

Han, D., Weber, J., Bastiaansen, M., Mitas, O., & Lub, X. (2018). Virtual and Augmented Reality Technologies to enhance the visitor experience in cultural tourism, M. Claudia tom Dieck & Timothy Jung (Eds.) *The Power of Augmented and Virtual Reality for Business*, Springer, Forthcoming.

## **Virtual and Augmented Reality Technologies to enhance the visitor experience in cultural tourism**

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### **Abstract**

Cultural tourism has been identified as an important economic and social contributor worldwide. Main drivers have been linked to an increasing desire for cultural awareness, meaning-creation and learning. An increasing body of research explores the application of VR and AR in this context. While previous studies outline VR and AR as promising technologies to positively influence the visitor experience, these typically do not focus on how such technologies should be built to suit the context or add value to tourists. This study investigates elements affecting the tourist experience in the cultural tourism context from a theoretical perspective by discussing the impact of VR and AR technology on the visitor's learning experience. It offers contributions in the area of cultural tourism and consumer psychology, discussing tourist sites mediated by engaging technologies to enhance the visitor experience. Further research is highlighted in the area of VR and AR development through purpose-driven design

**Keywords:** *cultural tourism, technology enhanced experience, virtual reality, augmented reality, visitor learning*

### **1 Introduction**

Cultural tourism has long been identified as an important economic and social contributor in Europe and globally (Richards, 1996), developing from a niche market to a key driver of tourism in a number of destinations. According to (McKercher, Wong

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& Lau, 2006), this development has been largely triggered by tourists seeking cultural awareness in form of meaning-creation and learning. As a result, numerous cultural tourist attractions have attempted to differentiate themselves by exploring opportunities to offer visitors an enhanced experience on site to amplify tourists' enjoyment. Self-motivated and self-guided learning was identified as one of the key motivators of visitors to engage with cultural tourism products (Ismagilova, Safiullin & Gafurov, 2015), suggesting a number of use cases to support tourists along the visitor journey. Self-motivated and self-guided learning have made noteworthy contributions in form of audio guides as well as more recent developments such as mobile applications that are able to present information and storytelling to the individual's pace and interest. However, as technology opens new opportunities to reshape the visitor experience, a number of studies have started to investigate the benefits of augmented (AR) and virtual reality (VR) applications in the cultural tourism context (Jung, Chung & Leue, 2015; Chung, Lee, Kim & Koo, 2017; Raptis, Fidas & Avouris, 2018).

Offering an added layer of virtual enhancement, AR and VR have been positioned as a promising tool in the cultural tourism context to enhance the tourist experience (Jung, tom Dieck, Lee & Chung, 2016). However, previous studies lack discussion on how AR and VR should be implemented for mass adoption and return on investment. As previous studies were exploratory, it is questionable whether a recommendation to invest in AR and VR is practical from an industry perspective. Because research outcomes have depended on prototype applications and demos, in-depth investigations of user interaction and impact on the visitor experience have been lacking. Thus, we lack the full picture on how AR and VR applications impact the visitor experience as a whole. A key question remains whether such technologies would help visitors to connect with cultural heritage or degrade the experience due to the added digital layer between the tourist and the cultural object, or technological challenges that prevent the unobtrusive interaction. Such developments need to be carefully designed in order to be perceived as meaningful and desirable for tourists.

This study aims to conceptually outline factors that shape the visitor experience in the cultural tourism context with a focus on the visitor's learning experience as key motivator for visiting cultural tourism destinations. Furthermore, the paper discusses how AR and VR technology development should be approached to ultimately enhance the overall visitor experience, linking consumer behaviour and psychological perspectives with the cultural tourism context in an attempt to bridge the two research areas with purpose-driven AR and VR development.

## **2 Literature Review**

### ***Cultural Tourism***

While cultural tourism has often been difficult to define due to the complex nature of the meaning of 'culture' (Richards, 1996; McKercher et al., 2006), Silberberg (1995) characterized cultural tourism as 'visits by persons from outside the host community motivated wholly or in part by interest in the historical, artistic, scientific or lifestyle/heritage offerings of a community, region, group or institution'. Cultural

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tourism, which was once considered as a niche market, has developed into a conventional building block for contemporary tourism and became a key driver for many tourists to travel. Thus, cultural tourism turned into an important economic and social contributor in Europe and globally (Richards, 1996) offering diverse products and services to a broad target audience.

Visitors' self-motivation of understanding and meaning making for cultural exposure in the context of foreign and own history motivates millions of tourists yearly to engage in cultural sites and destinations. Travelers created an appetite for authentic cultural experiences in heritage, ethnicity, cuisine, crafts, arts, and music, continues to expand. Cultural tourists are tourists who have interest in visiting heritage or cultural sites. According to different tourism studies (Silberberg 1995; Kerstetter, Confer & Graefe, 2001), they are believed to spend more than the average tourist, be highly educated, have a higher disposable income, be older and stay longer at a destination. However, culturally-motivated visits range from purposeful to incidental cultural travel. McKercher et al. (2006) distinguish between five cultural tourist categories: 1) Purposeful cultural tourists whose primary motivation for visiting a destination is to gain a deep cultural experiences; 2) sightseeing cultural tourists whose experiences are less deep but still primarily driven by culture; 3) serendipitous cultural tourists who do not travel for cultural reasons in the first place, but happen to have a deep cultural experience; 4) casual cultural tourists who do not have a particular motive and a shallow experience and finally 5) incidental cultural tourists which have no motive whatsoever to travel for culture and have very shallow experiences.

