Virtual reality, presence, and attitude change: Empirical evidence from tourism

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HIGHLIGHTS

- Sense of presence during VR leads to positive attitude change toward destination.
- The effect of presence on enjoyment of VR confirms VR as hedonic experience.
- Change in attitude leads to visit intention, confirming the persuasiveness of VR.
- VR is more persuasive when virtual environment conveys its situated affordances.

ARTICLE INFO

ABSTRACT

The rapid development of virtual reality (VR) technology offers opportunities for a widespread consumption of VR tourism content. It also presents challenges to better understand the effectiveness of VR experience in inducing more favorable attitude toward tourism destinations and shaping visitation intention. Based on two studies, one conducted in Hong Kong with 202 participants and another in the United Kingdom with 724 participants, this research identified several positive consequences of the sense of presence in VR experiences. First, the feeling of being in the virtual environment increases enjoyment of VR experiences. Second, the heightened feeling of being there results in stronger liking and preference in the destination. Third, positive attitude change leads to a higher level of visitation intention. Therefore, this study provides empirical evidence to confirm the effectiveness of VR in shaping consumers' attitude and behavior.

1. Introduction

One of the important technological developments expected to greatly impact the tourism industry today is virtual reality (VR). Recent innovation in VR platforms, devices, and content production tools allows for VR to evolve from a niche technology mainly enjoyed within the gaming communities into the realm of everyday experiences. The availability of low cost VR viewers such as Google Cardboard and the abundance of tourism-related VR content make it easier for anyone to experience virtual tours of cities and tourism attractions from anywhere in the world. Therefore, VR today offers unbounded potentials for mass virtual visitation to actual tourism destinations. The discussions on the roles of VR in tourism and hospitality management and marketing have been found in tourism literature since the past three decades (e.g., Cheong, 1995; Dewailly, 1999; Guttentag, 2010; Huang, Backman, Backman, & Chang, 2016; Williams & Hobson, 1995). With its unique ability to simulate intricate, real-life situations and contexts (Diemer, Alpers, Peperkorn, Shiban, & Mühlberger, 2015), VR has been touted as a substitute to actual travel (Cheong, 1995; Sussmann & Vanhegan, 2000), which can be beneficial for the management of protected areas such as vulnerable natural and cultural heritage sites where limiting the number of tourists or restricting visitations is desirable. In this case, the use of VR is considered a positive contribution to environmental sustainability (Dewailly, 1999). Studies also suggest

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VR as a powerful tourism marketing tool (Huang et al., 2016; Williams & Hobson, 1995; Williams, 2006) as it is able to offer more compelling imagery of tourism destinations to potential tourists by giving them a sense of what it is like to be there, a "try before you buy" experience. However, these studies are conceptual in nature, offering the potential benefits of VR applications in the tourism industry. Lacking, though, is theory-driven and evidence-based research to support these suggested potentials.

Research in psychology has sought to explain the reason behind the effectiveness of VR in shaping attitudinal and behavioral responses to virtual stimuli (Schuemie, Van Der Straaten, Krijn, & Van Der Mast, 2001), most of these have focused on the concept of presence. VR provides an environment where users can retrieve information in multi-sensory modalities, including visual, auditory, and kinaesthetic, enabling users to perceive realistic representation of the environment it portrays (Slater & Usoh, 1993). Further, VR environment offers situated affordances (Schuemie et al., 2001), action-supportive information on what users can do with the environment. For example, to a human, the grounds afford walking. Therefore, users' perception of the VR environment is dependent on possible actions. This perception leads to the sense of being "present" in or "transported" to the virtual environment (Lombard & Ditton, 1997; Schuemie et al., 2001; Slater, 1999; Zahorik & Jenison, 1998). The essence of travel and tourism experience is tourists' encounters with the destination environments, the "realities" of others. Tourists are tempted by the allure of places and landscapes; some mainly driven by desire to experience the visual sensations of distant territories (Steenjacobsen, 2001), others by the deeper meaning behind interacting with the sociocultural aspects of tourism destinations (Gibson, 2009). Drawing from Zahorik and Jenison (1998), successfully supporting actions such as sightseeing in a virtual tourism destination will lead users to perceive a sense of presence, of him/herself as being in the destination. Consequently, presence explains the effectiveness of VR as substitute to and/or simulation of travel.

Empirical evidence from various fields of studies, including in education, healthcare, entertainment, retailing, etc., demonstrate that VR experience leads to positive attitudinal and behavioral outcomes, such as consumer learning of products (Suh & Lee, 2005), brand recognition, product recall, and memory of experiences (Kim & Biocca, 1997; Mania & Chalmers, 2001). These outcomes are suggested as the results of presence (Schuemie et al., 2001). However, these studies, as well as VR studies in tourism context (e.g., Huang et al., 2016), mainly dealt with simulated virtual worlds, such as a virtual office, a virtual seminar room, and 3D tourism attractions, where resemblances to real places were rather coincidental. Theoretically, researching VR experience in tourism (what this study encapsulates) will provide a better understanding of presence in VR experiences that involve virtual depictions of real environments, where possible actions, such as navigation and sightseeing, resemble (are often indistinguishable from) actual consumption. Thus, it will lead to better conceptualization of the roles of VR experience in shaping attitude towards actual consumption. From a managerial point of view, understanding how travel consumers respond to various VR stimuli, the attitudinal consequences of "having been" in a destination, is of practical importance as destination managers are increasingly faced with strategic decisions to invest in various technology platforms and modalities. Therefore, this study aims to address the identified research gap in VR research in tourism context to address the aforementioned theoretical and managerial challenges. Specifically, the goal of this study is to investigate the sense of presence during a virtual walkthrough of a tourism destination and how presence influences post-VR attitude change toward the destination. Two studies were conducted to achieve this research goal. Study 1 was conducted with 202 participants in Hong Kong using VR street view of Tokyo, Japan, viewed with Google Cardboard or VR video of Porto, Portugal, viewed with Samsung Gear VR. Study 2 was conducted in the United Kingdom with 724 participants using 360-degree VR videos of Lake District National Park, United Kingdom, viewed with Samsung Gear VR.

