research that is situated at the intersection of adventure tourism, perceived risk, and immersive technologies (such as virtual reality or augmented reality) and
- 2) Behavioural intention and decision-making processes in high uncertainty environment in tourism.

Both systematic screening procedures, as well as theme synthesis with a theoretical approach, are used as methods of research. The publication trends were identified with the bibliometric analysis of selected literature under the selected time-period of 1542-1562, by identifying them, IPL occurrences in publication and the intellectual convergence, and relationship of the keywords. Thematic synthesis was then performed to identify common conceptual mechanisms relating to the relationship between an immersion experience and the uncertainty appraisal, perceived behavioural control, and behavioural intention formation in adventure tourism contexts.

The review design and analytical processes were designed to directly answer the above research questions in the context of the Introduction, including what constitutes a perceived risk, how immersive technologies are concurrent in tourism

cognition and how perceived immersive exposure is related to the behavioural intention formation.

2.2. Database selection and search strategy:

A literature search was carried out in the Scopus database in January 2026. The selected databases include Scopus which has a wide range of subject areas including tourism, behavioural, management, psychological and technology related publications. The broader indexing systems were compared, and Scopus was found to cover a wider scope of tourism and immersive technologies peer-reviewed literature and has been highly regarded as a reliable database for conducting bibliometric analysis and systematic review-based studies in the field. Considering the multidisciplinary nature of the research topic, which falls within the general area of the challenges of tourism studies, experiential systems and immersive technological environments, it was considered appropriate for the present review. To systematically capture literature related to adventure tourism, perceived risk, behavioural intention and immersive technologies, the search strategy was developed. Boolean operators and keywords combinations were used in Title, Abstract and Keyword to improve the accuracy and level of concepts retrieved. An initial exploratory search was undertaken to narrow down the keywords as well as to find out the major conceptual terminology within the literature. The last query used for the search was the following: TITLE-ABS-KEY ("Adventure Tourism" OR "Hard Adventure Tourism" OR "Soft Adventure Tourism" OR "Risk Perception" OR "Sensation Seeking" OR "Thrill Seeking") AND PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "re"))

Only peer-reviewed Scopus-indexed journal articles and review papers in English, from 2014 to 2026, were considered. The selected time-period appeared to be appropriate, as tourism and experiential research have recently seen a considerable amount of academic research

interest in immersive technologies such as VR and AR in the last decade. It was also necessary to limit the search to more recent publications. It further ensured the concepts were conceptually relevant to the more recent developments of immersive touristic technology-mediated behavioural research. Only conference proceedings, dissertations, editorials, notes and non-English publications were included because of methodological consistency and analytical comparability of the studies selected. The sources that were not peer-reviewed were excluded, to improve the trustworthiness and academic value of the synthesis. The first database search gave 555 results. Duplicate studies were later excluded using the metadata comparison and manual exclusion methods and there were 530 unique studies for screening and eligibility assessment.

2.3. Screening and Eligibility Assessment:

Screening and the assessment of eligibility were developed in a systematic way to ensure methodological transparency, analytical rigour and the potential for reproduction. The review process had four stages: identification, screening, eligibility assessment and final inclusion. During the identification phase, all the documents retrieved from Scopus were downloaded and initially scanned. Initial filters were applied to include only documents that are conceptually suitable for publication, published in the period 1542-1562, and documents of type "document" that are presented in the English language to ensure the conceptual coherence and academic relevance of the documents. Duplicate studies were found by comparing metadata and by manual processes. The 25 duplicate studies were

eliminated, and 530 altogether were moved to the screening stage. Screening has been done systematically, matching the objectives of the review, and the titles and abstracts of the articles have been evaluated for inclusion/exclusion criteria. At these stage 383 records were thrown out. Of these, 190 lacked conceptual relevance to tourism behaviour, immersive technologies, and perceived risk, and 73 did not fit the behavioural/experiential lens of the review. Further, 37 studies were not retrieved in full text and 83 studies that did not address the themes immersive exposure, adventure tourism and behavioural intention were excluded.

The 147 studies were then fully assessed for eligibility. The studies were then comprehensively evaluated for eligibility. Studies were then included when they were related to adventure tourism and/or high uncertainty tourism environments, if they had to do with immersive technologies such as VR or AR, and if they made a theoretical, conceptual, or empirical research contribution to perceived risk, behavioural intention, or perceived behavioural control. Only studies that were solely focussing on the development of the technical system were not selected, as well as those that were not focussing on tourism related behavioural implications.

To increase methodological reliability, screening and eligibility were double checked independently using consensus-based evaluation in an iterative process. The full text content analysis resulted in all 147 studies being included in the bibliometric mapping and in the theory-driven thematic synthesis process. The flow chart of the study selection is shown in Figure 1.