While Liu (2014) argues that the growing cultural tourism segment can be attributed to a growing demand for travel driven by economic growth, Falk et al. (2012) and Ismagilova et al. (2015) suggest that cultural tourism has often been linked to an increasing desire for cultural awareness and learning. Altunel and Erkut (2015) agree that learning, enjoyment and escape are the main factors determining the visitor experience in heritage destinations. In this sense, it is important to understand the whole tourism experience when visiting a cultural destination – what are the needs and motivations of a visitor and can culture, meaning making and learning be made more accessible?

Recently, experiential and participative tourism activities stimulated by arts, authentic artefacts, local festivals and cultural attractions allow tourists to engage in and witness extraordinary experiences (Rojek, 1997). Nevertheless, cultural visitors primarily prefer to see historic sites, buildings and monuments where they are seeking to encounter historic places (Hall & Zeppel, 1990). According to Brida et al. (2016), most museum visitors are searching for a 'light consumption' experience. Thus, people are not particularly interested in culture outside their travel experience. Serendipitous and casual cultural visitors find it difficult to connect to presented cultural artefacts. Some tourism scholars (Chang, Backman & Huang, 2014) propose a more creative and engaging form of tourism by integrating tourists in an active, long-lasting form of experience.

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### ***Visitor Experience***

Grounded in early psychological research (see Jantzen, 2013 for an extensive review), experience has been an essential object of study in tourism research (e.g. Arnould & Price, 1993; Beedie & Hudson, 2003; Sims, 2009; Tan, Kung & Luh, 2013; Tsaor, Yen & Hsiao, 2013; Zajchowski, Schwab & Dustin, 2016; for review, see Scott & Le, 2017). The reason for this is twofold. First, the experience of the (cultural) tourist is of essential importance to the cultural tourism industry, as experience is the core economic offering in tourism, and adds substantial economic value (Pine & Gilmore, 1998). Second, the tourist experience has been of interest to academics as it is the main pull factor for tourism destinations, heritage sites and related cultural venues, and additionally because of its demonstrable relationship with psychological well-being and quality of life (Fredrickson, 1998, 2000).

### ***Elements affecting the visitor experience***

The interest in the tourist experience has led academics to search for the core elements that define or constitute an experience. As reviewed by Scott and colleagues (Scott & Le, 2017), besides the physical context of the heritage site or destination – the stage on which the experience takes place—a number of prime candidates have been identified: *Attention* directs our mental resources to stimuli that are perceived as being salient. *Involvement* refers to a person's level of interest and personal relevance in relation to the staged offerings at a site or destination; *Engagement* is a complex construct involving multiple mental processes, all related to the feeling of being 'in the moment'; *Immersion* is the sensation of being surrounded by a completely different reality, and is most prominently studied in the context of gaming and virtual reality (Ermi & Mäyrä, 2005). Finally, there is the related notion of *cognitive absorption*, conceptually close to flow (Csikszentmihalyi, 1990), in which five dimensions are distinguished: temporal dissociation, attentional focus, increased enjoyment, personal control and curiosity. Besides these well-established constituent elements of tourist experiences, more recently there has been a growing awareness of the importance of *emotions* in shaping tourist experiences and in making them memorable (Li, Scott & Walters, 2014; Moyle, Moyle, Bec & Scott, 2017; Skavronskaya et al., 2017). Hooper-Greenhill et al. (2003) among others investigated factors that increase the retention of information and enhance learning in the cultural tourism context due to emotional connectedness. According to Bond (2014), active visitor engagement was identified as key driver of improved information retention.

### ***Visitor engagement for enhanced learning experience***

According to Hooper-Greenhill et al. (2003), learning was argued to influence the development of attitudes and values, while emotions positively influenced the desire to acquire knowledge. This view closely follows Kolb's definition of learning, as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984:38) and the suggested attachment of the learner's emotions. While learning is often seen as a lifelong process, Minocha et al. (2017) suggest that the learning process entails reflective observation as well as active experimentation, both of which affect

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the overall learning experience and are closely linked to the learner's emotions. While the Experiential Cycle (Kolb, 1984) is a useful tool to study the implementation of technology to enhance the learning experience, it also identifies a need to clearly understand the factors that shape the learner's experience. Ultimately, understanding how emotions affect the concrete experience and abstract conceptualization of the learning process is vital to attain a better grasp of what the learning experience entails.

Implementation of technology to support the learning process was recognized as an opportunity to redefine innovative learning possibilities. However, Bond (2014) argued that implementation alone was not sufficient to make a measurable impact on the learning experience of users. Instead, user interaction had to be carefully designed to encourage engagement of the learner with the provided content and result in an enhanced learning outcome. Stewart (2014) similarly suggested that technology should support concentration and motivation of learners to achieve the desired result. Naturally, development of emerging technologies such as AR and VR requires in-depth investigation how these can enhance the learning experience in a cultural tourism context.