2. Virtual reality and tourism

Since its early conception, VR has been described as a computer-simulated environment with and within which people interact (Diemer et al., 2015; Schuemie et al., 2001). Using VR devices, a user can experience the virtual environment as if he or she was part of it. The virtual environment is modified in real time as the device senses user's reactions and motions, allowing him or her to perceive a vivid mental representation of the environment, creating the illusion of interacting with and being immersed in the virtual world (Wirth et al., 2007). Table 1 presents an overview of VR technologies and their advantages within the tourism context. There are two kinds of established or commonly used headsets for VR, with numerous technical options within those two types. The first type includes untethered headsets (also referred to as mobile VR). These are headsets that work based on using a mobile device as a display. This can sometimes present a limitation due to the mobile devices processing power and limited ability to process real-time 3D content. The major benefits of these mobile-based systems are cost and uptake; many people already have a mobile device that is capable of displaying VR content to some degree (Byond, 2016). Examples of untethered or mobile VR headsets include Samsung Gear VR, Google Cardboard, and Google Daydream. The second common type is a tethered device, whereby the headsets contain a display alongside internal and/or external sensors to track the position of the user. These tethered headsets will usually require a personal computer (PC) to process the graphics and, thus, the user is attached to the PC via a cable. This usually allows for superior quality graphics as well as real-time tracking and interaction. Established examples include the HTC Vive, Oculus Rift, and OSVR (Byond, 2016).

Recently, a number of scholars explored the benefits of VR within the tourism context. From the tourists' point of view, the main benefits of VR include enhancement of tourism experiences (Bonetti, Warnaby, & Quinn, 2018; Moorhouse, tom Dieck, & Jung, 2018); facilitation of immersive, engaging, social, and entertaining experiences (e.g. Castro et al., 2017; Guttentag, 2010; Jung, Lee, Chung, & tom Dieck, 2018; Tromp, 2017), as well as the potential to provide accessible tourism for all (Guttentag, 2010; Williams & Hobson, 1995). From the perspective of businesses and destinations adopting VR, factors such as marketing and promotions, sales and distribution (Gibson & O'Rawe, 2018; Huang et al., 2016; Moorhouse et al., 2018; Williams & Hobson, 1995), additional revenue generation (Radde, 2017; Tromp, 2017), as well as sustainability and the preservation of heritage (Guttentag, 2010; Williams & Hobson, 1995) were identified as the benefits of VR. A full summary of previously explored benefits of VR is presented in Table 1.

3. Defining and measuring presence in virtual reality

The key concept that explains the effectiveness of VR in various use contexts is presence. Presence is defined in literature as the psychological state where a user is feeling lost or immersed in the mediated environment, the degree to which he or she feels physically "present" in a virtual environment (Schubert, Friedmann, & Regenbrecht, 2001; Slater & Steed, 2000; Slater & Usoh, 1993; Slater & Wilbur, 1997; Steuer, 1992). Lee (2004) defines presence as a psychological state in which the virtuality (artificiality) of an

Table 1
Virtual reality: Types and benefits.

VR	Examples and Literature
VR types	• Untethered/Mobile VR devices (e.g., Samsung Gear VR, Google Daydream, Google Cardboard) • Tethered VR devices (e.g., HTC Vive, Oculus Rift, OSVR) *More headsets exist on the market, but the aforementioned are considered at the forefront of current VR developments (Greenwald, 2017)
Benefits of VR in tourism contexts	
For customers	Enhanced experiences (Bonetti et al., 2018; Moorhouse et al., 2018) Full immersion (Castro et al., 2017; Tromp, 2017) Engagement (Gibson & O'Rawe, 2018) Entertainment (Guttentag, 2010; Jung et al., 2018; Moorhouse et al., 2018; Tromp, 2017) Social interactions and connectivity (Castro et al., 2017; Jung et al., 2018; Moorhouse et al., 2018) Personalization (Moorhouse et al., 2018) Accessibility (Guttentag, 2010; Hobson & Williams, 1995) Image formation (Gibson & O'Rawe, 2018; Moorhouse et al., 2018) Place attachment Staged experiences (Hobson & Williams, 1995)
For businesses and destinations	Marketing and promotion (Gibson & O'Rawe, 2018; Huang et al., 2016; Moorhouse et al., 2018; Williams & Hobson, 1995) Sales and distribution (Gibson & O'Rawe, 2018; Hobson & Williams, 1995; Tromp, 2017) Revenue generation, upselling (Radde, 2017; Tromp, 2017) Planning and management (Guttentag, 2010) Heritage preservation (Guttentag, 2010; Hobson & Williams, 1995) Training (Guttentag, 2010) Competitive advantage (Jung & tom Dieck, 2017) Gamification (Xu, Tian, Buhalis, Weber, & Zhang, 2016)

experience is unnoticed; presence is the "psychological similarities between virtual and actual objects when people experience—perceive, manipulate, or interact with— virtual objects" (p. 38).