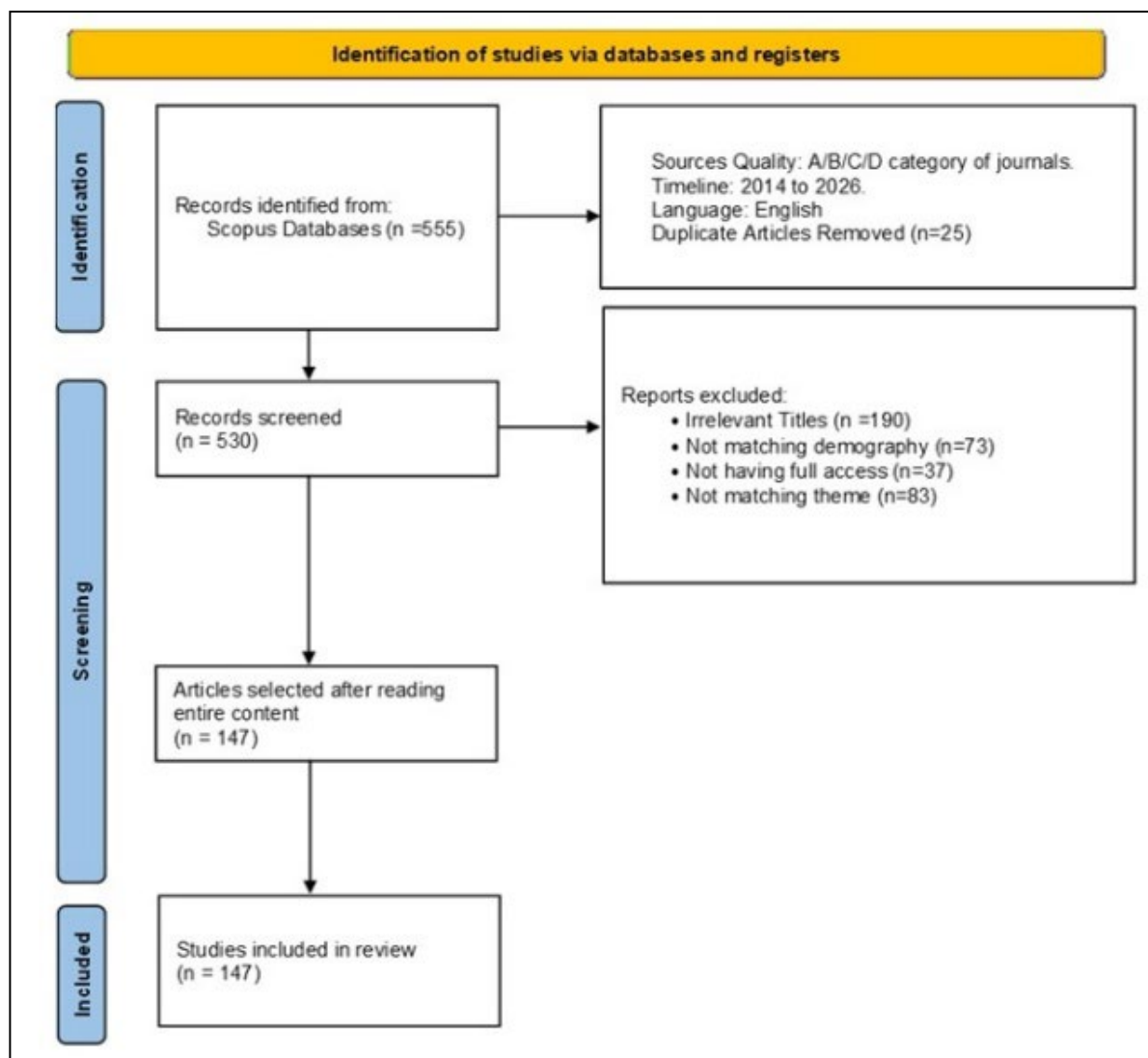


Figure 1. PRISMA Flow Diagram of Literature Identification, Screening, Eligibility Assessment, and Final Inclusion

After screening and checking eligibility, the identified studies were systematically documented and thematically coded.

2.4. Data Extraction and Coding Procedure:

A coding system was created to ensure uniformity in the analysis across the selected studies. Data extraction emphasised descriptive, as well as conceptual, aspects that were relevant to the review's goals. Systematic coding of each article was done with respect to the following dimensions:

- study context,
- immersive technology type,
- perceived risk construct,
- behavioural outcome

- theoretical framework,
- methodological approach,
- Repeated and important findings and concepts.

Open and axial coding procedures were used in an iterative process to engage in the coding process. The first open coding phase revealed a set of descriptive patterns, conceptual arguments, and common behavioural relationships that appeared in the studies analysed. The ideas that were accepted as preliminary codes were those of uncertainty reduction, immersion, familiarisation by experience, anticipating the procedure, technological immersion, preparation of the cognitive process, control of the behaviour and the formation of intentions. Prolonged

conceptual clusters were then used to classify the codes in Axial Coding. This stage facilitated the identification of the duplication of relationships between immersive exposure, uncertainty appraisal, perceived behavioural control, and behavioural intention that existed in the literature. The comparison of the data across studies helped to clarify concepts and minimised the risk of thematic duplication in the synthesis process.

Independent cross-coding and reviewing of a randomly selected subset of studies was undertaken for reliability and consistency during analysis and coding and subsequently full thematic synthesis was conducted. The cross-validation process enabled to adapt some coding categories and achieve thematically consistency. Coding of the thematic synthesis was done throughout the dimensions has shown in Table 1.

Table 1: Coding Dimensions

Coding Dimension	Description
Study context	The tourism setting or activity examined that defines the study
Technology type	VR, AR, immersive simulation, mixed reality
Risk construct	Physical, psychological, environmental, or social risk
Behavioural outcome	Intention, participation, revisit intention
Theory used	TPB, TAM, Flow Theory, behavioural frameworks
Methodology	Quantitative, qualitative, or mixed methods
Key findings	Core conceptual or empirical insight

2.5. Bibliometric and Thematic Analysis:

The study is a synthesis of bibliometric analysis and the theory guided thematic analysis to gain structural mapping and conceptual interpretation of the selected literature. Bibliometric analysis approach was used to analyse different trends, evolution and themes, co-occurrence of keywords, citation relations and intellectual convergence of the studies analysed. This stage facilitated mapping of dominant research streams and began to identify new areas of convergence involving both immersive technologies and tourism behaviour and cognition relating to risk.

An interpretive, theory-driven approach was used in the theme and synthesis. To detect common conceptual trends found in the literature, open coding was employed first. These obtained codes were then coded with the axial codes to form conceptual relationships between the study variables (namely immersive exposure, uncertainty appraisal, perceived behavioural control and behavioural intention).

The overall shape of the thematic structure was developed inductively and not imposed a priori, by clarifying the results of the studies, which have been compared repeatedly and integrated conceptually. Special focus was provided on findings regarding commonly used mechanisms underlying how involvement in technological interaction alters perceptions of the uncertainty prior to involvement.

Several similar conceptual trends appeared throughout the literature. Correlations with the familiarization and uncertainty reduction using immersive technologies were initially made through simulated environmental exposure and experiential visualisation. Secondly, there was a correlation between interaction immersion and perceived behavioural control (procedural anticipation, experiential preparedness and cognitive familiarisation). Thirdly, the interaction between perceived risk and perceived behavioural control in predicting behavioural intention in adventure tourism situations was found. Thematic analysis also revealed that immersive technologies make an informative contribution but they also

experience processes of 'cognitive calibration' which influence interpretations of uncertainty and their behavioural appraisals. For this reason, perceived risk was not found to be composed of static factors, but became a dynamically reconstructed cognitive appraisal, which was formed in the process of interaction in immersion mode. These recurring relationships were analysed to create the immersive risk calibration model. The proposed framework does not try to introduce new ideas to the definition of behaviour and constructs, but it only reshapes the time sequence and cognitive sequence of the perceived risk and behavioural control in the technology mediated tourism environment. In this way, the framework understands perceived risk as a dynamic process of cognitive formation, which is achieved by confronting the risk in a lively way and through intensive exposure before the start of intention to act.

3. Results

The results are a mixture of bibliometric mapping and thematic synthesis to get a comprehensive understanding of the intellectual structure and conceptualisation of research.

3.1. Descriptive and Bibliometric Overview of the Literature:

Finally, a set of 147 peer-reviewed studies were collected that were published in the period between 2014 and 2026 and explored the relationship between adventure tourism, immersive technologies, perceived risk, and behaviour intention. Bibliometrically, it was determined that there was a significant rise in academic interest in the research on the issue of 'immersive technology mediated tourism behaviour' after 2020, that is, uncertainty management in tourism and technology-based experiential systems increased. By using the temporal distribution of publications, it was found that early publications were mainly concerned with adventure tourism risk perception and behavioural intention based on traditional behavioural models such as the Theory of Planned Behaviour (TPB) and Technology Acceptance Model (TAM). Increasingly, however, recent studies in

neuroscience also emerge a combination of immersive technologies with the field of tourism behavioural studies, especially virtual reality (VR) and augmented reality (AR). This shift is part of a wider concept shift from 'static' conceptions of tourist behaviour to technology-mediated experiences and perceptions.

The reviewed studies were also clustered in accordance with the six themes and identified three major research streams:

- 1) perceived risk and attitude, and
- 2) for adoption of immersive technology and enhancement of tourism experiences,
- 3) Additionally, it involved behavioural intention and the decision-making of technology.

Previous tourism research mainly illustrates the concept of tourist risk as a deterrent affecting tourists' intention, choice of destination, and willingness to be involved in an uncertain tourism situation. More recent research instead defines immersive technology as a mechanism which impacts tourists' cognitive evaluation processes prior to their involvement.

The concepts of immersive technologies, attitude towards use, perceived behavioural control and experiential engagement showed a robust conceptual convergence in the form of co-occurrence patterns across the various keywords. In the keywords, some of the words were frequently used, like Virtual Reality, Technology Acceptance, Risk perception, Behavioural intention, Adventure tourism and Immersive experience. The number of concepts referring to immersive technology and behaviour related constructs has been increasing and therefore an integration in the field of theory has taken place between the concepts of tourism psychology and the concepts of technology mediated experiences.