## ***AR & VR***

AR and VR have received a lot of attention since being introduced in the consumer market through devices such as Oculus Rift, Google Cardboard or Magic Leap Lightwear. However, according to Bonetti et al. (2018), AR as well as VR have already been implemented in a number of industry contexts. While both types of technology are often packaged into the frame of 'mixed reality', it needs to be recognized that each has its unique approach to generating a virtual enhancement of reality and deserve to be considered individually for purposeful development and implementation. AR was defined as the overlay of computerized information that is projected into the view of the user through devices such as smartphones, tablet computers and wearable devices such as AR glasses (Rauschnabel and Ro, 2016). In this form, AR can be categorized into two key pillars, marker-based and GPS-based AR. While GPS-based augmentation of the real environment seems to be the logical method of AR implementation for tourism purposes, it was argued to lack sufficient accuracy as well as processing power of current devices to project meaningful AR overlays to enhance the tourist experience (Gherghina et al., 2013). On the other hand, marker-based AR enhancements are triggered through 'markers' that bind virtual content to specific objects or pictures and were therefore regarded the more accessible form of AR enhancements. Apart from mobile-based AR applications, site-based AR was mentioned as a third form of AR, which uses fixed installations at certain locations such as theme parks and retail outlets, enabling virtual augmentations for on-site users (Williams & Mascioni, 2017). In contrast to AR, VR uses a computer-generated environment to completely immerse the user into a virtual world (Tussyadiah et al., 2018). VR has received more attention due to the exploding amount of demos and applications, both in form of CG animated as well as 360-degree virtual environments particularly in the gaming and entertainment sector. However, it has made little impact in the consumer market relative to expectations and predictions (Abrash, 2016), despite the increasing amount of use cases in theme parks or other tourist destinations. Underlying reasons might be the previously

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largely limited accessibility to consumers due to the need of using a set of VR-glasses or VR-enabling headset such as Samsung Gear VR or Google Cardboard using high-end smartphones, or the currently limited value that VR can provide compared to the required financial investment. A number of cultural tourism providers have attempted to implement AR and VR in their context to enhance the visitor experience and attract more tourists.

### ***AR, VR use cases and prior studies in cultural tourism***

Many cultural tourism sites such as art galleries, museum or cultural heritage sites have discovered AR and VR in the past few years. They have enhanced their visitor experiences with innovations ranging from virtual enhancements to re-live historical sites and events, engage with content in museums, or to visit remote destinations in virtual environments. Whereas most AR/VR experiences start off as a research or pilot project (Fino, Martín-Gutiérrez, Fernández & Davara, 2013; Fritz, Susperregui & Linaza, 2005; Han, Jung & Gibson, 2013), some have recently expanded and commercialized. Cultural heritage sites and destinations follow different strategies in implementing AR/VR.

A recent study of Marasco et al. (Marasco, Buonincontri, van Niekerk, Orłowski & Okumus, 2018) examined the potential of VR to increase destination competitiveness. The study revealed a positive and significant effect of visual appeal (PVA) of VR and emotional involvement (EI) on tourists' behaviour visiting a cultural heritage site. Appealing visuals and emotional triggers in VR applications allegedly increase likelihood of visiting cultural sites, as AR/VR often portrays an optimal virtual representation of the real experience. AR and VR can also increase cultural tourism accessibility. Cultural sites welcome a more diverse target group, with different interests. To stay attractive for visitors, new technologies are often key for visitor engagement. A recent study from Puyuelo et al. (Puyuelo, Higón, Merino & Contero, 2013) analysed AR as a tool to increase accessibility to architectural and cultural monument sites. The AR application supported the understanding of a UNESCO World Heritage location by letting users identify and visualise 3D models. The experience was positively evaluated, reporting a more engaged experience in terms of aesthetic and figurative appeal, enjoyment, and interactivity.

Industry is following these research pioneers, implementing VR on a large scale by launching these technologies mostly as interactive storytelling platforms engaging visitors in tourist attractions or urban destinations. Thirty-five major art museums in France cooperate in the project *eMotion* to animate art exhibitions and let the visitor travel around the world. Animated characters come to life in a symbiosis of photo, art, and digital animation to tell stories and let the visitor explore the virtual world (De Paola, 2018). Commercial projects often aim at engaging potential visitors in the pre-travel phase to trigger their interest. Microsoft's HoloMaps and HoloTour, for instance, uses 360-degree video content and spatial sound to encourage the user to move around the CG-augmented places such as Machu Picchu or the Colosseum in Rome without traveling to the actual location (Microsoft, 2017). However, as the HoloLens AR headset, which delivers these experiences, might not be yet affordable for mainstream

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tourism applications, other commercial projects using VR make use of cheaper headsets such as Google Daydream View headset or Cardboard. The *Discovery TRVLR* application from Google and Discovery Communications try to address a bigger audience with their VR experiences. The project aims to make remote locations more accessible by inviting the virtual traveller to follow a local host in spectacular tour guides (Discovery VR, 2018). Other early adopters, largely developing VR experiences on the HTC Vive, have access to much of the VR travel content, ranging from a Grant Canyon CR Experience to Stonehenge VR Sandbox (Steam 2017a, 2017b).

