Salient features and emotions elicited from a virtual reality experience: the immersive Van Gogh exhibition

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Abstract

This research is based on the cognitive-affective-conative model applied to the online reviews posted by visitors of a tourist attraction titled "Van Gogh: The Immersive Experience" held in York (UK). The goals of the study specifically focus on the identification of the cognitive features triggered using the VR device and on the understanding of sentiments and emotions activated by the VR experience. To this end, Text mining and Sentiment analysis have been utilised. This work extends prior studies on VR based on surveys by providing a comprehensive hybrid view of how knowledge is derived from the posted online reviews. The findings offer practitioner insights into the cognitive and affective aspect of the VR experience, which requires special attention for its adaptation so that it continues meeting visitors' expectations.

Keywords Cognitive features · Affective features · Emotions · VR experience · Text mining · Sentiment analysis

1 Introduction

Statistics show an exponential increase in Virtual Reality (VR) and Augmented Reality (AR) experiences worldwide. The growing market size of Augmented Reality and Virtual Reality, forecast to hit $296.0 billion within a decade, is a clear indication of their potential (Statista 2023a). Major growth in the market size of the VR tourism industry, reached 24 billion U.S. dollars by 2027 (Statista 2023b). Likewise, millions of customers use online reviews as a means of expressing their opinions, by sharing and recommending tourist experiences and places to visit (Okazi, Andreu & Campo, 2017). Statistics show that TripAdvisor worldwide reported more than one billion reviews and that 96% of the

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online reviews on hotel and hospitality brands are influential in the generation of reserving accommodation (Statista 2022).

Research into Virtual reality (VR) experiences in tourism has increased in recent years (González-Rodríguez et al. 2020a, b; Griffin, & Muldoon 2020; Nayyar, Mahapatra, Le, & Suseendran, 2018; Sousa, Alén, Losada, & Melo, 2022). Despite the growing interest in VR in tourism, most of the studies utilise survey methods (Elkhwesky, Abuelhassan, Elkhwesky, & Khreis, 2023), although questionnaires fail to capture the holistic salient features, namely the cognitive, affective, and conative aspects of an experience. User-generated content (UGC), such as e-WOM reviews, through which visitors post their experiences, opinions, images, and recommendations, constitutes a crucial source of data to this end (Cheung, Leung, Cheah & Ting., 2022; González-Rodríguez et al. 2016). With this regard, the present paper focuses on the cognitive and affective information behind de online reviews when participating in a VR experience not enough studied in tourism and hospitality literature, above all when online reviews are analysed. In fact, through the analysis of e-WOM reviews when visiting museums or heritage sites, the principal satisfaction/dissatisfaction attributes of a VR experience and the sentiments behind the online reviews can be uncovered. This approach therefore would lead us to the capture of the holistic VR tourism experience by addressing the cognitive, affective, and conative aspects of a tourism experience.

The cognitive-affective-conative (CAC) model has been widely used in the tourism literature to classify the attributes of destination image into cognitive, affective, and conative dimensions (Michael et al. 2019). The cognitive image is connected to tangible aspects of a destination (e.g., natural resources, infrastructure, history and art, economic aspects), whereas the affective image is intangible and includes emotional facets. Both cognitive and affective aspects shape the conative dimensions of a destination image and lead to individuals' behaviour intention (e.g., recommend, visit intention, word-of-mouth). This study contributes to the literature by approaching a VR tourism experience under the CAC model. In a VR experience, while the cognitive information indicates the tangible aspects of the technology, such as immersion and ease of use, the affective information is more intricately connected to the human-related features, such as visitors' feelings, sentimental expressions, and emotions activated by the VR device stimulus. Furthermore, the cognitive and affective dimensions undoubtedly play a significant role in visitors' behaviours.

In this study, a text mining approach to guide the thematic analysis and sentiment analysis has been employed to analyse the e-WOM reviews from visitors of the Van Gogh VR exhibition held in York (UK). Based on the cognitive-affective-model applied to the VR experience through e-WOM reviews, two research questions guide the study: What are the most frequent words or word segments associated to the main cognitive, affective, or conative aspects from have participated in a VR experience? What are the sentiments and emotions generated from the virtual experience? What emotions are linked to the most frequent attributes? Addressing these research questions provide destination marketing organisations (DMOs), business owners, and tourist planners with valuable information on cognitive and affective features to improve the tourism product and therefore to improve the tourism experience. Furthermore, a holistic approach based on the analysis of both the most frequent words in terms of cognitive, affective, and conative attributes of an VR experience and the evoked emotions from the experience also shed light for future research agendas.

The structure of the paper is as follows: the next section presents a literature review on both previous studies on VR and on the importance of emotions in tourism. Then, the methods employed are described, and the results from the holistic analysis are synthesized

and exposed. Next, the results are discussed in relation to different studies. Lastly, the paper concludes with theoretical contributions and practical implications for practitioners.

2 Literature review

2.1 The antecedents of the VR experience response

In Tourism literature, Arena, Hyun, and O'Keefe (2012) argue that the value of tourism products increases when they are experienced. A virtual experience of a destination through virtual reality can provide clients with a proxy for the experience (Lee & Gretzedl, 2012). Furthermore, as stated by Cho et al. (2002), not only can the virtual reality experience of a destination help tourists translate experiential cues into "objective" compliance criteria, but the use of virtual reality also has a significant effect on their behaviour, by influencing their attitude and intention to visit. Accordingly, Berger et al. (2007) establish that VR experiences led tourists to attain a real sense of a visit. That is, using virtual reality, potential tourists can undergo the experience of a tourist destination or a tourist activity or product (e.g., a visit to a museum or an exhibition) before the actual visit and by themselves, without being influenced by the descriptive information available in different channels such as the media or social networks.