Presence has been conceptualized in terms of its descriptive (the what) and structural (the how) models; the former focuses on delineating the dimensions of presence, while the latter on explaining how presence is generated in the mind of a user (Diemer et al., 2015). Following an extensive review of literature, Lombard and Ditton (1997) summarize six explications of presence: presence as social richness, realism, transportation, immersion, social actor within medium, and medium as social actor (Lee, 2004; Schuemie et al., 2001). Schuemie et al. (2001) find that presence as transportation, which is the sensation of being transported to the virtual environment, dominates the discussion in presence literature. Heeter (1992) suggests three types of presence: personal, social, and environmental presence, each corresponds to the sense of self and encountered objects as being part of the interactive virtual environment. Similarly, Lee (2004) proposes three types of presence: physical presence (i.e., virtual physical objects experienced as actual physical objects), social presence (i.e., virtual social actors experienced as actual social actors), and self presence (i.e., virtual self/selves experienced as actual self/selves).

Kim and Biocca (1997) operationalize the transportation metaphor of presence with two measures: arrival, which describes a feeling of being present in the virtual environment, and departure, a feeling of separation from the physical environment. These were conceptualized following Gerrig's (1993) theory that through a medium, a user is first transported, then arrives at a mediated environment, and finally returns to the original physical environment. Kim and Biocca (1997) further argue that arrival and departure are not exactly equal and may exert different influence on the user's memory and/or attitude change (Kim & Biocca, 1997). Slater and his colleagues (1993; 1994) propose a navigation metaphor of presence in virtual environments, which includes the user's sense of being there, the extent to which the VR experience becomes more real than everyday experience, and the locality of the virtual environment, in that users perceive it as a 'place' instead of set of images (Slater & Wilbur, 1997). Slater (1999) suggest that experiencing-*as*-a-place is the meaning of presence: people are there,

they respond to what is there, and they remember it as a place. It is important to note that Slater et al.'s (1993; 1994) measurement of presence, as explicated in SUS Questionnaire, include the state post VR experience, namely how a user remembers the virtual environment, while others focus only on the mental state during the VR experience. In fact, numerous studies regard memory of (objects within) the virtual environment as a consequence of presence (e.g., Keng & Lin, 2006; Kim & Biocca, 1997).

The experience of presence is a complex, multidimensional perception, which is formed through an interplay of multi-sensory information and various cognitive processes (Diemer et al., 2015). Lombard and Ditton (1997) describe presence as the perceptual illusion of being unmediated (non-mediation), an extent where the technology and the physical environment disappear from the user's awareness. That is, a user experiences the sense of presence when he or she fails to perceive the existence of a medium (i.e., a VR device) and responds as if the medium were not there. The term "perceptual" in their description shows that the illusion of non-mediation involves real-time responses of the sensory, cognitive, and affective processing systems to objects in a person's environment (Lombard & Ditton, 1997). This emphasizes the attention-directing role of activity within complex interactive situations to generate the sense of presence, in addition to the immersive nature of the virtual environment (Diemer et al., 2015; Witmer & Singer, 1998). Indeed, Witmer and Singer (1998) stress that both fundamental psychological states of involvement and immersion are necessary conditions for experiencing presence (see also Witmer, Jerome, & Singer, 2005). They develop the measurement of presence using Presence Questionnaire (PQ) and found the following subscales of presence: involved/control, natural, and interface quality (Witmer & Singer, 1998). Similarly, Schubert et al. (2001) conducted factor analyses and identified three dimensions of presence: spatial presence, involvement, and realness. A more recent operationalization by Wirth et al. (2007) associates spatial presence with two dimensions: self-location, which is the feeling of being located in mediated environments (the presence of self in the virtual environment), and perceived action possibilities.

Further, literature suggests that vital to presence is the suppression of information that is incompatible with the VR experience (Schuemie et al., 2001). With his estimation theory, Sheridan

(1999) postulates that presence is the result of a continuously updated mental model of the environment. He assumes that people can never have true knowledge of objective reality and, instead, continuously make and refine a mental model that estimates reality. Through sensing and interacting with a virtual environment, designed to have a perceptual and functional similarity to a physical environment, a user would create a mental model of the virtual environment and of how he or she relates to it. The structure of this mental model determines whether or not the user experiences presence. Even when he or she is uncertain about the reality of his or her perception in the virtual environment, such perception would be a close relative of what he or she has in the physical environments. This emphasizes the need for suppression of information or a willing suspension of disbelief for the sense of presence to come about (Nowak, Krcmar, & Farrar, 2008; Schuemie et al., 2001). Seth, Suzuki, and Critchley (2012) postulate that presence rests on the continuous prediction of emotional, or interoceptive, states, instead of the external environment. They suggest that, when encountering a stimulus (such as a virtual environment), a user would compare the actual interoceptive state (i.e., what he or she feels when encountering the environment) with the predicted state (i.e., what he or she expects to feel when encountering such environment). Therefore, presence is the result of successful suppression of the mismatch between the predicted and the actual interoceptive states. To summarize, Hofer, Wirth, Kuehne, Schramm, and Sacau (2012) suggest that the experience of presence follows two steps: (1) a construction of a mental model of the virtual environment and (2) the suppression of external cues that signal the artificiality of the virtual environment.