The bibliometric findings also indicate a positive trend of interconnections between the tourism studies, the behavioural sciences, the digital experience and immersive technological systems. This interdisciplinary awakening and development is related to the increasing awareness on the fact that immersive technologies are not only

experiential enhancing tools, but also cognitive processes which influence the perception of how uncertainty is assessed and how behaviours are taken and evaluated in tourism environments.

The annual publications about the research on immersive technology-mediated tourism behaviour are presented in Figure 2.

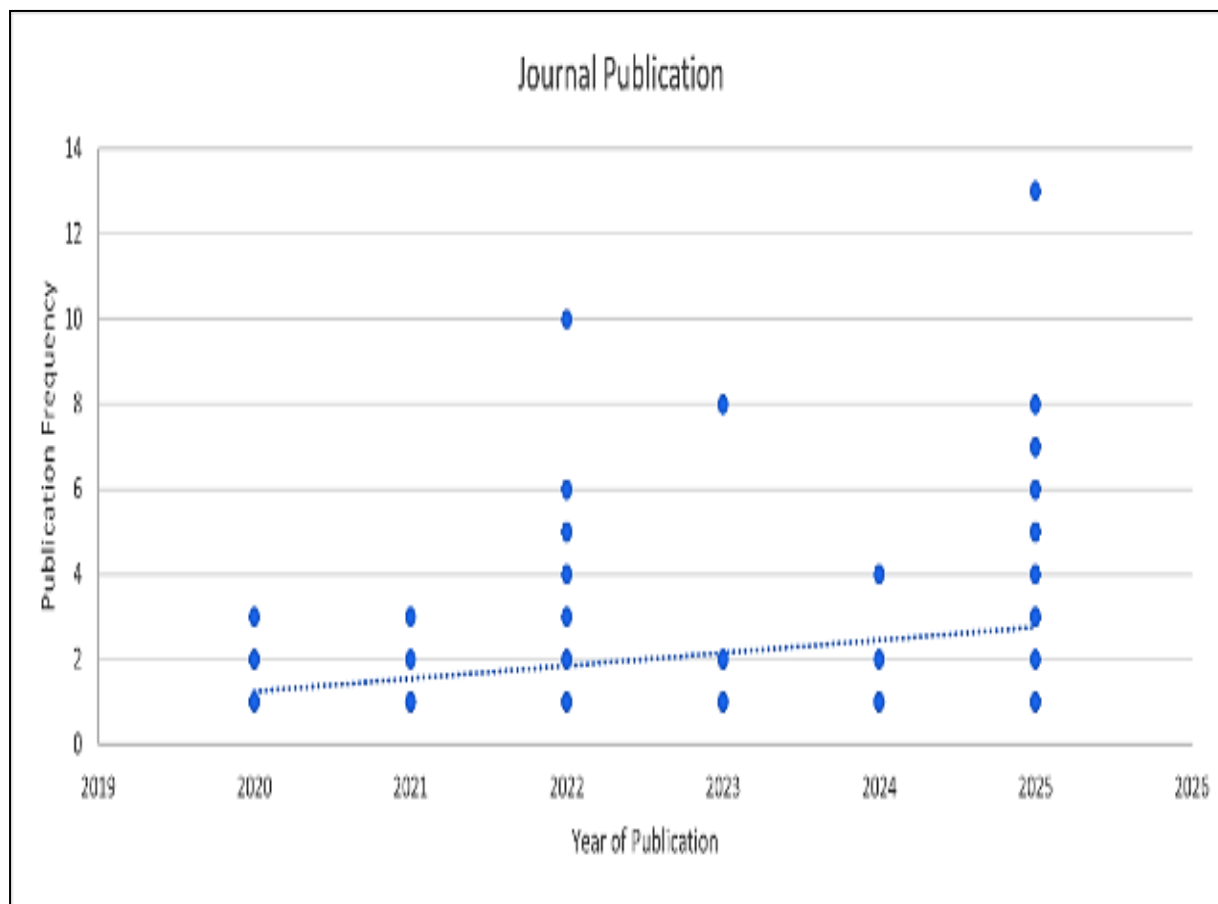


Figure 2. Temporal distribution of publications on adventure tourism, risk perception, and immersive technologies

3.2. Thematic synthesis of the literature:

A common set of conceptual relationships were identified after thematic synthesis, which included exposure to the different adventure tourist technologies, and how these technologies were linked to risk perception and behavioural intention in adventure tourist settings. In the studies found in the literature, three main thematic dimensions emerged in the exploration and integration of the theme through the iterative coding process:

- 1) Familiarisation and uncertainty reduction in an immersive manner,
- 2) Exposure and perceived behavioural control, and

- 3) Re-calibrated risk and intention to form behaviour.

These results are collectively indicative of the fact that immersive technologies are not only information or promotion, but also actively engage in the cognitive appraisal process.

3.2.1 Immersive Familiarisation and Uncertainty Reduction

A common trend in the literature reviewed is immersive technologies as tools to decrease uncertainty by familiarisation with the environment. Many research projects have shown that virtual reality spaces prove to be effective in cognitively immersing people in novel contexts of tourism before they get there. The virtual simulations, 360-degree visualisations and experiential interfaces lead to an increased sense

of understanding the environment, anticipating procedures, and being prepared experientially.

Literature suggests that exposure can reduce the informational ambiguity and thus help a person visualise the environmental conditions, perceived difficulties and procedural requirements in relation to adventure tasks. Through this process, before being engaged in, tourists can make simulations in the mind about how it will be during actual participation to eliminate the uncertainty-related thinking obstacles. Further studies also indicate that with the use of immersive technologies, the familiarity with the terrain, equipment, activity structure, and expectations of safety can be increased, resulting in reduced perceptions of uncertainty and increased cognitive confidence.

It is important to note, however, that according to the literature reviewed, the decrease in uncertainty can occur not only by providing information, but also by simulation experience. Immersive technologies are a rich medium to engage with simulated environments, and to build up an anticipatory understanding in the body, distinct from the frame of a traditional promotion. Then perceived risk dynamically turns to be an appraised cognition and not an evaluated cognition.

The study outcomes challenge the traditional perspectives of perceived risk, as it is categorised in the tourism behavioural models, in terms of its stable nature and independence of the participant before the experience. Rather, the literature indicates an active restructuring of the processes of appraisal of uncertainty due to immersion before expressing behavioural intent.

3.2.2 Immersive Exposure and Perceived Behavioural Control

The second dominant theme was related to the relationship between Immersion and Perceived Behavioural Control. In the analysed research papers, it was found that with immersive technological interaction, self-efficacy, perceived competence to do an adventure tourism activity and procedural confidence have been constantly linked across the papers analysed.

According to the literature, immersive simulation environments enable people to imagine how they might perform an activity without doing it. Tourists can see the conditions and requirements for participating in a system of procedures as well as visualise the environment; they will then become more familiar with the participation requirements and increase their confidence to participate in uncertain or challenging tourism experiences.

Multiple research trials proved that the psychological preparedness of the use of VR and AR environments is effective in reducing unfamiliarity in cognitive aspects related to high-risk tourism activities. Simulated interaction enables the user to rehearse the procedural behaviour, visualize the reaction of the simulated environment and increase the perception of the involvement outcome. This was particularly evident in studies of high-uncertainty, physical challenge and/or perceptions of unsafe conditions or perceptions in an adventure context.