### **Proposed Framework**

Based on the reviewed literature, we propose the following conceptual framework. In this framework, the final aim is defined in the cultural tourism context as the overall learning experience of the visitor. The framework adapts the Experiential Cycle (Kolb, 1984) to define the effect of AR and VR implementations on the visitor's learning experience. In this regard, the concrete experience, which was defined by Kolb and Kolb (2005) by sensory and post-sensory experience of the visitor, is linked to the visitor's emotional attachment of the learning experience. Thus, emotions are needed to solidify the impact on the overall learning experience and therefore should be clearly understood to avoid creating negative emotions in the process, which influences the overall experience. Furthermore, we propose that active experimentation is triggered by the degree of visitor engagement with the tourism product. The higher the visitor engagement, the higher the impact on the learning experience by means of increased active experimentation. AR and VR implementation has therefore a high potential to influence the degree of visitor engagement through the interactive user experience the technology can provide. Furthermore, AR could potentially produce means of enhancing reflective observation through virtual enhancements. As abstract conceptualization in the Experiential Cycle (Kolb, 1984) was regarded a process that takes place within the individual, it is not further discussed in this paper. Nonetheless, to develop and implement AR and VR technology meaningfully in the cultural tourism context, it is vital to understand the benefit this technology will provide for the end-user. In the case of employing AR and VR in the cultural tourism context, it is therefore imperative to understand what the underlying tourist motivations to visit the destination entail. Potential applications need to be developed to support tourists' motivations and should not be developed separately from the overall experience. The need to understand how emotions affect the learning experience and the resulting overall tourist experience in the cultural tourism context is often overlooked, despite being a crucial element in the learning process.

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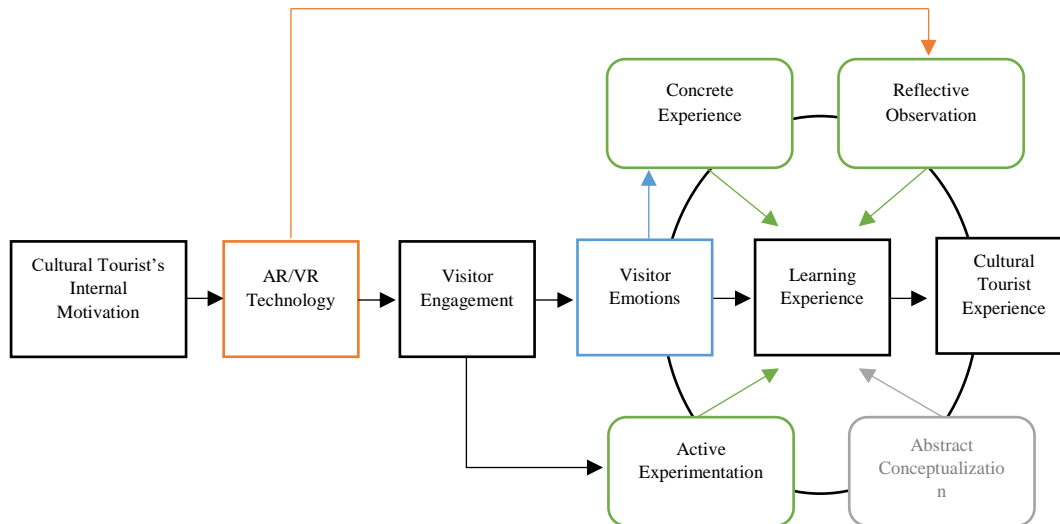


Figure 1: Conceptual Framework for AR/VR impact on the learning experience of cultural tourism visitors

## Discussion

This paper aimed to investigate elements affecting visitor experience in the cultural tourism context by discussing the impact of VR and AR technology and the resulting paradoxical effects on the overall experience in the cultural tourism context. In this discussion we reflect on five elements: 1) the importance of customer-centric design; 2) the objective of technology implementation; 3) technological issues with AR/VR implementation; 4) effects of AR/VR on the visitor experience and 5) the increasing use of EEG and physiology in measuring experiences

### *The importance of consumer-centric design of visitor experiences*

As pointed out previously in this paper, tourists are increasingly seeking authentic and meaningful visitor experiences. Although the degree of sought meaningfulness and authenticity may differ between tourist groups (McKercher et al., 2006), it seems that in many cases the authenticity and meaningfulness are more in the eye of the beholder, the visitor. As Wang (2000) pointed out, many visitors are seeking a specific form of authenticity in the locations they visit, namely existential authenticity. What this means is that not so much the objective authenticity of the touristic object matters, but the way in which it helps visitors to create their own idiosyncratic, meaningful authentic experience. This means that in presenting the touristic object, one should carefully consider how this object creates meaning for the visitor, how it connects to his/her values and enables the visitor to create his/her own version of the experience. This is where customer-centric design becomes highly relevant, and in particular so-called user empathy -finding out what truly matters to the visitor at the level that the visitor may not even be consciously aware (Koupric & Visser, 2009). Having this deeper level of



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understanding allows AR/VR designers to build emotionally engaging layers to enhance the experience of cultural tourism sites.

***Objective of technology implementation – need for meaningful design of emerging consumer technologies such as AR/VR***

Technology has continuously enhanced human life, making processes faster, more effective, convenient and accessible. However, when looking at early stages of consumer technologies until mass adoption, a common cycle can be observed time and time again (Weaver et al., 2017). While early studies are often focussed on the capabilities of an emerging technology to get a full grasp on how the technology performs, later studies tend to change the focus to take a larger perspective on the potential value emerging technology can provide. Considering AR and VR research, it is time we investigate how the technology will benefit consumers, industry and other stakeholders, and think about specific value propositions that can be realised through meaningful design of AR and VR applications. While firms are still often responsible to design and stage consumer experiences in meaningful ways through proper understanding of customer needs and wants, a shift towards value co-creation by peers is becoming more evident. Particularly with interactive consumer technologies such as AR and VR, we propose in the conceptual framework that visitor engagement plays a crucial role in the aim of influencing the cultural tourist experience. Prebensen (2013) supported this view suggesting that customers should be part of the value creating process in order to create meaningful experiences for themselves. However, the value that AR and VR are promising to provide needs to be clearly understood and relevant for the tourists' context to encourage use of the application and ultimately influencing the cultural tourist experience.