Following these conceptualizations of presence, researchers measure presence in a variety of different ways depending on the theoretical lens they use: presence as non-mediation, presence as involvement, etc. Most of these conceptual frameworks emphasize the aspects that contribute to presence. This study focuses on presence and its consequences in inducing more favorable attitude toward the tourism destination depicted in the virtual environment. Therefore, presence is defined and measured with self-reported mental states *during* the VR experience (i.e., the experienced level of presence), following Wirth et al.'s (2007) conception of spatial presence. Table 2 summarizes the dimensions and measurements of (experienced) presence.

4. Consequences of presence

Presence is the key feature for effective VR applications designed for persuasion as it may be a causal factor of human information processing performance and other cognitive variables (Kim & Biocca, 1997; Lombard & Ditton, 1997). The propositions and findings from previous research on presence in VR demonstrate that the enhanced sense of reality during a VR experience increases enjoyment and values of the VR experience (in itself), generates positive consequences on attitude, belief, and intention, and increases performance (Bystrom, Barfield, & Hendrix, 1999; Kim & Biocca, 1997; Suh & Lee, 2005; Schuemie et al., 2001; Vora et al., 2002). For example, research in education and training found that virtual presence promotes enjoyment and higher cognitive engagement for better learning outcomes (Bailenson et al., 2008; Lee, Wong, & Fung, 2010; Mikropoulos & Strouboulis, 2004) and improves task performance in training simulations (Vora et al., 2002). Research in medical sciences identified presence as the main contributor to performance during rehabilitation intervention programs and immersive Virtual Reality Exposure Therapy (VRET) to eliminate phobias (Carlin, Hoffman, & Weghorst, 1997; Hodges et al., 1995; Riva, Mantovani, & Gaggioli, 2004). The role of presence is also suggested in the field of marketing,

especially with regards to advertising effectiveness, as sense of presence in mediated environments is positively correlated with more favorable attitude toward ad and brand, brand recall or product knowledge, and purchase intention (Choi, Miracle, & Biocca, 2001; Klein, 2003; Li, Daugherty, and Biocca 2001, 2002; Lombard & Snyder-Duch, 2013). In the context of tourism, Hyun and O'Keefe (2012) found that presence via web-mediated information directly leads to positive virtual destination image.

In essence, the consequences of presence can be separated into those during and after the VR experience. During VR experience, a higher sense of presence is associated with enjoyment of virtual environment participation, the feeling of pleasure of interacting with virtual environment (Larsson, Västfjäll, & Kleiner, 2001; Li, Daugherty, & Biocca, 2001). That is, virtual environments that engender a high level of presence are perceived to be more enjoyable (Sadowski & Stanney, 2002; Sylaiou, Mania, Karoulis, & White, 2010). For example, Weibel, Wissmath, Habegger, Steiner, and Groner (2008) found a significant positive correlation between presence and enjoyment in the context of playing online games. The effect of presence on enjoyment, however, is mediated by the state of flow (Weibel et al., 2008). Still in the context of video game experience, Shafer, Carbonara, and Popova (2011) found that spatial presence is a significant predictor of enjoyment. Ijsselsteijn, De Kort, Westerink, De Jaggerand, and Bonants (2006) shows that greater spatial presence leads to greater enjoyment in an exercise-promoting virtual environment. More relevant to tourism, Zarzuela, Pernas, Calzón, Ortega, and Rodríguez (2013) demonstrate that through a VR Serious Game, educational tourism can be designed in a fun and entertaining way, implying an association between VR involvement and enjoyment, to allow tourists to learn different aspects of a city. Likewise, Sylaiou et al. (2010) investigated the relationship between presence and enjoyment in a virtual museum and identified a significant positive correlation between the two variables. Therefore, it can be suggested that the sense of presence during VR experience with a tourism destination leads to enjoyment of the VR experience.

H1: Sense of Presence during VR experience has a positive effect on Enjoyment of VR Experience.

Importantly, VR studies substantiate its persuasive role, suggesting that the subjective experience of presence in VR can translate into real world attitude and induce behavioral change (Fox, Christy, & Vang, 2014). Indeed, VR applications have been designed for various persuasive goals, such as health behavior change (Fox, Bailenson, & Binney, 2009; Girard, Turcotte; Bouchard, and Girard 2009; Ijsselsteijn et al., 2006), promotion of prosocial behavior (Ahn, Le, & Bailenson, 2013; Gillath, McCall, Shaver, & Blascovich, 2008; Rosenberg, Baughman, & Bailenson, 2013), advertising and e-commerce (Keng & Lin, 2006; Li, Daugherty, and Biocca 2002, 2001; Suh & Lee, 2005), etc. These studies found that the heightened sense of realism during VR experience leads to attitude change and the effect is transferred into the physical world, which is manifested in positive behavioral change. In marketing literature, higher levels of presence of various advertisements communicated in computer-mediated environments have been found to increase subject recall and recognition (Keng & Lin, 2006), leading to more positive attitude and liking toward the ad and the advertised product (Klein, 2003; Sundar & Kim, 2005). In tourism, VR provides tangible images of and experiences with the destination, inducing the construction of a mental image about destination attributes (i.e., destination image) and its affordances (Govers, Go, & Kumar, 2007; Nicoletta & Servidio, 2012), which can be a manifest of spatial presence. Previous studies suggest that the ability to visit a tourism destination through VR may assist tourists in

Table 2
Dimensions and measurements of presence.