The thematic synthesis also identified that immersive technology is instrumental in the support of experiential learning processes and therefore helps in achieving behavioural preparedness. Immersive systems offer the potential to provide “passive” information but also allow the user to interact with a virtual environment, engaging in cognitive assessment of his/her ability to interact with the virtual environment. This means that experienced perceived behavioural control is influenced by an experiential process of technological interaction before the actual behavioural decision is taken. Thus, perceived behaviour control in the context of the experience follows an immersive process with technology before the actual process of behaviour decision is made.

The findings therefore provide an insight into current behavioural models and suggests that engaging with immersive technologies can be considered a cognitive calibration process and potentially could reframe perceived behavioural capability prior to engagement.

3.2.3 Recalibrated Risk Perception and Behavioural Intention

A third key thematic dimension that was developed in the synthesis focused on the link between the recalibration of risk perceptions and behavioural intention. In the literature examined, there was strong evidence of the perceived risk and perceived behavioural control as the central variables that impact the attitude to take part in adventure tourism.

However, in the literature reviewed perceived risk is an antecedent in traditional behaviour models, but in the case of immersive technological exposure, the perceived risk is dynamic and therefore affects the perception of risk and behaviourally evaluation. Immersive familiarisation with procedural anticipation is an effective approach to create a re-evaluation of the perception of uncertainty before the formation of behavioural intention.

Additionally, the literature suggests that immersive exposure could decrease uncertainty with concomitant maintenance of some aspects of excitement and novelty of adventure tourism participation. In this respect the duality is all the more significant because adventure tourism is often more about the wonderful balancing act between perceived hazards and perceived capability—than it is about the prospect of total death and damage.

Furthermore, the results revealed that the use of immersive technologies also has an indirect impact on behavioural intention through familiarity, cognitive readiness and augmentation of perceived behavioural control. Rather, behavioural intention is not just a product of inert cognitions, but a product of interacting processes of immersive appraisal of experiences and uncertainty re-calibration.

The thematic findings summarised above show that the use of immersive technologies seems to alter decision-making in the tourism sector and impact on the cognitive processes to interpret

uncertainty and behavioural capability prior to participation.

3.3. Derivation of the Immersive Risk Calibration Model:

Overall, the thematic synthesis and the bibliometric results appeared to be converging and pointing towards a gradually developed shift in conceptual understanding of perceived risk in adventure tourism from static to dynamic cognitive appraisal process in the presence of technologies. Past literature regarding behavioural tourism has mostly defined risk as a pre-existing factor that leads to the decision to participate in tourism. As seen in the literature, risk has come to be a not only a pre-condition of the choice to participate in tourism, but also risk is an exposure and risk is a cognitive reinterpretation of risk, which directly affects tourism decision making.

Furthermore, the bibliometric analysis showed an increasing conceptual convergence between the topic of immersive technologies, experiences, cognition and perceived behavioural control on the one hand and the topic of behavioural intention on the other hand. The convergence shows a theoretical gradual transition from the traditional tourism behaviour models on destinations to technology mediated tourism behaviour models on experiential decision-making models. Its results show the contribution of VR/AR with regard to informational quality and interest of building visitors in visiting a destination as well as experiential simulation process and familiarisation process including all the studies analysed.

For literature mining exercise, the development of the themes and development of the concepts presented in the literature were recorded in Figure 3. The figure shows an evolution of the traditional behavioural risk model to an immersive cognitive calibration model in the research of adventure tourism decision-making.

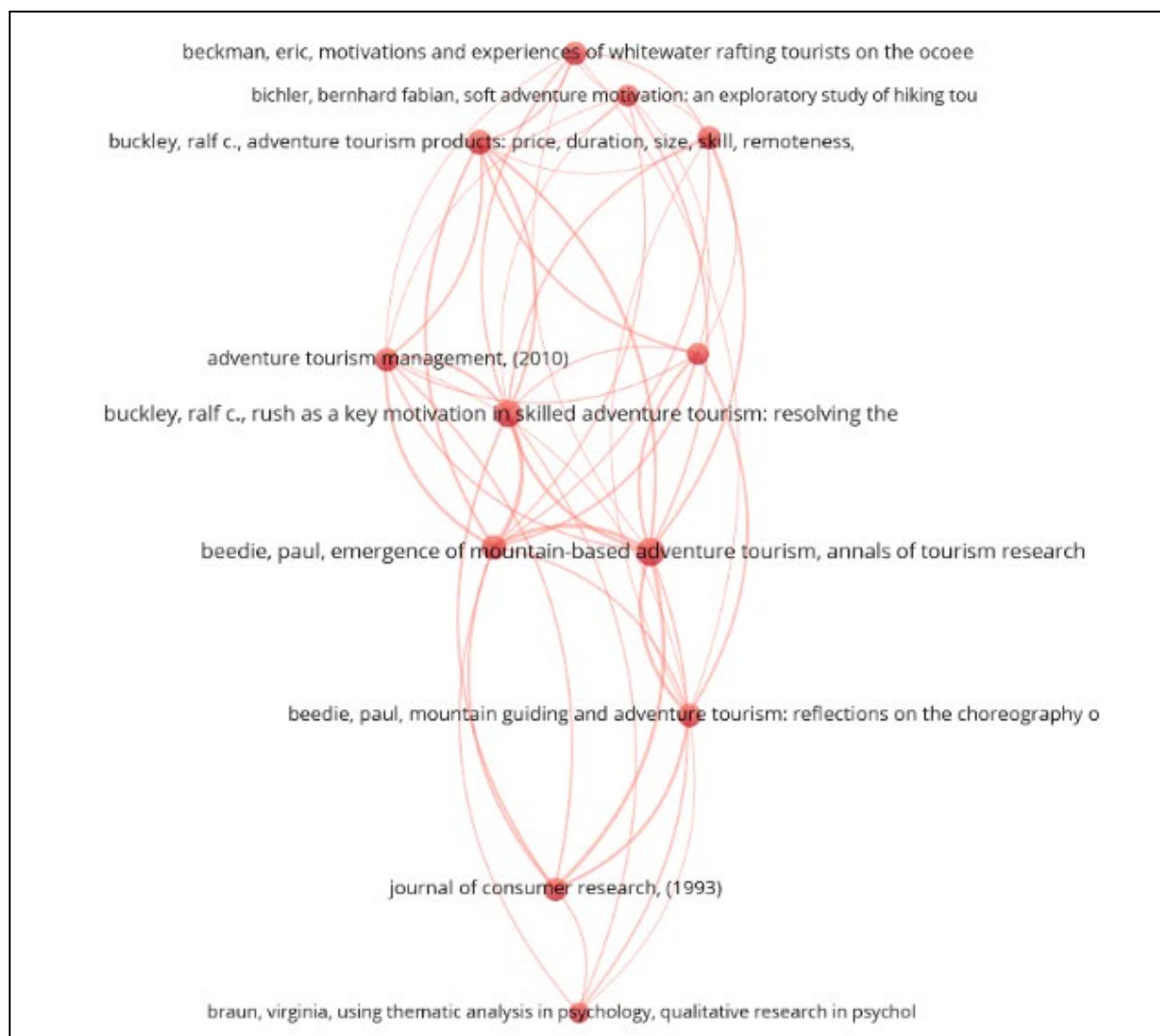


Figure 3. Co-citation network from Static Risk Perception to Immersive Cognitive Calibration in Adventure Tourism

Three recurring conceptual mechanisms were identified through thematic synthesis, associated with immersive technology and decision-making processes, as behaviour in the adventure tourism context.