The immersive power is a critical element of VR (Peng & Ke 2015). Disztinger et al. (2017) define perceived immersion as 'an individual's ability to engage in a virtual environment fully'. Thus, when users enter a virtual world, they feel immersed in that environment (Dobrowolski et al. 2014; Schuemie et al. 2001). Kothgassner et al. (2012) stated that the acceptance of VR rises with an increased level of immersion. Moreover, in the context of VR, social presence also plays a vital role within the literature (Jung et al. 2016). Therefore, social presence can be explained by "whether there is positive interpersonal and emotional connection between communicators" (Cui et al., 2013, p. 663). People tend to find social interactions largely enjoyable (Ryan & Deci 2000, 2022).

The results of studies on VR experiences are widely heterogeneous in the academic literature (Afshardoost & Sadeghi, 2020, p. 2). Furthermore, in-depth analyses of antecedents of the responses to VR experiences in tourism remain scarce. In this context, the existing papers can be characterised by the following common elements: 1) The theoretical framework is mainly based on the Technology Acceptance Model (TAM), currently considered the most influential model by many researchers (Haider et al. 2018; Huang et al. 2013; Luna-Nevarez & McGovern 2021; Sánchez-Prieto et al. 2017; Vishwakarma et al. 2020); 2) Only two or three common antecedents are analysed together with their interrelationships and their influence on certain tourist´s behavioural intentions. Enjoyment/entertainment, immersion, usefulness, price, service quality, and telepresence are commonly specified as the antecedents that influence intention to use VR (Alalwan et al. 2018; Angelino et al. 2022; Beck et al. 2019; Bogicevic et al. 2019; Chen & Chen 2010; Chen, Duh, Phuah, & Lam, 2006; Ha & Stoel 2009; Jung et al. 2016; Kothgassner et al. 2012; Luna-Nevarez & McGovern 2021; Padilla-Meléndez et al. 2013; Petrick 2004; Qin et al. 2021; Teo & Noyes 2011; tom Dieck et al., 2017; Venkatesh et al. 2012; Ying et al. 2022; Zhu et al. 2023); 3) Many studies focus on TAM model relationships applied to a VR experience in a particular tourist place; 4) Structural equation modelling is often applied to analyse the responses obtained from a sample size of respondents from different countries and cultures (Tonteri et al. 2011).

Furthermore, although most of the research on VR is based on self-reporting questionnaire and focus groups (Elkhwesky, Abuelhassan, Elkhwesky, & Khreis, 2023; Liu et al. 2022), the studies that identify the main features of a VR experience through User-generated content (UGC) remain in their infancy. The analysis of UGC is particularly important in revealing patterns of experience and behaviour since it avoids any bias derived from questionnaires or any physical contact with the interviewers. For the purpose of this study, the following research question is formulated:

RQ1: What are the salient features of a VR experience when the e-WOM online reviews are examined?

## 2.2 The importance of emotions

Traditionally, studies on VR experiences have been conducted from a cognitive rather than an affective perspective (Afshardoost, & Eshaghi 2020; Kim et al. 2020; Lui & Goel 2022; Qin et al. 2021; Liu et al. 2022). As claimed in the literature from the late 1980s, satisfaction and behavioural intention needs to be examined under a cognitive-affective approach (González-Rodríguez et al. 2020a, b). For an in-depth understanding of the consumers' response to a VR experience, certain topics related to the affective component of an experience require clarification. First, various terms have been employed to describe an individual's emotional processes in psychology, namely affect, mood, and emotion, which are considered as the three affective variables. Affect is the most general of the three concepts (Batson et al. 1992; Eisenberg 2000). Affect is the general concept that encompasses the other two affective variables, those of mood and emotion, which are considered specific forms of affect (Holbrook & Gardner 2000). Although emotion and mood are mostly treated as being interchangeable, differences between these affective variables can be observed related to duration, intensity, and the stimuli by which they are triggered (Russell& Norvig, 2003). Emotion is more fleeting since it refers to a specific relation of the individual with the environment at a given moment in time. In contrast, there is mood, or state of mind, which may last for several days and may vary according to the expectations of the individual regarding experiencing positive or negative affect in the future. A second difference between the two terms is related to the intensity of the emotion with respect to mood. Bagozzi et al. (1999) point out that emotions are more intense than moods and that these are usually accompanied by expressive manifestations that characterise them, while, in contrast, moods are usually associated with explicit manifestations or behaviours (Batson et al. 1992). The third difference between emotions and moods refers to the fact that, in the case of emotion, there is a certain trigger or specific stimulus, which is the result of a specific consequence or response to a specific event (Neumann & Strack 2000). However, moods are linked to those causes that take place at a certain time that might occur further away from the present. Thus, mood as an affective variable is more diffuse and generalised than that of emotion (Holbrook & Gardner 2000).

The two major approaches for the conceptualisation of emotions in the literature are the categorical approach and the dimensional approach. For the categorical approach, emotions are considered as a set of discrete affective states, such as happiness, sadness, and anger, which are easily recognisable and distinguishable from each other, and that are assumed to be universal and present from birth or developed in early childhood. However, there is no consensus regarding their number or their nature. In the categorical approach, the most widely recognised classifications for emotions are the Differential Emotions Scale (Izard 1977, 1992) and the Circular Model of Emotion (Plutchik 1980). According to Izard

(1977), exposure to emotional situations triggers innate and universal emotional expressions, mainly manifested in facial expressions. Izard (1977) recognises ten basic emotions, namely: interest, joy, surprise, sadness, anger, disgust, contempt, fear, shame, and guilt. On the other hand, the Circular Model of Emotion by Plutchik (1980) identifies only the four basic emotions of, fear, anger, joy, and sadness, which can be combined with adjacent emotions, thereby creating new emotions. From either approach, emotions of a more complicated nature are the result of a mixture of the basic and/or primary emotions (Fig. 1).