Key Literature	Definition and Dimensions	Measurements
Heeter (1992)	Types of Presence: • Personal presence — the extent to which the person feels like she/he is part of the virtual environment; • Social presence — the extent to which other beings also exist in virtual environment; • Environmental presence — the extent to which the environment itself acknowledges and reacts to the person in virtual environment.	Conceptual
Lee (2004)	Types of Presence: • Physical Presence — a psychological state in which virtual physical objects are experienced as actual physical objects in either sensory or non-sensory ways; • Social Presence — a psychological state in which virtual social actors are experienced as actual social actors in either sensory or non-sensory ways; • Self Presence — a psychological state in which virtual self/selves are experienced as actual self/selves in either sensory or non-sensory ways.	Conceptual
Slater (1999); Slater and Wilbur (1997); Slater, Steed and Usoh (1993); Slater, Usoh, and Steed (1994)	Aspects of Presence: • The sense of being there in the environment depicted by the virtual environment; • The extent to which the virtual environment becomes the dominant one (that participants will tend to respond to event in the virtual environment rather than the real world); • The extent to which participants, after the virtual environment experience, remember it as having visited a place rather than just having seen computer-generated images.	Subjective measure, Slater, Usoh, and Steed (SUS) Questionnaire
Kim and Biocca (1997)	Dimensions of Presence as transportation: • Arrival — a feeling of being present in the virtual environment; • Departure — a feeling of separation from the physical environment.	Subjective measure, questionnaire
Witmer and Singer (1998)	Subscales of Presence: • Involved/Control — perceived control of events in the virtual environments; • Natural — the extent to which the virtual environment was consistent with reality; • Interface Quality — whether control devices of display devices interfere or distract from task performance.	Subjective measure, Presence Questionnaire (PQ)
Schubert, Friedmann, and Regensburg (2001)	Dimensions (lower-order factors) of Presence: • Spatial presence — the sense of being in virtual environment; • Involvement — the level of attention to real and virtual environments; • Realness — judgement of realness of virtual environments.	Subjective measure, questionnaire
Wirth et al. (2007); Vorderer et al. (2004)	Dimensions of Spatial Presence: • Self-location — a feeling of being located in mediated environments; • Possible actions — perceived action possibilities in the virtual environments.	Subjective measure, Spatial Presence Questionnaire (SPQ)

developing a set of realistic expectations of tourism experience with the destination (Cheong, 1995; Guttentag, 2010; Williams & Hobson, 1995). Studies also show that encounters with images of tourism destinations in mediated environments shape interest and attitude toward the destinations (Thomas & Carey, 2005; Tooke & Baker, 1996). A potential tourist who has experienced various destinations through VR will be in a better position to make an informed decision and initiate travel arrangements (Sussman and Vanhegan 2000).

H2: Sense of Presence during VR experience has a positive effect on Post VR Attitude toward destination.
H3: Enjoyment of VR experience has a positive effect on Post VR Attitude toward destination.

Attitude is a central concept in social psychology as well as consumer behavior literature as it is generally accepted that attitude predicts behavior, although the degree of attitude — behavior

consistency may differ in various situations (e.g., Ajzen & Fishbein, 1977; Glasman & Albarracín, 2006; Smith & Swinyard, 1983). Further, based on the Belief—Attitude—Intention—Behavior hierarchy (Fishbein & Ajzen, 1975), the relationship between attitude and (actual) behavior is mediated by behavioral intention (Kim & Hunter, 1993). The link between attitude toward tourism destination (with its characteristics) and behavioral intention to visit the destination or to participate in tourism-related activities has been supported in previous studies (e.g., Huang & Hsu, 2009; Lam & Hsu, 2004; Phillips, Asperin, & Wolfe, 2013; Ryu & Han, 2010). Researching Beijing tourists' revisit intention to Hong Kong, Huang and Hsu (2009) identified significant influence of attitude on intention. Similar results were identified by Lam and Hsu (2004). Phillips et al. (2013) found significant influence of attitude toward consuming Korean cuisine on intention to visit Korea and to try Korean cuisine. Similar results were identified by Ryu and Han (2010) in New Orleans. As supported by previous research, it can be suggested that attitude toward tourism destination as a result of

VR experience is a predictor of visitation intention to the destination.

>H4: Post VR Attitude toward destination has a positive effect on Intention to visit destination.

5. Research design

The main goal of this research is to assess the effects of VR experience on post-VR attitude and behavioral intention to visit a tourism destination. Key to VR experience is the extent of presence, which contributes to the level of enjoyment of VR participation. In order to assess the relative contribution of VR experience in inducing more favorable attitude toward VR stimuli (i.e., the tourism destination), it is crucial to measure post-VR attitude change, comparing attitude before and after VR experience. That is, identifying whether and how much a user's attitude changes as a result of being exposed to the virtual environment will delineate the specific effect of VR experience. Previous studies suggest that VR induces more positive attitude toward stimuli. Therefore, a positive change in attitude (i.e., stronger attitude) after VR experience is expected. Finally, this research tests the influence of attitude change on visit intention to the destination. The research framework is illustrated in Fig. 1.

5.1. Measurement items

VR Presence. In order to assess presence in VR experience, subjective measures of spatial presence as conceptualized and operationalized in Wirth et al. (2007) and Vorderer et al. (2004) were utilized. Following the research framework, the main interest in this study is to assess presence as the subjective mental states of being in and interacting with the virtual environment during the VR experience. Two constructs from MEC Spatial Presence Questionnaire (MEC-SPQ; Vorderer et al., 2004): Self-Location and Possible Actions scales, each measured with four items, were included in the questionnaire. The measurement items were presented in a 5-point Likert-type scale with "Strongly disagree" – "Strongly agree" anchored statements (see Appendix A for a list of measurement items). VR presence was operationalized as a second-order variable, consisting of the two first-order constructs.