The first thematic mechanism was about the immersive familiarisation and the uncertainty reduction. In all the studies analysed, the use of immersive technologies was always associated with better understanding of the environment, anticipation of procedures, and experiential preparedness. In order to reduce the ambiguity of a new environment, some of the environments under the tourism context have been exposed to the participants using virtual simulations and immersive visualisation systems, in order to cognitively experience the tourism environments

before entering into such contexts. Results showed that the immersive mode exposure might stimulate anticipatory experiential cognition process, which was not passive information transmission.

The second thematic mechanism was related to strengthening the perceived behavioural control, which was accomplished using immersive procedural simulation. Several studies have shown that putting people in complex environments could boost their self-efficacy, behavioural confidence and perceived participation capability, which means that they can 'practise' the tourism activities in their mind before the actual engagement. Thus, in the uncertain tourism context, the sense of psychological preparedness and of cognitive familiarity can help reinforce the

perceived behavioural control with the help of immersive interaction.

The third thematic mechanism is linked to the changes in risk perceptions and their influence on the formation of intentions. Literature reviewed clearly showed that such a multi-faceted mode of familiarisation and better behavioural control together have an impact on the cognitive interpretation of uncertainty leading up to participation decisions. Immersive exposure does not eliminate the perception of risk, but instead appears to re-frame the risk into a cognitively manageable and controllable risk. The result is very interesting in the context of adventure tourism forms and functions, where "participation motivation" is often generated in a process of a blend of perceived challenge and perceived capability and not by complete elimination of uncertainty.

All these recurring thematic connections indicate that immersive technologies can be used as cognitive calibration tools to alter factors that impact behaviour prior to the formation of intention. Perceived risk is therefore not just a mental attitude, but an appraised reconstruction, which strongly relies on the influx of immersive experiential interaction.

The overarching conceptual relationships found in the thematic synthesis guided the creation of the suggested immersive risk calibration model. The framework includes three elements - immersive exposure, uncertainty appraisal, and perceived behavioural control and behavioural intention - consistent with a sequential cognitive calibration process that explains technology-mediated tourism decision making.

The proposed model redefines perceived risk as a cognitive construct and proposes that it is constructed by exposure instead of being a cognitive factor. The two intertwined relationship between immersive technologies and behavioural intention are:

- 1) Increase in uncertainty from experiential unfamiliarity, and then
- 2) Improving the perceived behavioural control by anticipation in the procedure and cognitive preparedness.

A model was constructed that incorporates the mechanism of immersive technological exposure as a mechanism for creating a cognitive calibration prior to participation that serves as a pre-intentional determinant of uncertainty interpretation and behavioural evaluation, extending the conventional behavioural models (e.g. the Theory of Planned Behaviour).

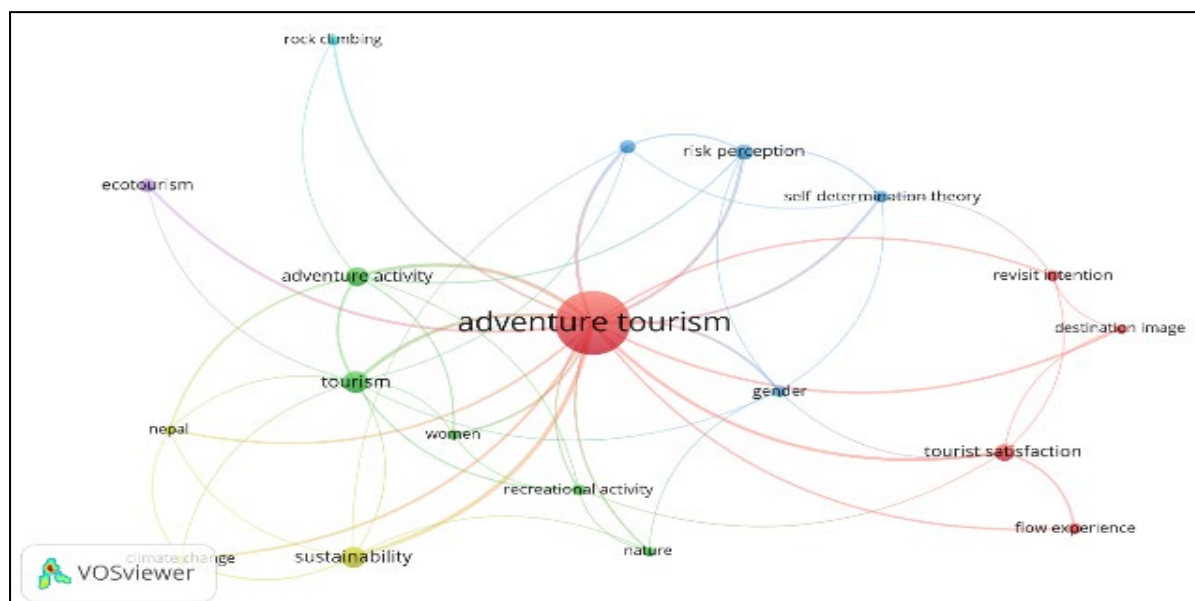


Figure 4. Keyword co-occurrence network demonstrating thematic convergence

. Theoretical interpretation of the immersive risk calibration model

Thematic synthesis revealed conceptual relationships in the form of patterns, indicating that immersive technologies are active participants in the cognitive assembly of elements of uncertainty, behavioural capability and participation intention in an adventure tourism environment. On the back of these repeated processes, the conceptual framework of the present research is the Immersive Risk Calibration Model (IRCM) that aims to conceptualise the dynamic relationship between immersive technological exposure and the nature of perceived risk before forming behavioural intentions. The proposed framework has come together inductively from the literature reviews, not by extrapolating from them. In particular, the model has been based on three thematic relationships that were recurrent throughout the thematic synthesis, which were:

- 1) Immersive familiarisation and uncertainty reduction,
- 2) Increasing the perceived behavioural control by means of simulated procedures, and
- 3) Perceived risk towards behaviour intention is scaled.

All of these are thematic relationships which indicate that immersive technologies do not only serve as experiential enhancers but are cognitive calibration tools that can restructure behavioural evaluative processes even prior to participation. Theories used in the study of tourist behaviours are conventional and based on the Theory of Planned Behaviour (TPB) (Ajzen, 1991), which is the theory used to explain behavioural intention as a construct that is formed based on attitude, subjective norm and perceived behavioural control. In such models, risk is typically considered as a relatively stable property that influences the assessment of actions and intentions to participate. As it was demonstrated in the reviewed literature, however, this assumption can be completely changed by the exposure of a tourist environment using immersive technology before actually going into the field. The proposed framework thus calls into

question an essentially ontological assumption that perceived risk exists as a stable cognitive antecedent before risk evaluation of behaviour. Perceived risk, however, is dynamically created and modified through immersive cognition interaction, according to a thematic synthesis. Familiar, simulated, experiential exposure is prior to actual involvement, and conditions of the environment, issues of procedure, and issues of participation related uncertainty are anticipated. As such, uncertainty is known to be negotiated dynamically in terms of immersive experiential cognition. The proposed model assumes that immersive exposure is the main initiating process with respect to cognitive appraisal processes. Virtual reality (VR), augmented reality (AR), immersive simulation and interactive visualisation systems create simulated experiential access to other kinds of tourism environments that the user is not familiar with. There is embodied cognitive interaction in immersive systems, as they are able to visualise the environment, procedures, perceived challenges, and potential hazards in these adventure systems, in contrast with conventional informational media.