However, in the dimensional approach (Russell & Norvig 2003; Mehrabian & Russell 1974; Russell & Mehrabian 1976), emotions are conceived as a continuum ranging from a set of dimensions. Thus, for instance, pleasure is considered as a continuum ranging from extreme unhappiness to extreme happiness to describe a person's level of pleasure. The dimensional approach is more parsimonious than the categorical approach by conceptualising emotions mostly with two dimensions (valence and arousal) or three (valence, arousal, and dominance). Valence, arousal, and dominance are, respectively, related to affective, cognitive, and conative responses that indicate a person's state of feeling (Bakker et al. 2014; Kusumasondjaja, & Tjiptono 2019; Srivastava et al. 2023).

In the tourism literature the affective component of the experience has largely been measured through self-reporting questionnaires and observation techniques (Coghlan & Pearce 2010; Isomursu, Tähti, & Kuutti, 2007; Lee & Kyle 2012; Wang & Minor 2008; Li et al. 2015; Scuttari, & Pechlaner 2017). While self-reporting techniques are mainly based
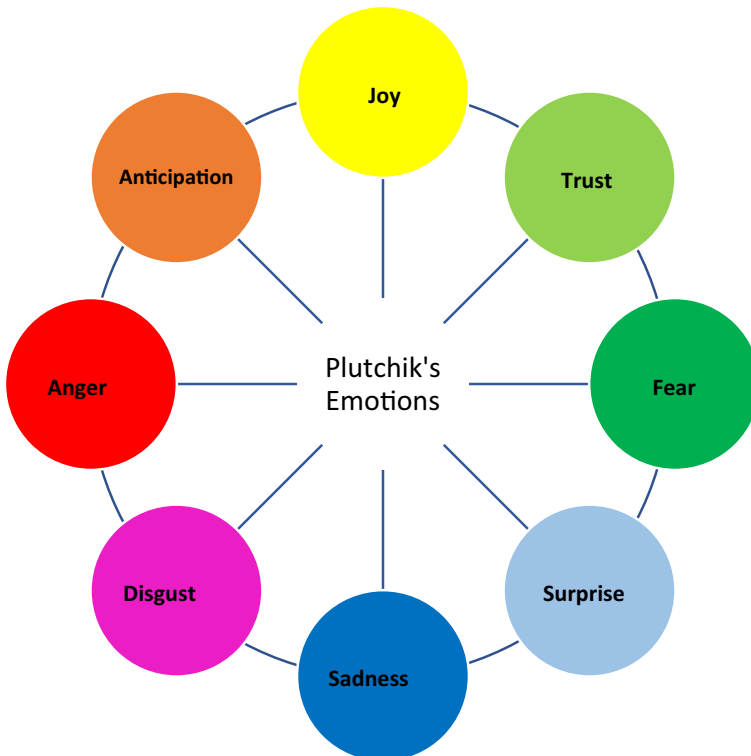
Fig. 1 The eight emotions by Plutchik (1980)

on dimensional theories of emotions since they focus on cognitive aspects of a subjective or memorable experience, observation techniques are mostly related to categorical theories since they observe physiological and expressive responses derived from a stimulus. Since the aim of the study is to ascertain the emotions triggered by a VR stimulus through the expressions on the e-WOM online reviews, the present research focuses more closely on the categorical theory of emotions such as that by Plutchik (1980), and consequently the following research question is formulated:

RQ2: What are the emotions triggered by the VR headset stimulus regarding the Van Gogh VR experience?

3 Methodology

3.1 Study sample

The data set contains information on a virtual reality experience on Van Gogh's art and life. The virtual experience is titled "Van Gogh: The Immersive Experience" held in York (UK). The exhibition combines Van Gogh's life story with an in-depth immersion into the heart of his art. The immersive aspect of the VR experience provides a large variety of didactic information through 8 works of art and their sources of inspiration (https://www.vangoghexpo.co.uk/about-the-exhibition/).

Information available on the TripAdvisor.co.uk website, such as individuals' demographic profile, the reviews and, the quantitative assessment of the experience, through a rating from 1 = poorest to 5 = excellent, were extracted. Online reviews and also the reviews have been collected using a web scraper developed in Python. Reviews written in English are included in the study. 350 reviews were available in TripAdvisor in May 2023. These reviews are analysed with a total of 2,700 sentences in the data set. Regarding the visitors' profile, 41.71% of the reviewers visited the exhibition with their partner, 25.49% with family, 16.99% with friends, 8.50% alone, and only 1.31% due to business purposes.

3.2 Methods

Text mining dealing with unstructured and textual information has been applied to extract relevant information and knowledge (Jia 2023). The main advantage of text mining techniques is that they face with a huge corpus of text to find out hidden information, either cognitive or affective, as it usually occurs when analysing online reviews (Toral et al. 2018). In the context of tourists' experience through UGC, there are two main methodologies applied to specific types of research questions and which have been applied in this study.

The first methodology, the key-words analysis allows for the identification of the main topics within a corpus of text. The most important terms within a corpus are extracted offering relevant information of the salient features of a tourist experience. The second methodology is the sentiment analysis that consists of the identification of sentiment orientation (either positive, negative, or neutral) or the predominant emotions (sadness, trust, joy, disgust, happiness etc.) derived from the tourist experience.