VR Enjoyment. In order to measure VR enjoyment, this research refers to Davis, Bagozzi, and Warshaw's (1992) definition of perceived enjoyment, which is the extent to which the activity of using VR technology to experience tourism destination is enjoyable in its own right. Measurement items from previous research on technology acceptance and use (e.g., Moon & Kim, 2001; van der Heijden, 2003) were consulted. As a result, a 5-item perceived enjoyment scale was utilized. The items were presented a 5-point Likert-type scale with "Strongly disagree" – "Strongly agree" anchored statements.

Post VR Attitude Change. In literature, the measurement of attitude change has been conducted in a variety of different ways, mostly involving taking multiple measurements at different times (generally in longitudinal studies) to measure an increase or decrease in the level of attitude (see Hughes, 1967). In this study, a limited time allotted for VR experiment and survey only allows for the questionnaire to be distributed to participants after they have experienced VR. Therefore, attitude change was measured using self-reported change in intensity of preference, liking, and interest in the destination after experiencing VR on a 5-point Likert-type scale from 1 – "Much weaker" to 5 – "Much stronger," with 3 – "About the same" as the middle point.

Visit Intention. Visit Intention was measured by 3-item scale targeting behavioral intention to visit the destination in the future, validated in previous studies on tourists' intention to visit or revisit a destination in the future (e.g., Kozak & Rimmington, 2000; Phillips et al., 2013). The scale was presented a 5-point Likert-type scale with "Strongly disagree" – "Strongly agree" anchored statements.

5.2. Data analysis

In order to assess the measures given the data in this study context and test the hypotheses, data analyses were conducted using covariance-based structural equation modeling (CB-SEM) following the two-step approach suggested by Anderson and Gerbing (1988). The first step was to test the adequacy of the measurement model with a confirmatory factor analysis (CFA), then the second step to assess the adequacy of the structural model for hypotheses testing. The analysis was performed using MPlus program (Muthén and Muthén 1998–2012). Based on skewness and kurtosis values of all variables, an appropriate parameter estimate was selected. Several criteria were used to assess the model fit. The analysis will determine if the complete set of paths specified in the model is plausible given the sample, thus the proposed causal model is a sufficiently "good" way to model the relationships among the variables (Gefen, Straub, & Boudreau, 2000).

6. Study 1. stimuli: Tokyo, Japan or Porto, Portugal

In March 2016, undergraduate and graduate students enrolled in a university in Hong Kong were invited to participate in the study as part of an experiential component of a course on tourism and technology strategy. In order to ground this research in the context of personal use of VR, existing free VR applications and personal VR devices were used in the study.
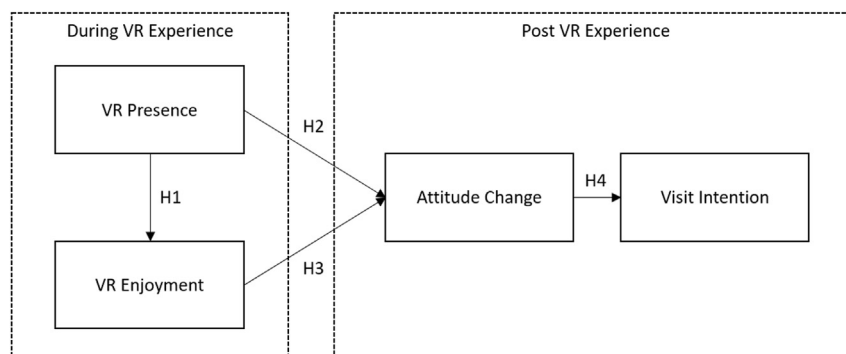

Fig. 1. Research framework and hypotheses.

Table 3
Study 1: Characteristics of participants.

Characteristics	Frequency	Percent	Characteristics	Frequency	Percent
Gender			*Education*		
Male	40	19.6	High School Graduate	3	1.5
Female	161	78.9	Some College	36	18.0
			2-Year Degree	8	4.0
Age (years)			4-Year Degree	152	76.0
18–24	196	98.0			
25–34	4	2.0	*Prior Experience*		
			Tried VR	0	0
			Visited destination	58	28.7

Participants with Apple's iOS smartphones were asked to download the Cardboard app and use Google Cardboard VR viewer to experience a virtual walkthrough of Tokyo, Japan, experiencing VR street view with Urban Hikes on Cardboard app (developed by Google). Other participants were asked to use Samsung Gear VR with a Samsung smartphone to visit Porto, Portugal, experiencing interactive 360-tour with Porto Interactive app (developed by Vertigo VR Studios). Participants experienced VR for about 10 min after a short period of familiarization with the device. After the VR experience, all participants were asked to complete the questionnaire online. A total of 202 participants completed the questionnaire. As presented in Table 3, the majority of participants are between the ages of 18 and 24 (98%), female (79%), and have a 4-Year University Degree (76%). Most participants (N = 136; 67%) used Google Cardboard, and most had never visited the destination portrayed in the VR experience (N = 144; 71%). In order to account for non-normality in the data distribution (see Table B1 in Appendix B), the analysis was performed using maximum likelihood parameter estimate with standard errors and a mean adjusted Chi-square test statistic (Satorra-Bentler corrections) that are robust to non-normality (MLM).

6.1. Findings

The results from the analysis suggest that the measurement

Table 5
Study 1: Correlations and square roots of AVE.