While a number of studies are highlighting the potential that AR and VR can provide in the cultural tourism context, it is not clear at what stage in the visitor journey this technology is indeed sought after by visitors and what the economic and non-economic benefits entail for other stakeholders. A number of papers have highlighted the technological challenges that are still evident with AR and VR technologies (Han et al., 2018; tom Dieck & Jung, 2018) and will therefore not be explicitly indicated here. However, it needs to be understood that technological challenges such as inconsistent interaction are not only challenges for user interaction, but detrimental for the tourist experience. In an industry that promotes itself as dealing with 'experiences', a small glitch in a visitor application could potentially have a much higher cost of damage than the understandably underwhelming AR or VR experience. In order to understand how and where AR and VR will influence the tourist experience, the visitor journey needs to be fully understood. Therefore, we propose that contextual information will play a key role in defining and designing the added value of AR and VR enhancements. Comparing AR and VR use cases in tourism and retail, it can be observed that two rather different stages of the customer journey are tackled. While AR and VR studies in tourism often explore how the visitor experience can be enhanced at the tourist site (Jung et al., 2016; Chung et al., 2017), studies in the retail industry largely explore the use of AR and VR in the pre-purchase stage, more specifically in the product selection process (Bonetti et al., 2018). Evidently, studies in tourism are focused on the 'tourist

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experience', however, we should keep in mind that the experience is not limited to the activities and engagement on-site, but have a much wider scope before and after that is able to influence the overall perception and memories of visitors. Furthermore, it seems rather contradicting that AR and VR implementation is studied on-site at a time when tourists are looking to engage with the destination or attraction. Considering the internal motivation of visitors to make the effort and travel to specific tourist sites to learn, be inspired and get emotionally attached (Falk et al., 2012), it is questionable whether implementing an application to be interacted by means of a device such as smartphones or headsets is the logical solution. Arguably, this is creating an additional barrier between tourists and tourism product, which potentially prevents the establishment of a deeper connection and is rather detrimental to the tourists' internal motivation. This of course does not propose that AR and VR implementation should be avoided on-site. However, it is crucial to understand and consider tourist motivations such as the intention to learn and the value that such technologies can provide along other touchpoints of the visitor journey, in order to create meaningful applications that will ultimately enhance and not deter the cultural tourist experience. To measure how the tourist experience is actually affected, we propose the use of EEG and physiology as complementing methods to get a clearer indication on what is actually happening at the time of experience consumption when interacting with technology such as AR and VR that supposedly enhance the visitor experience.

### ***Increasing use of EEG & physiology for measuring experiences in addition to reflective indications***

As discussed in the section on visitor experience, there has been a growing awareness that emotions play an essential role in shaping the tourist experience, and in making experiences meaningful and memorable (Li et al., 2014; Moyle et al., 2017; Skavronskaya et al., 2017). This in turn has led academics to consider which experience measurement tools would be most effective in capturing the emotional dimension of experience (Li et al., 2014). To date the dominant research methodology has been to rely on post-experience self-reports in the form of questionnaires or interviews. However, one may question whether relying exclusively on these traditional research techniques constitutes the optimal research methodology for measuring the emotions that create memorable experiences. It has been argued (see Larsen & Fredrickson, 1999 for extensive discussion) that self-reports inherently fail to fully capture the essential emotional dynamics of experiences in a sufficiently valid manner (Larsen & Fredrickson, 1999). In order to overcome these methodological shortcomings, and to more fully and validly capture the ebb and flow of emotions as an experience unfolds over time, researchers in the field of tourism are increasingly using biometric (physiological) measures as well as recordings of brain activity.

Physiological measures such as Skin Conductance Responses (SCR) and Heart Rate Variability (HRV) have long been used in psychological research as proxies of emotional arousal (Appelhans & Luecken, 2006; Bradley, Miccoli, Escrig & Lang, 2008), and can nowadays be reliably recorded with wearable devices (e.g. wristbands). This technological development allows for reliable emotion measurements as tourists are freely walking around and are experiencing a destination or cultural heritage site,

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and therefore has become an accessible and affordable tool for scholars in tourism research. Consequently, these tools are increasingly being used by researchers in our field. For example, Kim and Fesenmaier (Kim & Fesenmaier, 2015) measured the SCR of two heritage tour participants in the city of Philadelphia and linked a descriptive qualitative analysis of these data to their verbal descriptions of the experience. Li et al. (Li et al., 2012) studied HR along with self-reports of emotions while tourists were interacting with macaques in a Chinese natural park, and found both indicators to reveal positive responses to these interactions. Tröndle and colleagues conducted a large-scale study on museum visitors (Tschacher et al., 2012) in which they continuously measured HR and SCR in more than 500 visitors while their exact location was tracked. It enabled them, amongst others, to make ‘emotion maps’ of the museum floorplan (Tröndle, Greenwood, Kirchberg & Tschacher, 2014), and to identify emotional responses to individual artworks (Tröndle & Tschacher, 2012).