In order to ascertain the salient features of the VR experience, a two-stage procedure has been employed: 1) Frequent-word list; and 2) Coding for features that exemplifies the same concept. The software "KH Coder" (Higuchi 2016) has been employed to this goal.

In order to recognise the most frequent words and therefore identify the most frequent salient features, the data set is pre-processed by means of the following stages: Tokenisation (e.g., splitting a stream of text into words, symbols, or other meaningful elements called tokens); Dropping the stop words (e–g., articles, auxiliary verbs, conjunctions, prepositions); Part of Speech (POS) tagging (e.g., assigning the part of speech to each word in terms of nouns, verbs, adjectives, etc.).; Lemmatisation (e.g., conflating tokens into their root forms, such as "immersive" into "immersion". Subsequent to the exclusion of the stop words, 25,998 tokens and 2,257-word types (e.g., representative terms) remained for analysis.

Features that exemplify the same concept are coded with the same name and identified as a salient feature:

The following parts of a sentence were all coded under the term "Sense of Presence":

"…, bring/bought the paintings to life…."

"…the paintings/static pictures come to life…".

"…it comes/comes back to life…".

"…bigger than life and real…".

The words "price", "overprice", "cost", "additionally charge", "expensive" etc. were also coded as the salient feature "Cost".

Expressions such as "calm/inspiring experience", "fabulous/worthy experience", "unique experience", "excellent attraction", "visually impressive", etc. wee coded as the salient feature "perception".

Expressions such as "story telling" and "information" (related to knowledge) were coded as "knowledge retention".

A lexical-based sentiment analysis has been applied using R software to identify both the sentiment orientation and the prevailing emotions of the online reviews. This analysis is very valuable in the field of natural language processing (NLP) and text mining (Liu 2012; Silge & Robinson 2017). This type of analysis allows organizations and analysts to understand the opinions, attitudes and emotions expressed in texts, which can have several useful applications such as in business decision making, opinion monitoring and political and social analysis.

In the present study, eliciting emotion that focuses on the user's emotional state (e.g., joy, anger, surprise, disgust, etc.) and the positive and negative valance of the comments have been identified by using the sentiment analysis package in the R statistical program.

4 Results

From the most frequent words analysis, 6 salient features of the VR experience are identified in the sample. These are: immersion, presence, cost, experiential perception, knowledge retention, and emotions. These features were categorised into technical-oriented, human-oriented, and performance-oriented features according to their attachment to technology, individuals' psychological attributes or performance. The technical-oriented features include those that are derived from the use of the VR technology; human-oriented features are related to psychosocial factors, such as how individuals perceive, engage, and are influenced by stimuli; and performance-oriented features are related to the outcomes derived from the VR experience, such as learning through the VR experience and perceived value in terms of money. Table 1 shows the classification of the salient attributes of the VR experience of the Van Gogh exhibition.

Table 1 Classification of Salient features

Technical-oriented features	Human-oriented features	Performance-oriented features
Immersion	Presence	Knowledge retention
	Emotions	Cost
	Experiential perception	

When analysing the ratings (from 1 = poorest to 5 = excellent), the perception of the reviewers regarding their experience seems to be positive according to the descriptive statistics in Table 2. The rating average is above 3 (mean = 3.54), and most of participants have scored with a rating of 5 the virtual experience.

In order to identify the reviewers' coherence between their satisfaction with the experience (as expressed in the ratings) and the positive or negative feelings as expressed in their reviews, a sentiment analysis as implemented in R software was conducted. Through the sentiment analysis, the 8 emotions as recognised by Plutchik are identified and analysed from a total of the 14,870 words scrutinised from the reviews posted by the VR users after the experience. Once having eliminated the neutral words (articles and others), we are left with a total of 1,043 words. The emotions are scored on a scale from 0 (absence of emotion) to 1 (full presence of emotion). A descriptive summary of the emotions derived from these words are provided in Table 3. From the table, the 25% of words with the highest score in emotions, display full presence of anticipation, joy and trust, and absence emotion in anger, disgust, fear, sadness, and surprise.

Figure 2 shows which emotions present the highest frequency in the reviews. This information reveals that the joy, anticipation, and trust emotions are more prevalent in

Table 2 Descriptive Statistics for reviewers' ratings

	Ratings	
Mean	3.53	
Median	4.00	
Mode	5.00	
Standard Deviation	1.521	
Minimum	1	
Maximum	5	
Percentiles	25	2.00
	50	4.00
	75	5.00

Table 3 Summary of emotions

|	Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1st Qu	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean	0.0921	0.0355	0.0061	0.0058	0.0355	0.0161	0.0194	0.0343
3rd Qu	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000
Max	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
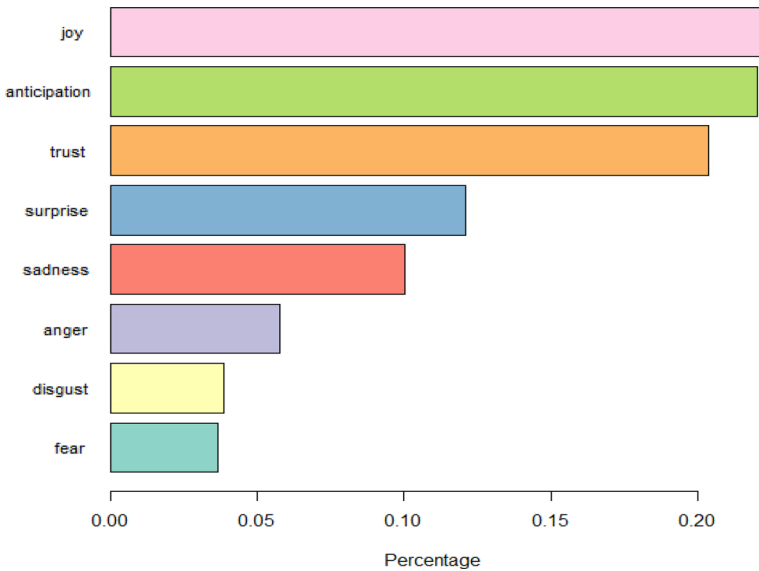
Fig. 2 Frequency distribution of emotions

the words employed by reviewers than the emotions anger, disgust, and fear. Particularly, over 20% of words are associated with the joy and anticipation emotions.