	Correlation				
	(1)	(2)	(3)	(4)	(5)
(1) Self-Location	**0.848**				
(2) Possible Actions	0.759	**0.810**			
(3) Enjoyment	0.554	0.526	**0.878**		
(4) Attitude Change	0.355	0.337	0.398	**0.865**	
(5) Visit Intention	0.118	0.112	0.132	0.134	**0.850**

Note: Square roots of AVE in the diagonal; AVE = average variance extracted.

model is adequate based on several criteria. As presented in Table 4, all factor loadings are above 0.6 and the average variance extracted (AVE) values of all latent variables are above the cutoff point of 0.5 (Hair, Black, Babin, & Anderson, 2010). Therefore, convergent validity was supported. The composite reliability (CR) values of all latent variables are above the cutoff criteria of 0.7 (Hair et al., 2010). Further, the values of square roots of AVE of all latent variables, which are presented in the diagonal, are larger than the correlations between the corresponding variable and any other variables (see Table 5). This indicates that discriminant validity is supported. Further, the fit indices are above the thresholds of 0.9 (Hu & Bentler, 1999): Comparative Fit Index (CFI) = 0.963 and Tucker Lewis Index (TLI) = 0.957. The value of Root Mean Square Error of Approximation (RMSEA = 0.056) indicates good model fit (Hu & Bentler, 1999)

Table 4
Study 1: Factor loadings, composite reliability (CR), and average variance extracted (AVE).

	Factor Loadings	Composite Reliability	Average Variance Extracted
Self-Location		0.911	0.720
Self-Location → SELF_LOCATION1	0.801		
Self-Location → SELF_LOCATION2	0.833		
Self-Location → SELF_LOCATION3	0.866		
Self-Location → SELF_LOCATION4	0.891		
Possible Actions		0.884	0.656
Possible Actions → POSSIBLE_ACTIONS1	0.860		
Possible Actions → POSSIBLE_ACTIONS2	0.842		
Possible Actions → POSSIBLE_ACTIONS3	0.793		
Possible Actions → POSSIBLE_ACTIONS4	0.739		
Enjoyment		0.938	0.753
Enjoyment → ENJOYMENT1	0.932		
Enjoyment → ENJOYMENT2	0.878		
Enjoyment → ENJOYMENT3	0.886		
Enjoyment → ENJOYMENT4	0.776		
Enjoyment → ENJOYMENT5	0.858		
Attitude Change		0.899	0.748
Attitude Change → ATTITUDE_CHANGE1	0.887		
Attitude Change → ATTITUDE_CHANGE2	0.897		
Attitude Change → ATTITUDE_CHANGE3	0.808		
Visit Intention		0.885	0.722
Visit Intention → VISIT_INTENT1	0.760		
Visit Intention → VISIT_INTENT2	0.949		
Visit Intention → VISIT_INTENT3	0.829		
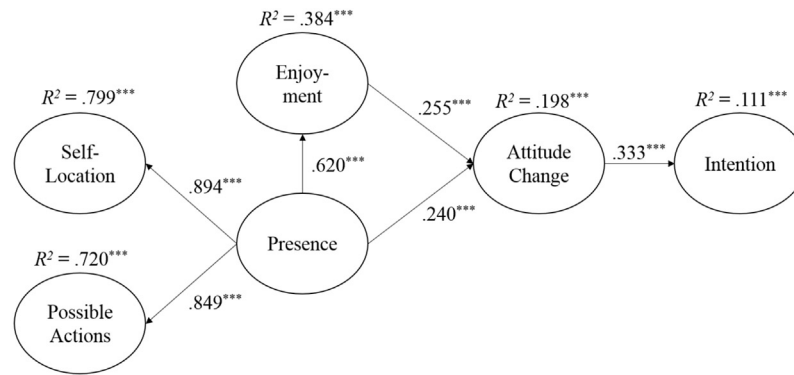
Model Fit Criteria: AIC = 6736.165; BIC = 6941.715; Sample-size Adjusted BIC = 6742.147; Chi-square = 233.977; df = 146; p = .000; RMSEA = .056 (90%: .042 - .069); CFI = .963; TLI = .957; SRMR = .047; N = 202.

Fig. 2. Study 1: The structural model.

and the value of Standardized Root Mean Square Residual (SRMR = 0.047) is below the threshold of 0.09 (Hu & Bentler, 1999). These criteria suggest the adequacy of the measurement model.

In order to estimate the relationships between the variables hypothesized in the research framework, the structural model was consulted (see Fig. 2). As a second-order variable, the paths from VR Presence to its two lower-order variables are significant (Presence → Self-Location = 0.894, p = 0.000; Presence → Possible Actions = 0.849, p = 0.000). As hypothesized, Presence has a significant positive effect on Enjoyment of VR participation (β = 0.620; p = 0.000; R^2 = 0.384; p = 0.000), providing support for H1. Both Presence and Enjoyment have significant positive effects on attitude change (Presence → Attitude Change = 0.240, p = 0.000; Enjoyment → Attitude Change = 0.255, p = 0.000; R^2 = 0.198; p = 0.000), supporting H2 and H3. It can be observed from the R^2 value that about 20% of the amount of variance in Post VR attitude change can be explained by the model. Finally, a significant positive effect of Attitude Change on Intention (β = 0.333; p = 0.000) was also identified (R^2 = 0.111; p = 0.000), providing support for H4. About 11% of variance in visit intention can be explained by the model.