Immersion and uncertainty reduction is the first large pathway in the framework. The reviewed studies all showed that immersive simulation increased understanding of the environment and decreased informational ambiguity as a result of allowing for anticipatory experiential cognition. People can be exposed to simulated environments to prepare for participation in scenarios they have never encountered before and thus acquire mental competence in presenting new tourism environments. Cognitive interpretation or control of uncertainty becomes easier when familiarity grows, which minimises the perceived ambiguity when making participation decisions.

Most of all, the framework doesn't provide any recommendations for how to remove the perceived risk. The absence of any ambiguity can diminish the experience value of adventure tourism and the adventure itself. The immersive technologies, however, seemingly adjust perceived risk into an optimally interpretable and behaviourally manageable construct, as suggested

by the thematic synthesis. However, there is a difference between the terms of the re-calibration process and absolute minimisation of risk in favour of cognitive restructuring of uncertainty.

The second relates to improving perceived behavioural control by using immersive procedural simulation. Self-efficacy and procedural confidence and sense of participation capacity were consistently higher in the literature reviewed when the participants were immersed. Simulated interaction lets users learn the expected, or required, performance of the activity, the body's reaction to their environment, and their own reactions to the activity. This implies that the perceived behavioural control is increased through immersive exposure because the psychological preparedness and experiential familiarity is increased.

The theory also expands the traditional behavioural explanations by providing a partial agent of perceived behavioural control that is moulded in an immersive experiential manner, not just by existing attitudes or previous experiences. This extension is particularly important in adventure tourism contexts that are unpredictable, new and problematic.

The third pathway in the model relates between the recalibrated perceived risk, improved

The thematic synthesis was used to propose an Immersive Risk Calibration Model (IRCM), as shown in Figure 5.

behavioural control, and formation of behavioural intention. Familiarization and preparation with behavior both had an impact on the evaluation of participation decision making in situations of high tourist uncertainty, as revealed by the thematic synthesis. There is not a linear relationship between perceived risk and perceived behavioural control, but rather an interactive relationship between the two processes, involving immersive cognitive appraisal prior to the development of intention.

In the framework a further aspect of the “doubleness” of perceived risk in the adventure tourism context is emphasised. High perceived uncertainty can be a participation inhibitor, moderate and cognitively appropriate uncertainty can be a participation facilitator, and moderate and cognitively appropriate uncertainty can be a facilitator for adventure motivation, novelty seeking and experiential satisfaction. Immersive technologies, therefore, affect behavioural intention by reconfiguring uncertainty, not by removing it, but in optimizing for technology's perception, by bringing the uncertainty into a level of stimulus that is optimally interpreted by the individual as a challenge matched with the perceived capabilities.

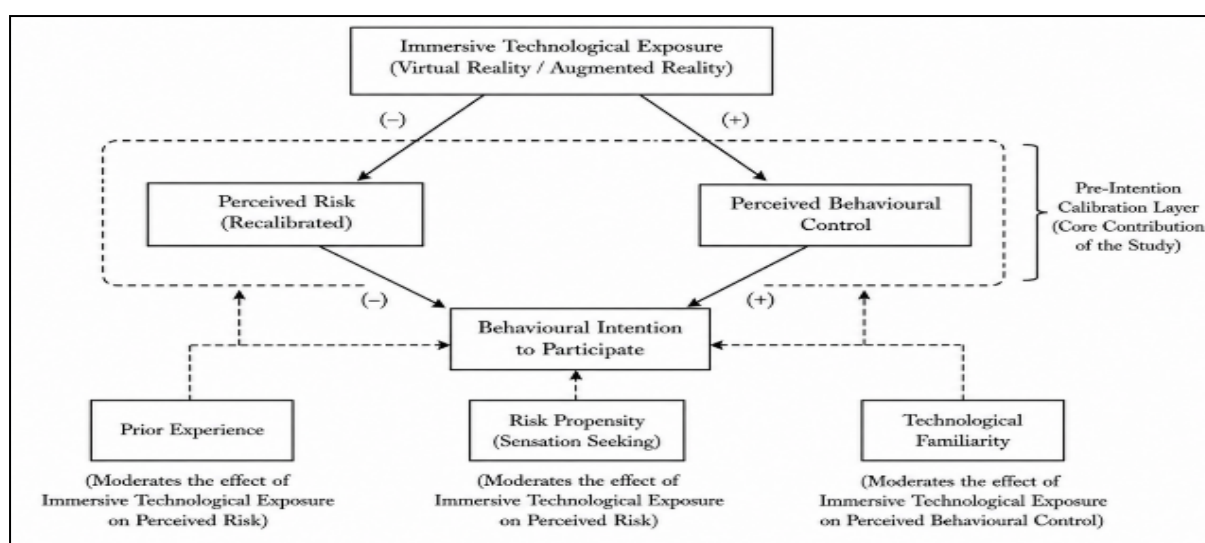


Figure 5. Immersive Risk Calibration Model Derived from Thematic Synthesis

The model has several important contributions to tourism theory. It restates the definition of perceived risk as an interactive, cognitive process and not a static antecedent to behavioural intention. Secondly, the framework covers the immersive technological exposure as a pre-intentional cognitive calibration process in the tourism behavioural decision-making processes. Third, the model extends previous behaviour-oriented models by adding a description of how uncertainty appraisal and behavioural capability evaluation change before entering the participation due to the immersion and experiential system. The design offered differs from the adding of additional variables to the behavioural theory, as it reconfigures the chain of behavioural determinants in the immersive conditions. Therefore, in this framework, analytical attention has been shifted from a static prediction of behaviour to dynamic processes of cognitive calibrations prior to the formation of the intention. The model is also applicable to the scholarship of immersive technologies in tourism because of the fact that immersive technologies are leaving their traditional role as experiential enhancements and destination marketing tools. The thematic synthesis reveals that the immersive systems are actively engaged in cognitive mediation processes that impact the behavioural assessment, interpretation of uncertainty and readiness to enter into high uncertainty environments of tourism. The conceptual tie between the framework also ties in the research of immersive technologies, tourism behavioural theory, and adventure tourism risk research. These aspects have been intertwined in various fields and the model provides a theoretically informed explanation of how the immersive experiential system affects tourism decision-making processes through the dynamic processes of reorientation of uncertainty and behavioural capacity. The Immersive Risk Calibration Model is therefore an instrumental model that can be explored through empirical studies in future research, where the causal relationships between the variables of immersive exposure, uncertainty appraisal, behavioural control and participation

intention in the adventure tourism experience are examined.

5. Discussion

The aim of this study was to critically review the types of these technologies in relation to their relationship with perceived risk and behavioural intent in adventure tourism environments in a systematic way, using a methodology that combines PRISMA guidelines for screening and bibliometric mapping with theory-based thematic synthesis. The results showed that there is a significant change in the conceptual approach to adventure tourism research: A key question is not whether someone has a high or low level of perceived risk before they make an adventure tourism decision, but rather, whether they have a high or low level of perceived risk as they make that decision. However, the literature examined has become increasingly in support of a more dynamic role played by exposure to technology in the processes of cognitively interpreting uncertainty, behaviourally evaluating uncertainty, and psychologically dealing with uncertainty prior to intention formation.