Next, Table 4 displays the total words associated to each emotion, as well as those different words linked to the respective emotion. This analysis shows that most of words in the online reviews correspond to "joy", "anticipation" and "trust". As observed from Table 4, 92 different words are associated to "anticipation", 91 words to "joy" and 102 to "trust".

To go deeper in the analysis offered by Table 4, it is even more interesting to know which words are used with the highest frequency regarding to its identification with each emotion. By doing this analysis, Table 5 displays the main words associated with the corresponding emotion. To cite some examples, the words overprice and waste (as referred as waste of money) are associated with the emotion disgust; and the emotion joy is linked to nouns as gift, art and music and adjectives such as brilliant, beautiful, pretty, among others.

Figure 3 visualize this information, so that the bigger the size of the words, the highest occurrence of the words in the reported emotion.

The sentiment analysis also enables identification of the positive and negative connotations of the language. In this regard, the difference between emotions and sentiments should be borne in mind. While emotions are physical reactions under stimuli,

Table 4 Summary of total and different words associated with each emotion

Words	Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
Total	137	528	91	87	528	239	289	510
Different	44	92	39	45	91	55	42	102

Table 5 Main words associated with each emotion in order of highest to lowest frequency

Anger

Money	Disap-point	Over-priced	Feeling	Bad	Fee	Annoying	Musical	Ridiculous
Awful	Cash	Distracted	Limited	Rating	Bitterly	Challenge	Chaotic	Complaint

Anticipation

Art	Church	Time	Money	Good	Pay	Lovely	Watch	Thought
Gift	Enjoy	Expect	Brilliant	Long	Feeling	Glad	Come	Pretty

Disgust

Disap-point	Over-priced	Waste	Feeling	Bad	Ridicu-lous	Awful	Interested	Nausea
Toilet	Bitterly	Corrup-tion	Egregious	Failure	Finally	Gall	Greedy	Hate

Fear

Watch	Feeling	Bad	Avoid	Awful	Cash	Change	Difficult	Immerse
Journey	Missing	Problem	Rating	Advance	Afraid	Beware	Case	Challenge

Joy

Art	Church	Music	Money	Good	Pay	Lovely	Wonder-ful	Beautiful
Gift	Enjoy	Found	Animated	Brilliant	Feeling	Glad	Daughter	Pretty

Sadness

Art	Music	Lovely	Disap-point	Over-priced	Leave	Feeling	Bad	Lost
Black	Sadly	Awful	Fall	Interested	Limited	Lower	Missing	Problem

Surprise

Art	Money	Good	Lovely	Wonder-ful	Gift	Expect	Leave	Trip
Feeling	Break	Unique	Chance	Young	Musical	Peaceful	Spectacu-lar	Surprised

Trust

Show	Church	Money	Good	Pay	Lovely	Wonder-ful	Recom-mend	Don
Enjoy	Found	Brilliant	Expect	Feeling	Real	Fact	Fully	Pretty

sentiment is the effect from feeling an emotion. The results of the sentiments (polarity of feelings) are displayed in Fig. 4, showing that 80% of the words in the online reviews manifest positive feelings whereas the 20% of the words display negative feelings.