Recordings of electrical brain activity (electroencephalography, or EEG) also reliably measure emotional responses (Hajcak, Weinberg, MacNamara & Foti, 2012; Harmon-Jones, Gable & Peterson, 2010). They offer greater precision than the physiological measures discussed in the previous paragraph, at the expense of only being usable in a laboratory setting. Ongoing work in our research group is seeking to validate the use of so-called frontal alpha EEG asymmetry (which is a continuous EEG-based measure of positive and negative emotions; Harmon-Jones et al., 2010) in experience research. In this project, short VR movies (durations ranging from three to 14 minutes), delivered through Samsung VR Gear equipment, were used to engage research participants in an immersive experience. Preliminary analyses show that, amongst others, there are significant correlations between valence ratings and frontal alpha asymmetry. These findings validate EEG as a tool to study, with sub-second resolution, the succession of positive and negative emotions during an experiential episode, which bypasses the use of self-reports.

As said, a major limitation of EEG as a tool for measuring emotions during a tourist experience is that it can only be reliably recorded in a lab setting. It is precisely here that we see a great potential advantage of combining EEG measurements with AR/VR technology, as this technology allows for immersing tourists and visitors in realistic, ecologically valid experiences while at the same time being in a well-controlled laboratory condition. EEG is therefore a potentially very useful tool for AR/VR experience design and optimization: it can be used for evaluating the emotional contents of an AR/VR experience, and by systematically varying elements of the AR/VR experience and subsequently optimizing the design, it allows for truly evidence-based AR/VR experience design.

## **Conclusion**

The aim of the present paper was to examine the connection between AR/VR and the visitor experience of cultural tourism attractions. Cultural tourism institutions are increasingly implementing technologies such as AR and VR. Academic research on these experiences is in a nascent stage, and is in need of theoretical development. Based on the Experiential Cycle of Kolb (1984), we have proposed a theoretical model for

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understanding the visitor experience of AR/VR in the context of cultural tourism. This model implies the need for further research into appropriate measurement methodologies of these experiences. Biometric methods such as EEG and wearable measurement of peripheral emotion physiology holds particular promise herein. Furthermore, additional research is needed to develop existing theories of cultural tourism to keep pace with the technological landscape. The AR/VR technologies discussed, the software they use, and the cultural tourism experiences they can support are becoming increasingly accessible and, therefore, increasingly widespread. It is reasonable to predict that AR and VR will soon be seen as common dimensions of cultural tourism experiences. It is our urging that academic research in cultural tourism should keep pace.

## References

- Abrash, M. (2016). Welcome to the Virtual Age. Blog [Online] <https://www.oculus.com/en-us/blog/welcome-to-the-virtual-age>.
- Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of General Psychology*, 10(3), 229-240. doi: 10.1037/1089-2680.10.3.229
- Arnould, E. J., & Price, L. L. (1993). River magic: Extraordinary experience and the extended service encounter. *Journal of consumer Research*, 20(1), 24-45.
- Beedie, P., & Hudson, S. (2003). Emergence of mountain-based adventure tourism. *Annals of tourism research*, 30(3), 625-643.
- Bond, E. (2014). *Childhood, mobile technologies and everyday experiences: changing technologies = changing childhoods?* Hampshire, Palgrave Macmillan.
- Bonetti, F., Warnaby, G., & Quinn, L. (2018). Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda. *Augmented Reality and Virtual Reality*, 119-132.
- Bradley, M. M., Miccoli, L., Escrig, M. A., & Lang, P. J. (2008). The pupil as a measure of emotional arousal and autonomic activation. *Psychophysiology*, 45(4), 602-607. doi: 10.1111/j.1469-8986.2008.00654.x
- Brida, J. G., Dalle Nogare, C., & Scuderi, R. (2016). Frequency of museum attendance: motivation matters. *Journal of Cultural Economics*, 40(3), 261-283.
- Chang, L. L., Backman, K. F., & Huang, Y. C. (2014) Creative tourism: a preliminary examination of creative tourists' motivation, experience, perceived value and revisit intention. *International Journal of Culture, Tourism and Hospitality Research*, 8(4), 401-419.
- Chung, N., Lee, H., Kim, J. Y., & Koo, C. (2017). The role of augmented reality for experience-influenced environments: the case of cultural heritage tourism in Korea. *Journal of Travel Research*, 0047287517708255.
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal performance*: New York: Harper and Row.
- De Paola, F. (2018). La destination France s'anime en realite augmentee [Online] <https://www.lechotouristique.com/article/la-france-se-montre-en-realite-augmentee>.
- Discovery VR (2018). Travel the world from the edge of your seat [Online] <https://www.discoveryvr.com>
- Ermi, L., & Mäyrä, F. (2005). Fundamental components of the gameplay experience: Analysing immersion. *Worlds in play: International perspectives on digital games research*, 37(2), 37-53.
- Falk, J. H., Ballantyne, R., Packer, J., & Benckendorff, P. (2012). Travel and learning: A neglected tourism research area. *Annals of Tourism Research*, 39(2), 908-927.