The results then offer an extension of existing knowledge regarding tourism behavioural decision-making and the introduction of the concept of immersive cognitive calibration. The behavioural intention is traditionally conceptualised in existing tourism theory as a relatively stable cognitive determinant of behaviour and has been defined by some basic cognitive elements, such as attitudes, subjective norms and perceived behavioural control (Ajzen, 1991). In such contexts, perceived risk tends to be conceived as an outsourcing estimation issue which impacts willingness to participate. Thematic synthesis indicates that these models have some value as theory and are useful lenses to look at the behavioural consequences, but they do not provide a lot of opportunity to shed light on the cognitive construction of these uncertainties and their subsequent reconfiguration in immersive technological contexts. The literature reviewed in this study all supported the effect of immersive technologies (VR and AR) on tourism cognition rather than

the informational effect. VR and AR technologies are demonstrated to impact tourism cognition through simulated experiential engagement, not informational exposure, it was revealed that in the literature reviewed. Theoretically, a distinction is important. Information-awareness is generally promoted through traditional tourist communication channels such as brochures, static visual media, or descriptions of the tourist destination. While this is the case with immersive technologies, there's an interaction level that's just before it: anticipatory experiential interaction. This interaction occurs when a person cognitively engages with the conditions of the environment, the requirements of the procedures and/or the perceived challenges of active participation in tourism before actually being there. Because of this, immersive systems seem to be cogently mediated spaces in which uncertainty is not conceptually evaluated but rather experientially interpreted.

The results that are emerging from the thematic synthesis that are most relevant to this work are the findings of the role of immersive familiarisation in the reduction of uncertainty-related ambiguity. Student's experience of the immersive experience has consistently been linked to an increase in understanding of the environment and experience, and anticipation of procedure and knowledge of what to expect in the examined literature. The results confirm a general cognitive appraisal framework that posits that familiarity will act to constrain the meaning that is elicited from ambiguous information in uncertainty and enhance cognitive predictability. The present review is aimed, however, at broadening this understanding through showing that orientation in an immersive environment does not only mean information but experience and simulation. Immersive exposure ensures that people can mentally rehearse participation situations and predict behavioural responses prior to entering into the situation.

Importantly, a conclusion from these findings is that perceived risk cannot be avoided with the use of immersive technologies. The conceptual

incongruity with the experiential roots of adventure tourism is that the concept lacks the elements of uncertainty, novelty and perceived challenge which are important motivational factors in involvement in adventure tourism. Rather, the review recommends that the tools of immersive technologies transform the status of uncertainty into an interpretable cognitive and manageable behavioural state. In theory, it is an important distinction as the extent of adventure tourism participation could be related to the extent of perceived challenge and perceived capability or lack of risk. Thus, the results corroborate the notion that the adoption of immersive technologies has an impact on people's behavioural intention, as it helps to rethink the way they process uncertainty prior to a participation decision.

The theme synthesis also demonstrated positive correlation between immersive exposure and perceived behavioural control, with a high score. Multiple studies demonstrated that immersive simulation has the potential to enhance self-efficacy, confidence with procedures, and psychological preparedness due to an anticipatory experiential cognition process. These findings challenge previous explanations of perceived behavioural control in that it shows that perceived behavioural control can be partly determined through immersive interactive experience without first-hand experience. The simulated procedural rehearsal seems to boost the confidence of the participants to perform the activities in an uncertain tourism environment, which in turn fosters the reduction of unfamiliarity because of activity performance or the uncertainty of the environment.

Theoretically, the proposed Immersive Risk Calibration Model benefits the tourism field in many ways. First, the framework breaks down perceived risk as a static behavioural antecedent, and redefines perceived risk as a dynamic cognitive appraisal that happens during immersive interaction. Secondly, the model introduces immersive technological exposure as a pre-intentional mode of cognitive calibration in behavioural decision making processes to affect

uncertainty interpretation and evaluation of the behaviour. Thirdly, the framework offers a conceptual connection between the studies on immersive technology, the behavioural tourism theories, and the study on adventure tourism risk, which have been independently developed in the current literature.

This study also contributes methodologically to the tourism reviews research. In theory-building systematic reviews, there are often concerns raised by the reviewers about conceptual abstraction and the lack of a connection between the review process and the development of the theory. For this reason, the present study applied a clear and pre-structured hybrid review methodology, consisting of the application of the PRISMA protocol for screening, the application of structured coding strategies, bibliometric mapping and iterative thematic synthesis. Therefore, the method of problem framing in this study was inductive which was based on the conceptual relationship that occurred repeatedly in the literature that was reviewed, not on the concepts that were given in advance to be analyzed. This methodological approach confirms the explanatory power of the model presented and demonstrates the value of the method of theory-building systematic reviews for conceptual development of a field of scholarship such as tourism.

The results further suggest a new paradigm in tourism behavioural research, which went from a static predictive type to a dynamic experiential cognition type. Traditional theories in tourism have focused on the process of making predictions about behaviour, based on the attitudes and evaluations of the tourists as stable determinants of their behaviour. In tourism decision-making, the technological environments used in recent years have become increasingly immersive, involving pre-experiential cognitive interaction in the process. When the situation is of this kind, intention to behave may not only form as a result of abstract appraisal of a tourism product or a tourism destination but also as a result of simulated experiential appraisal that takes place before participation. The results imply that

in the future model for tourism behaviour that uses technology and cognition in the interpretation of tourism, drawing attention to the creation of more explicit cognitive processes technologically mediated for the interpretation of the uncertainty and preparing to participate in tourism are important.

Regardless of this, the results should be taken with the limitations of the study design. This review considered only publications which, between 2014 and 2026, were published in English and have been indexed in the Scopus bibliography database and have passed through the peer-review process. This led to methodological homogeneity and academic rigour but also to the possibility that studies that were potentially relevant and that were published in other databases or languages were not retrieved. Furthermore, the proposed framework is conceptually based and should be tested and validated in different contexts of adventure tourism in the future with different demographic and technological use groups.

For the future, causal relationships mentioned in the Immersive Risk Calibration Model should be further empirically tested with special focus on the mediating role of immersive familiarisation and perceived behavioural control in the relationship between immersive familiarisation and perceived behavioural control and/or attitude and behavioural intention. Comparative studies analysing the differences between VR, AR, MR and new augmented reality systems could further consolidate knowledge of the technology-specific cognitive impacts on the tourist decision-making process. Longitudinal research may also help identify if immersive cognitive calibration impacts evaluation, satisfaction, and revisit intent beyond participation and if effects endure.

From a general perspective, the results of the current research work show that immersive technologies are not only experiential enhancement aids in an environment of tourism but can also be interpreted as an additional experience, even at the risk of the virtual world intruding into the real-world setting. However, the literature reviewed in this study increasingly indicates that the role of the immersive system in

cognitive appraisal processes, which influence the interpretation of uncertainty, the capability to act and intentions of participation before adventure tourism, is participatory. The proposed framework thus becomes relevant to the current debates about technology-mediated tourism behaviour, as perceived risk is a dynamically renegotiated construct that unfolds as people enter into a dynamic and experiential interaction process.

6. Implications

Based on the current research, the research in the field of tourism scholarship has been expanded by providing an interpretation of the decision-making process in the adventure tourism environment which is considered technologically mediated. The study combines and redefines the conflated literature for immersive technologies and perceived risk with behavioural intention, allowing perceived risk to emerge as a variable cognitive appraisal from an immersive experiential interaction, instead of being an antecedent to uptake behaviour. This theoretical repositioning is based on the theories of behavioural tourism and incorporates immersive cognitive calibration processes into the pre-intentional decision-making process.

The respective Immersive Risk Calibration Model also aids conceptually in how research is conceptualised by integrating a structured link between the factors of immersive familiarisation, perceived behavioural control, uncertainty appraisal, and behavioural intention. The framework emphasises the impacts of immersive technological environments on shaping cognitive evaluations prior to participation, in contrast to existing touristic frameworks, which elaborate mostly on static attitudinal determinants. The study therefore provides a solid theoretical basis for linking the research on immersive technology and the tourism behavioural theory, which are two relatively unconnected research areas in the literature.