Finally, Fig. 5 presents the time evolution of the online reviews posted in terms of positive and negative sentiments. The first image offers the measures of the algorithm. The second image of Fig. 5 is a normalisation of the first image. In the x-axis, the text is fragmented into 100 normalised fragments, and the y-axis provides information regarding the valence of the feelings in the text. The second image of the graph analyses the reviews from the oldest comment to the most recent comment, and hence the curve should be read from left to the right. It can be observed how, at the beginning of the VR exhibition, the first visitors show negative feelings towards the experience, however, these comments evolve towards positive feelings that turn into neutral as the time elapsed.
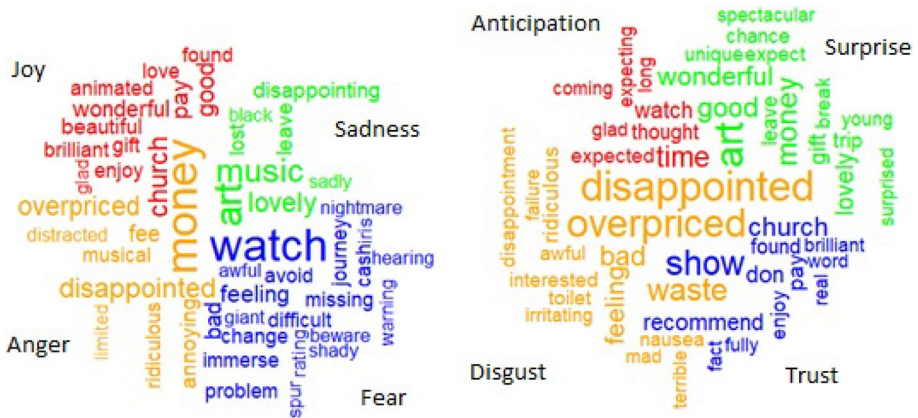
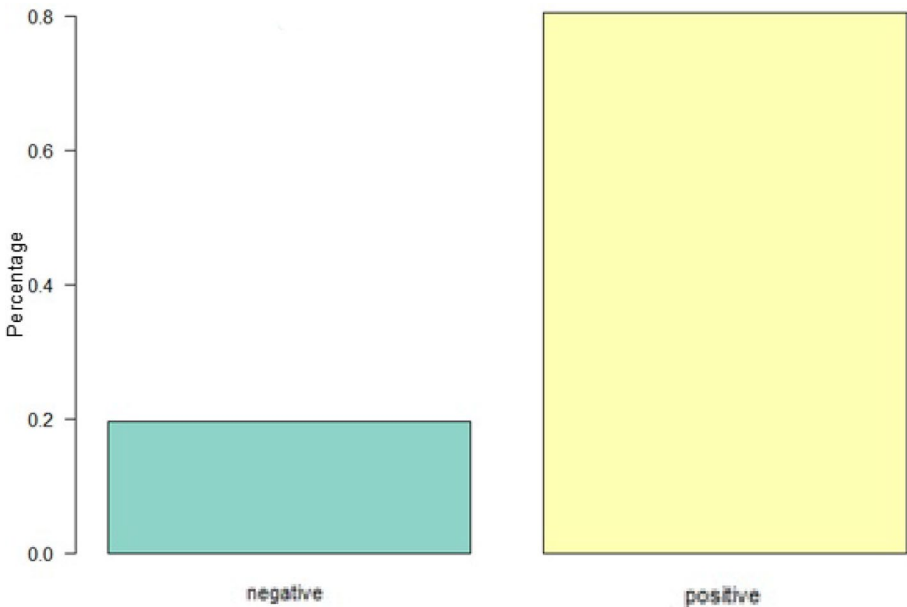**Fig. 3** Clouds of words associated to each emotion

Fig. 4 Sentiment analysis: negative and positive reviews distribution

5 Conclusion and Discussion

Any virtual reality system comprises two components: the technological component and the psychological experience (Coelho et al. 2006; González-Rodríguez, Díaz-Fernández, & Lopes Dias, 2023). In this vein, a qualitative analysis has been carried out of the e-WOM online reviews written by those who were involved in the VR Experience, titled "Van Gogh: The Immersive Experience" in York (UK). The VR experience as case of study is linked to an exhibition on Van Gogh art. The VR experience combines Van Gogh's life
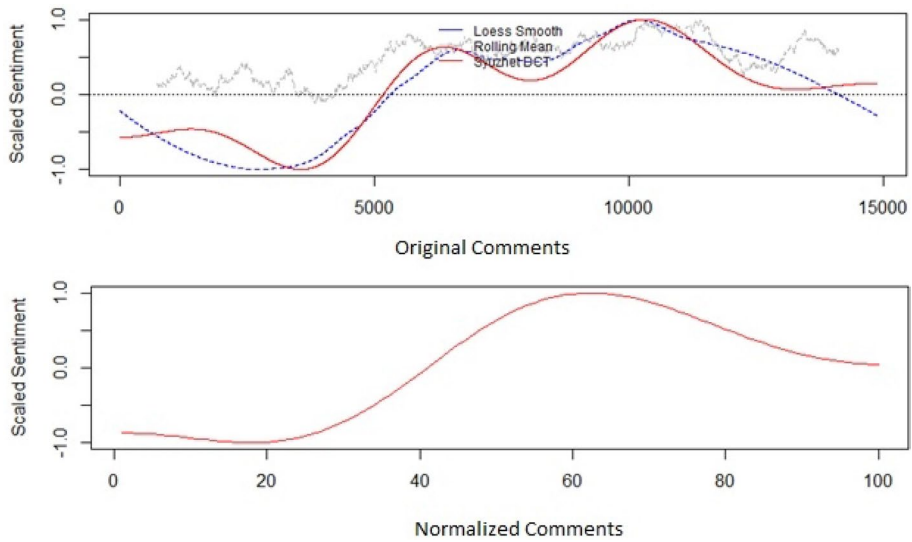
Fig. 5 Time evolution of the online reviews in terms of sentiment valence

story with an in-depth immersion into the heart of his art. This paper aims to identify the salient attributes of a VR experience (technological and psychological aspects) and the emotions triggered using a VR experience. To this end, Text-Mining and Sentiment Analysis have been employed to offer a more complete evaluation of the design of the virtual experience. The salient attributes along with the emotions derived from the use of the VR experience provide valuable information to improve the design of this experience.

From the most frequently discussed attributes in the online reviews extracted from the Van Gogh's virtual exhibition posted in TripAdvisor, six salient attributes of the VR experience are identified: immersion, presence, perception, cost, knowledge retention, and emotions. The salient attributes were classified into three categories: VR technical features, human factors, and performance features. The VR technical features are those derived by the VR technology employed; human factors are related to the psychological factors, such as the unique perception by individuals (Kim, Ritchie, McCormick, 2012), and the unique way of being affected by an external stimulus (the use of the technology) and internal stimuli (the desire for experiential travel, motivation) (Chung et al. 2015, 2018); and performance-oriented attributes include features related to the individuals' learning processes and perceived values (Chung et al. 2015; Kim and Chung 2017). Most of the features identified are also observed in other studies (Abadia, Calvert & Tauseef, 2018).