- Han, D., Weber, J., Bastiaansen, M., Mitas, O., & Lub, X. (2018). Virtual and Augmented Reality Technologies to enhance the visitor experience in cultural tourism, M. Claudia tom Dieck & Timothy Jung (Eds.) *The Power of Augmented and Virtual Reality for Business*, Springer, Forthcoming.
- Fino, E. R., Martín-Gutiérrez, J., Fernández, M. D. M., & Davara, E. A. (2013). Interactive tourist guide: Connecting web 2.0, augmented reality and QR codes. *Procedia Computer Science*, 25, 338–344. <https://doi.org/10.1016/j.procs.2013.11.040>
- Fredrickson, B. L. (1998). What good are positive emotions? *Review of general psychology*, 2(3), 300.
- Fredrickson, B. L. (2000). Extracting meaning from past affective experiences: The importance of peaks, ends, and specific emotions. *Cognition & Emotion*, 14(4), 577-606.
- Fritz, F., Susperregui, A., & Linaza, M. (2005). Enhancing cultural tourism experiences with augmented reality technologies. *The 6th International Symposium on Virtual Reality Archaeology and Cultural Heritage VAST*, 20–21. Retrieved from <http://public-repository.epoch-net.org/publications/VAST2005/shortpapers/short2005.pdf>
- Gherghina, A., Olteanu, A. C., & Tapus, N. (2013). A marker-based augmented reality system for mobile devices. *Roedunet International Conference (RoEduNet)*, 2013, 1-6.
- Hajcak, G., Weinberg, A., MacNamara, A., & Foti, D. (2012). ERPs and the study of emotion. *Oxford handbook of event-related potential components*.
- Han, D.-I., Jung, T., & Gibson, A. (2013). Dublin AR: Implementing Augmented Reality in Tourism. In Z. Xiang & I. Tussyadiah (Eds.), *Information and Communication Technologies in Tourism 2014* (pp. 511–523). Cham: Springer International Publishing.
- Han, D. I., tom Dieck, M. C., & Jung, T. (2018). User experience model for augmented reality applications in urban heritage tourism. *Journal of Heritage Tourism*, 13(1), 46-61.
- Harmon-Jones, E., Gable, P. A., & Peterson, C. K. (2010). The role of asymmetric frontal cortical activity in emotion-related phenomena: A review and update. *Biological psychology*, 84(3), 451-462.
- Hooper-Greenhill, E., Dodd, J., Moussouri, T., Jones, C., Pickford, C., Herman, C., Morrison, M., Vincent, J., & Toon, R. (2003). *Measuring the Outcomes and Impact of Learning in Museums, archives and Libraries*, Research centre for Museum and Galleries, University of Leicester, 1-24.
- Ismagilova, G., Safullin, L., & Gafurov, I. (2015). Using historical heritage as a factor in tourism development. *Procedia-Social and Behavioral Sciences*, 188, 157-162.
- Jantzen, C. (2013). Experiencing and experiences: A psychological framework. In J. Sundbo & F. Sørensen (Eds.), *Handbook on the experience economy* (pp. 146-170). Cheltenham: Edward Elgar.
- Jung, T., Chung, N., & Leue, M. C. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism management*, 49, 75-86.
- Jung, T., tom Dieck, M. C., Lee, H., & Chung, N. (2016). Effects of virtual reality and augmented reality on visitor experiences in museum. In *Information and Communication Technologies in Tourism 2016* (pp. 621-635). Springer, Cham.
- Kim, J., & Fesenmaier, D. R. (2015). Measuring emotions in real time: Implications for tourism experience design. *Journal of Travel Research*, 54(4), 419-429.
- Kolb, D.A. (1984). *Experiential Learning: Experience as the source of learning and development*. New Jersey: Pearson Education.
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, 4(2), 193-212.
- Koupric, M., & Visser, F. S. (2009). A framework for empathy in design: stepping into and out of the user's life. *Journal of Engineering Design*, 20(5), 437–448.
- Larsen, R. J., & Fredrickson, B. L. (1999). Measurement issues in emotion research.
- Li, J., Yang, D., He, L., Tao, S., Zeng, L., & Buckley, R. (2012). Psychological, physiological and behavioural responses of tourists to interactions with rhesus macaques at Zhangjiajie, China. *Journal of Ecotourism*, 11(3), 202-206.
- Li, S., Scott, N., & Walters, G. (2014). Current and potential methods for measuring emotion in tourism experiences: a review. *Current issues in Tourism*. doi: <http://dx.doi.org/10.1080/13683500.2014.975679>