The study methodology illustrates the importance of using PRISMA-related systematic review procedures and bibliometric mapping and

theory-based thematic synthesis to create a framework in interdisciplinary tourism research. The elaborated framework construction of the conceptual model is immediately evident, and the entangled connection between thematic findings and the construction of theoretical frameworks is explicitly mentioned, which fundamentally tackles the thematic issues that are often discussed in abstract conceptual reviews. Results point to a possible practical application of immersive technologies as instruments for cognitive preparation to diminish participation barriers related to uncertainty in participating in adventure tourism environments. Adventure tourism operators, and destination managers and immersive experience designers, can therefore utilise virtual or augmented reality (VR/AR) simulation environments to promote and engage participants as well as to familiarise them beforehand and prepare them in the process of thinking about their behaviour.

Considering the above, the study is a valuable contribution to the current debate on the role of immersive experiential systems in the processing of cognition, uncertainty interpretation and the development of behavioural intention in high-risk and high-uncertainty tourism contexts.

7. Conclusion:

This study proposes a critical change in the role of immersive technologies from peripheral experience to the technology as a strong cognitive mediator of tourists' behaviour that affects the decision-making process in adventure tourism contexts. The methodology is a well-structured systematic review of the hybrid type, which involves screening based on the PRISMA principles, elaboration of the bibliometric map, and a theoretical approach of thematic synthesis to identify the fundamental change in the cognitive interpretation of uncertainty that takes place before a person enters into a technological environment.

The results suggest an important conceptual shift in the development of adventure tourism research. Perceived risk is not an antecedent, but rather it is a constantly changing cognitive

evaluation that is constructed as we experience the risk, imagine what could happen, and imitate what is to come. The proposed Immersive Risk Calibration Model proposes a theoretical framework of how immersive technologies affect behavioural intention through uncertainty interpretation and perception of behavioural control. The experiential systems approach is integrated into the theory of behavioural tourism in order to further enrich the concept of the decision-making process from the static-predictive approach to a process-oriented cognitive calibration mechanism in an uncertain and complex experiential environment.

Most importantly, though, the study does not consider immersive technologies as risk reduction tools. Rather, the synthesis shows that immersive exposure transforms the experience of uncertainty and opens an interpretative, manageable cognitive field which preserves the experiential aspects of uncertainty, novelty and perceived challenge found in adventure tourism participation. Theoretically, this distinction is important because it moves the idea of immersive technologies away from the idea of replacement and towards that of a new kind of mediator that will influence how uncertainty is psychologically negotiated in the presence of behaviour.

The study also has methodological significance, as it demonstrates the potential of the systematic review methodology to transform the descriptive synthesis process into a transparent process for constructing an actionable theory to guide future research and practices in a structured and

thematic way. A direct link between bibliometric tendencies and thematic coding, conceptual convergence and framing of the model is added to enhance the explanatory legitimation of the proposed model and to fill an important gap in the research on the tourism from a technology perspective.

The review is however limited to other peer-reviewed English language journals indexed only in Scopus published from 2014 to 2026. The proposed structure is thus conceptually motivated and needs to be empirically tested in various tourism situations, immersive technologies and cultures.

Future studies should employ longitudinal designs, experimental designs and comparative designs to gain better insights into the stability and causal relationships of immersive cognitive calibration processes using various immersive technologies, including VR, AR and mixed reality systems. Based on immersive systems, the proposed insights and findings of uncertainty appraisal and behavioural adaptation in high-risk tourism situations can be complemented by further research in different demographic and cultural contexts.

The overall contribution of the study is to theory building in tourism behaviour research, and it offers new implications to the transformation of immersive technology as cognitive architectures that facilitate tourists' interpretation, negotiation and calibration of behaviour before they embark on tourism adventures.

8. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/1542-1562\(91\)90020-T](https://doi.org/10.1016/1542-1562(91)90020-T)
- Akbar, M. D. (2017). Risk as a motivation for adventure tourist. *ASEAN Journal on Hospitality and Tourism*, 15(1), 48–61. <https://doi.org/10.5614/ajht.2017.15.1.4>
- Bratić, M., Radivojević, A., Stojiljković, N., Simović, O., Juvan, E., & Lesjak, M. (2021). Should I stay or should I go? Tourists' COVID-19 risk perception and vacation behavior shift. *Sustainability*, 13(6), 3573. <https://doi.org/10.3390/su13063573>
- Cater, C. I. (2006). Playing with risk? Participant perceptions of risk and management implications in adventure tourism. *Tourism Management*, 27(2), 317–325. <https://doi.org/10.1016/j.tourman.2004.10.005>

- Daassi, M., & Debbabi, S. (2021). Intention to reuse AR-based apps: The combined role of the sense of immersion, product presence and perceived realism. *Information & Management*, 58(4), 103453. <https://doi.org/10.1016/j.im.2021.103453>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Fuchs, G., & Reichel, A. (2011). An exploratory inquiry into destination risk perceptions and risk reduction strategies of first time vs. repeat visitors to a highly volatile destination. *Tourism Management*, 32(2), 266–276. <https://doi.org/10.1016/j.tourman.2010.01.012>
- Guttentag, D. A. (2010). Virtual reality: Applications and implications for tourism. *Tourism Management*, 31(5), 637–651. <https://doi.org/10.1016/j.tourman.2009.07.003>
- Jung, T., tom Dieck, M. C., Lee, H., & Chung, N. (2016). Effects of virtual reality and augmented reality on visitor experiences in museum. In A. Inversini & R. Schegg (Eds.), *Information and communication technologies in tourism 2016* (pp. 621–635). Springer. https://doi.org/10.1007/1542-1562-1542-15621542-1562_45
- Kiatkawsin, K., Bui, N. A., Hrankai, R., & Jeong, K. (2021). The moderating roles of sensation seeking and worry among nature-based adventure tourists. *International Journal of Environmental Research and Public Health*, 18(4), 2021. <https://doi.org/10.3390/ijerph18042021>
- Mensah, E. A., Agyeiwaah, E., & Otoo, F. E. (2021). Re-conceptualizing volunteer tourism organizations' roles: A host perspective. *Tourism Management Perspectives*, 37, 100785. <https://doi.org/10.1016/j.tmp.2020.100785>
- Nurtanto, M., Nawanksari, S., Sutrisno, V. L. P., Syahrudin, H., Kholifah, N., Rohmanto, D., Utami, I. S., Mutohhari, F., & Hamid, M. A. (2025). Determinants of behavioral intentions and their impact on student performance in the use of AI technology in higher education in Indonesia: A SEM-PLS analysis based on TPB, UTAUT, and TAM frameworks. *Social Sciences & Humanities Open*, 11, 101638. <https://doi.org/10.1016/j.ssaho.2025.101638>

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Declaration of the use of generative ai in the writing process

This publication uses generative artificial intelligence (AI) tools in an advisory role as a grammar check and language refinement tool during the manuscript preparation process. The selection, analysis, interpretation and generation of research findings are all original works of the authors. There works are done without the use of any AI tool. All academic content and critical interpretations originated from and were checked by the authors themselves from open-access scholarly sources, and all are to be held responsible for the accuracy and originality of the manuscript.

All the authors are educated in English-medium schools, studied in English-medium schools up to and including the doctoral level (PhD) and are professionally knowledgeable, fluent and competent in English. A careful review of the manuscript for grammatical accuracy, consistency, and its language and structure to reflect inclusive academic language in line with the journal guidelines.