From the review of the literature, the effectiveness of the VR experience is related to the sense of presence and immersion. Presence is a key concept in any research where there is a human interaction with VR technology and represents the sense of being physically present at a virtual environment through the interaction with the technological system (Riva et al., 2006). However, immersion is widely related to the technological capacity of the system to decrease any stimuli from the real world and to increase stimulation due to the virtual environment (Coelho et al. 2006). While immersion is a "technology-oriented aspect" of VR, presence is a "human-based aspect", representing the psychological, perceptual, and cognitive consequences of immersion (Abadia, Calvert & Taussef, 2018; Herrera et al. 2018; Slater & Wilbur 1997). Both salient features are frequently discussed in the tourism

literature review (Beck, Raionoldi & Egger, 2019). Experiential perception (such as satisfaction and enjoyment) has also been studied in the tourism literature as a consequence of the salient features of VR technology (immersion, interaction, usability, illusion) (Wu et al. 2020).

Knowledge retention, as a salient feature in our study, also constitutes a learning outcome derived from VR experiences as observed in the tourism literature review (Leung et al. 2022). This study demonstrated that VR game training resulted in poorer immediate and long-term knowledge retention, unlike other studies (Lovereglio & Kinateder, 2020). Otherwise, it is interesting to observe that price is one of the salient features in the present study. This feature has been also found in Han, tom Dieck and Jung (2018). This study analyses the visitor experience when using augmented reality smart glasses (ARSG) at an art gallery in UK through a semi-structured interview. Participants showed concerns regarding the high price of wearable devices and revealed that the experience might be less attractive if the art gallery charged for their use. A similar perception is derived from those who visit the Van Gogh exhibition for whom the VR Experience cost is not included in the ticket price.

Other salient features considered as common in other studies are not displayed or appear only marginally in the online reviews from the Van Gogh VR experience. In particular, certain technological-oriented salient features when using VR, such as usability (Fang & Lin 2019; Wu, Ai & Chen, 2020) and system information quality (Wei 2019), which are used in other studies that conduct self-reporting measures, have not been displayed in the online-review data sets analysed. The human-related features, such as engagement, appear only a very limited number of times, unlike in other studies found in the literature review (Rather, Hollebeek & Hsan, 2023; Wagler & Hanus 2018). Embodiment, another popular salient attribute in the literature, also fails to appear in the online reviews of the Van Gogh exhibition.

Not only were the negative and positive connotations of the language unveiled by the results from sentiment analysis, but also the emotions derived from the online reviews of the VR experience. Although there is no final agreement on the number of basic emotions, most research refers to Ekman's six basic emotions (González-Rodríguez et al. 2020a, b): anger, joy, disgust, fear, sadness, and surprise (Ekman 1999). For the purpose of this study, these six basic emotions are employed together with the secondary emotions of anticipation and trust. These eight emotions represent the Plutchik's Circumflex Model of Emotions (Plutchik 1980).

The most frequent emotions are "joy" (with 528 total words/91 different words), "anticipation" (with 528 words/92 different words), and "trust" (with 510 words/102 different words) followed by "surprise" (with 289 words/42 different words), "sadness" (with 239 words/55 different words), "anger" (with 137 words/44 different words), "disgust" (with 91 words/39 different words), and "fear" (with 87 words/45 different words). Hence, the positive emotions of joy, anticipation, trust, and surprise prevail over the negative emotions of anger, disgust, fear, and sadness in terms of frequency.

"Anticipation" is the emotion someone experiences when they are expecting something to happen (either good or bad). The most frequent words that are identified with this emotion are, "exhibition" (art), "infrastructure" (St Mary's Church in York as the exhibition place), "cost" (in terms of time, money/pay), and "experiential perception" (good/lovely). The topics with the highest positive sentiment among those who participate in the VR experience for the emotion "joy" are church (infrastructure), art (exhibition), and experiential perception (enjoyment/good/lovely/wonderful/brilliant/animated). The emotion "anger" is displayed mainly for the words related to the extra price charged to enjoy the

VR experience (e.g., "money", "overpriced", "cash", and "fee"). Emotional trust is trusting behaviour driven by positive affect for the object of trust. From the online reviews, "recommend" as behavioural intention clearly explains the emotion, "trust". Other words motivating the emotion "trust" are related to the experiential perception (good/lovely/wonderful/brilliant/enjoy), presence (alive/presence), infrastructure (church), exhibition (show) and cost (money/pay).

A positive sentiment towards immersion is also observed from the technical-oriented feature of the VR experience, since it is mainly related to the emotions of "joy", "surprise", "anticipation", and "trust". The perceived value (cost) and the knowledge retentions are the themes with the highest negative sentiment among those who used the VR headset when visiting the Van Gogh exhibition. The majority of the participants in the exhibition indicate that the exhibition was not worth the money spent. These results are also found in Liu et al. (2022). The participants also revealed that they learnt little to add to their previous knowledge of Van Gogh's life and art.

From an illustrative approach, Fig. 3 displays the clouds of words that describe each of the eight emotions. Words related to knowledge retention (entertaining, knowledge) and positive experiential perception (glad/fun/inspiration) report the emotion of "anticipation". Words related to cost (overpriced) and negative experiential perception (rubbish/ruined/sickness/terrible) indicate the emotion of "disgust". Cost (money) and positive experiential perception (wonderful/lovely/spectacular) describe the emotion "surprise". "Joy" is reported by positive experiential perception (wonderful/excellent/brilliant), and presence (alive). Cost (overpriced) and negative experiential perception describes the emotion "anger". "Sadness" is mainly described by negative experiential perception ("disappointed"), while "fear" is largely described by the technical-oriented feature (immerse).