- Han, D., Weber, J., Bastiaansen, M., Mitas, O., & Lub, X. (2018). Virtual and Augmented Reality Technologies to enhance the visitor experience in cultural tourism, M. Claudia tom Dieck & Timothy Jung (Eds.) *The Power of Augmented and Virtual Reality for Business*, Springer, Forthcoming.
- Marasco, A., Buonincontri, P., van Niekerk, M., Orłowski, M., & Okumus, F. (2018). Exploring the role of next-generation virtual technologies in destination marketing. *Journal of Destination Marketing and Management*, (December 2016), 0–1. <https://doi.org/10.1016/j.jdmm.2017.12.002>
- McKercher, B., Wong, C., & Lau, G. (2006). How tourists consume a destination. *Journal of Business Research*, 59(5), 647–652.
- Microsoft (2017). HoloTour. Microsoft [Online] <https://www.microsoft.com/en-us/hololens/apps/holotour>.
- Minocha, S., Tudor, A. D., & Tilling, S. (2017). Affordances of Mobile Virtual Reality and their Role in Learning and Teaching. *Proceedings of British HCI 2017 – Digital Make Believe*, Sunderland, UK, BCS Learning and Development Ltd.
- Moyle, B. D., Moyle, C.-I., Bec, A., & Scott, N. (2017). The next frontier in tourism emotion research. *Current Issues in Tourism*, 1-7.
- Pine, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard business review*, 76, 97-105.
- Prebensen, N. K. (2013). Value Co-Creation significance of tourist resources. *Annals of Tourism Research*, 42, 240-261.
- Puyuelo, M., Higón, J. L., Merino, L., & Contero, M. (2013). Experiencing augmented reality as an accessibility resource in the unesco heritage site called “la lonja”, valencia. *Procedia Computer Science*, 25, 171–178. <https://doi.org/10.1016/j.procs.2013.11.021>
- Raptis, G. E., Fidas, C., & Avouris, N. (2018). Effects of mixed-reality on players’ behaviour and immersion in a cultural tourism game: A cognitive processing perspective. *International Journal of Human-Computer Studies*.
- Rauschnabel, P. A., & Ro, Y. K. (2016). Augmented reality smart glasses: An investigation of technology acceptance drivers. *International Journal of Technology Marketing*, 11(2), 123-148.
- Richards, G. (Ed.). (1996). *Cultural tourism in Europe*. Cab International.
- Rojek, C. (2002). Indexing, dragging and the social construction of tourist sights. In *Touring cultures* (pp. 62-84). Routledge.
- Scott, N., & Le, D. (2017). Tourism experience: a review. In N. Scott, J. Gao & J. Y. Ma (Eds.), *Visitor Experience Design* (Vol. 5): CABI.
- Silberberg, T. (1995). Cultural tourism and business opportunities for museums and heritage sites. *Tourism Management*, 16(5), 361–365. [https://doi.org/10.1016/0261-5177\(95\)00039-Q](https://doi.org/10.1016/0261-5177(95)00039-Q).
- Sims, R. (2009). Food, place and authenticity: local food and the sustainable tourism experience. *Journal of sustainable tourism*, 17(3), 321-336.
- Skavronskaya, L., Scott, N., Moyle, B., Le, D., Hadinejad, A., Zhang, R., Gardiner, S., Coghlan, A., & Shakeela, A. (2017). Cognitive psychology and tourism research: state of the art. *Tourism Review*, 72(2), 221-237.
- Steam (2017a) Stonehenge VR Experience Sandbox [Online] [https://store.steampowered.com/app/457650/Stonehenge\\_VR\\_SANDBOX/](https://store.steampowered.com/app/457650/Stonehenge_VR_SANDBOX/)
- Steam (2017b) The Grand Canyon VR Experience [Online] [https://store.steampowered.com/app/407710/The\\_Grand\\_Canyon\\_VR\\_Experience/](https://store.steampowered.com/app/407710/The_Grand_Canyon_VR_Experience/)
- Stewart, N. (2014) *Active Learning*. In H. Moylett (Ed). *Characteristics of effective early learning: helping young children become learners for life*. Maidenhead: Open University Press
- Tan, S.-K., Kung, S.-F., & Luh, D.-B. (2013). A model of ‘creative experience’ in creative tourism. *Annals of Tourism Research*, 41, 153-174.
- tom Dieck, M. C., & Jung, T. (2018). A theoretical model of mobile augmented reality acceptance in urban heritage tourism. *Current Issues in Tourism*, 21(2), 154-174.
- Tröndle, M., Greenwood, S., Kirchberg, V., & Tschacher, W. (2014). An integrative and comprehensive methodology for studying aesthetic experience in the field: Merging movement tracking, physiology, and psychological data. *Environment and Behavior*, 46(1), 102-135.

Han, D., Weber, J., Bastiaansen, M., Mitas, O., & Lub, X. (2018). Virtual and Augmented Reality Technologies to enhance the visitor experience in cultural tourism, M. Claudia tom Dieck & Timothy Jung (Eds.) *The Power of Augmented and Virtual Reality for Business*, Springer, Forthcoming.

- Tröndle, M., & Tschacher, W. (2012). The physiology of phenomenology: The effects of artworks. *Empirical Studies of the Arts*, 30(1), 75-113.
- Tsaur, S. H., Yen, C. H., & Hsiao, S. L. (2013). Transcendent experience, flow and happiness for mountain climbers. *International Journal of Tourism Research*, 15(4), 360-374.
- Tschacher, W., Greenwood, S., Kirchberg, V., Wintzerith, S., van den Berg, K., & Tröndle, M. (2012). Physiological correlates of aesthetic perception of artworks in a museum. *Psychology of Aesthetics, Creativity, and the Arts*, 6(1), 96.
- Tussyadiah, I. P., Wang, D., Jung, T. H., & tom Dieck, M. C. (2018). Virtual reality, presence, and attitude change: Empirical evidence from tourism. *Tourism Management*, 66, 140-154.
- Wang, N. (2000). *Tourism and Modernity: A Sociological Analysis*. Oxford, UK: Pergamon.
- Weaver, P., Jansen, L., Van Grootveld, G., Van Spiegel, E., & Vergragt, P. (2017). *Sustainable technology development*. Routledge.
- Williams, K., & Mascioni, M. (2017). *The out-of-home immersive entertainment frontier: Expanding interactive boundaries in leisure facilities*. Routledge.
- Zajchowski, C. A., Schwab, K. A., & Dustin, D. L. (2016). The Experiencing Self and the Remembering Self: Implications for Leisure Science. *Leisure Sciences*, 1-8.