All the positive emotions trigger satisfaction with the visit, recommendation, and visit intention. The analysis of the polarity of the feeling provides knowledge regarding the influence of the positive and negative connotation of the language on individuals' responses. From the analysis, 80% of total words report positive emotions in contrast with 20% displaying negative emotions. Furthermore, the high degree of each individual's coherence between the ratings they provide to assess their satisfaction with the experience and the positive connotation they exhibit in the written text also deserves mention. This reveals that online reviews constitute worthy instruments for the evaluation of the individual's perception of the experience. Consequently, the experience with the Van Gogh exhibition has worked well, despite there being certain areas of improvement as highlighted by the presence of negative reviews.

Finally, is the evolution of the positive and negative connotations of the online reviews posted over time is particularly interesting for managers. As can be observed in Fig. 5, online reviews are aligned with a negative sentiment at the beginning of the exhibition. However, as time elapsed, the reviews display a positive sentiment until a saturation point is reached, where it turns back towards a neutral sentiment. This finding is particularly relevant for managers who must adapt the attraction continuously to meet customer expectations.

5.1 Theoretical and practical implications

The present research provides several implications for academics and practitioners. Previous studies on VR/AR experience have applied a variety of methodologies to assess the importance of salient attributes of the experience and of the technology itself and have

largely focused on the importance of ratings of various attributes through interviews or semi-structured interviews with the participants (Han, tom Dieck & Jung, 2018). However, the design and the responses of surveys involve unavoidable biases. First, when using a structured questionnaire, the salient attributes to be rated have previously been decided by the researcher from their knowledge of the topic. The participants are then asked to rate the importance of those attributes which have been selected for the questionnaire. Second, self-reporting measures have been traditionally employed to capture the most affective component of a VR experience, such as the emotions or sentiments triggered using technology for a vivid experience. However, these measures involve cognitive bias due to the respondents' conscious awareness of the emotion caused by a stimulus (González-Rodríguez et al. 2020a, b). In the online reviews, the participants write their comments freely without any pressure to respond to specific questions. Hence, not only does the use of online reviews enable the salient attributes, sentiments, and emotions of a VR experience to be identified, but it also avoids the typical bias inherent in surveys. The extraction of information regarding the salient features of a VR experience, and that of the emotions and sentiments from the online reviews together lead to gathering knowledge that is less biased than that uncovered by the structured questionnaire.

Hardly any studies in the literature use emotions as affective states to evaluate VR experiences (Felnhofer et al., 2015). Emotions constitute a complement of the technical-oriented features of VR that lead to the offering of a great experience. Text analytics and sentiment analysis ae widely recognised as providing valuable knowledge for business decisions from unstructured textual databases (Tussyadiah & Zach 2017; González-Rodríguez et al. 2020a, b). Hence, the present study contributes to the literature in tourism by analysing User Generated Content (UGC) both to create knowledge on the human-related and technology-related salient attributes and to recognise patterns in terms of emotions and sentiments triggered from a VR experience. These techniques are applied to better understand that which VR users gain from a cognitive and affective approach when participating in a VR tourism experience.

The findings of the study provide practitioners and service providers with a greater understanding of the strengths and weaknesses of the VR experience. The salient attributes and emotions analysed indicate the areas of investment so that high satisfaction can be reached with the experience and recommendations are boosted.

Practitioners must be made aware of the high-cost perception held by visitors to the Van Gogh exhibition. The fact that the museum charges a fee for the VR experience constitutes a weakness in the VR experience. As recognised by the reviewers, if the extra £3 charge for the VR headset were eliminated, then the reviews would improve dramatically.

Immersion and presence are recognised as the main interrelated features that allow for the evaluation of the effectiveness of VRs in providing a unique experience. These two attributes must be displayed in any VR experience for it to be successful. The better the VR technology displays all its sensory modalities, the more immersive the experience becomes (Goss & Sonnemann 2017; Wen et al. 2022), and hence the more the sense of presence appears as a human reaction to such an immersion. These two features appear only in certain online reviews since the VR headset is recognised as a truly immersive device that can lead someone to feel genuinely present in the virtual environment. However, these two features are missing in other reviews, particularly in those reviews that highlight the extra cost of using the VR experience.

Perception is another feature to be considered by practitioners and VR developers in the assessment of the effectiveness of the technology, especially for VR applications with narrative stories leading to the acquisition of knowledge. Perception in VR is usually

employed to describe how the information is extracted from the virtual environment and how the understanding or knowledge is built thereon. Despite the importance of this feature, it is also observed from VR online reviews that the users revealed that they had learnt very little to add to their previous knowledge.

Emotion constitutes a human-oriented aspect for the evaluation of a VR experience. Tourist destinations and the hospitality industry strive to provide tourists with memorable experiences that go beyond mere satisfaction. Thus, emotional responses might be employed to improve the design of VR attractions to result in a service of better quality.

Unlike studies that have utilised self-reporting questionnaires to measure immersion, presence, perception, emotions, and sentiment as the evaluation method for the VR experiences, online reviews provide practitioners and VR providers with constructive insights for the identification of the areas of investment which can lead to the high satisfaction of users.

5.2 Limitations and avenues of future research

Despite the aforementioned implications, this study suffers from several limitations that can be addressed in future research. The size of the data set might have an influence on the findings. Although the paper has extracted total reviews available at the time of the study, a bigger sample size might be beneficial in avoiding any potential bias towards positive/negative reviews. Any future analysis into the influence of the salient attributes and emotional states on satisfaction and behaviour intention with respect to the VR experience (recommendation, loyalty) should be conducted through supervised and non-supervised machine learning techniques. Future research into VR and behaviour intention should be more focused on information derived from online reviews of a VR experience rather than from the traditional surveys. Other approaches, such as word co-occurrence networks and review clusters can also be employed in order to enrich the study.

Declarations

Conflict of interest The authors report no conflict of interest.

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