6.2. Discussion

The results provide support for all hypothesized relationships in the model (see Table 6). The sense of presence during VR experience significantly leads to enjoyment of the experience, supporting Hypothesis 1. With regards to the consequences of presence on post VR attitude change, a significant effect was also identified, supporting Hypothesis 2. Further, enjoyment of VR experience also positively impacts post VR attitude change with a similar magnitude as the effect of VR presence, supporting Hypothesis 3. Finally, the relationship between post VR attitude change and visit intention is also significantly positive, which supports Hypothesis 4. Therefore, it can be suggested from these results that VR can be an effective tool for tourism marketing as it induces the sense of presence, which leads to enjoyment. These, in turn, induce positive attitude change that contributes to visit intention to the tourism destination portrayed in VR. Further, the indirect effects of VR presence and enjoyment on visit intention were calculated (see Table 7). Specifically, a significant positive indirect effect of VR presence on post VR attitude change, by way of enjoyment, was found. Other indirect effects, although smaller in magnitude, were also significant. The total effects of VR presence on post VR attitude

Table 6
Study 1: Hypothesis testing.

Hypotheses	Path Coefficients	Support for Hypotheses
H1: Presence → Enjoyment	0.620 (0.000)	Supported
H2: Presence → Attitude Change	0.240 (0.006)	Supported
H3: Enjoyment → Attitude Change	0.255 (0.001)	Supported
H4: Attitude Change → Visit Intention	0.333 (0.000)	Supported

Table 7
Study 1: Direct and indirect effects.

	Direct Effects	Indirect Effects
Presence → Enjoyment	0.620 (0.000)	
Presence → Attitude Change	0.240 (0.006)	
Enjoyment → Attitude Change	0.255 (0.001)	
Attitude Change → Visit Intention	0.333 (0.000)	
Presence → (Enjoyment) → Attitude Change		0.158 (0.001)
Presence → (Attitude Change) → Visit Intention		0.080 (0.010)
Presence → (Enjoyment) → (Attitude Change) → Visit Intention		0.053 (0.015)
Enjoyment → (Attitude Change) → Visit Intention		0.085 (0.011)

Table 8
Study 2: Characteristics of participants.

Characteristics	Frequency	Percent	Characteristics	Frequency	Percent
Gender			*Education*		
Male	314	43.4	No Formal Qualification	31	4.3
Female	410	56.6	GCSE/O-level	93	12.8
			A-level	128	17.7
Age (years)			Undergraduate Degree	224	30.9
18–24	146	20.2	Postgraduate Degree	171	23.6
25–34	149	20.6	Doctoral Degree	24	3.3
35–44	183	25.3	Professional Degree	53	7.3
45–54	139	19.2			
55–64	72	9.9	*Income*		
65+	35	4.8	Less than £20,000	192	26.5
			£20,000 - £39,999	245	33.8
Prior Experience			£40,000 - £59,999	123	17.0
Tried VR	181	25.0	£60,000 - £79,999	73	10.1
Visited destination	640	88.7	£80,000 - £99,999	48	6.6
			£100,000+	43	5.9

change is 0.778; while total effects on visit intention is 0.133.

While the data confirmed the hypotheses, this study has some limitations. First, the participants in this study are dominated by young, female consumers. Recent studies have found that the younger the customers, the more likely they are to be interested in VR (eMarketer, 2015; Global Web Index, 2016). It can be suggested that participants in this study represent a group of customers who are highly likely to experience and be influenced by VR. However, the imbalance in gender may or may not influence the results. Second, participants were exposed to different stimuli with an unbalanced ratio: 67% used Google Cardboard. Several independent-samples *t*-tests were conducted to identify the differences across stimuli in terms of all variables (i.e., presence, enjoyment, attitude change, and intention). The differences were not statistically significant. Nonetheless, conducting a follow up study with consistent stimuli is desirable to verify the results further. Lastly, the sample size is relatively low ($N = 202$). Previous literature suggests a minimum 100–150 sample size to test a simple model (Anderson & Gerbing, 1988) or 10 observations for every indicator variable (Nunnally, 1967). Based on a power analysis suggested by MacCallum, Browne, and Sugawara (1996), the

minimum sample size for a close of fit (Power = 90%, significance level = 0.05; $RMSEA_1 = 0.05$, and $RMSEA_0 = 0.08$) is 128. A further study to test the model with a larger sample size will further support these findings.

7. Study 2. stimuli: Lake District National Park, UK

Festival goers visiting Kendall Calling Festival in July 2016 and Lakes Alive Festival in August 2016 in the Lake District, UK were invited to participate in this study. Participants were asked to experience Bird Hive Lake District National Park VR application using Samsung Gear VR headset for about 5 min. The content for VR experience was captured by a drone and it contained a flight over the natural landscape of the Lake District National Park including its mountains, lakes, and forests. After the VR experience, all participants were asked to complete a questionnaire. A total of 741 participants completed the questionnaire. After eliminating responses with missing data and outliers, 724 responses were included in the analysis (see Table 8). In contrast with Study 1, participants in Study 2 are relatively balanced in gender (57% female). While the majority of participants is young (41% younger than 35), older participants

Table 9
Study 2: Factor loadings, composite reliability (CR), and average variance extracted (AVE).

	Factor Loadings	Composite Reliability	Average Variance Extracted
Self-Location		0.915	0.729
Self-Location → SELF_LOCATION1	0.889		
Self-Location → SELF_LOCATION2	0.891		
Self-Location → SELF_LOCATION3	0.764		
Self-Location → SELF_LOCATION4	0.865		
Possible Actions		0.706	0.706
Possible Actions → POSSIBLE_ACTIONS1	0.747		
Possible Actions → POSSIBLE_ACTIONS2	0.827		
Possible Actions → POSSIBLE_ACTIONS3	0.917		
Possible Actions → POSSIBLE_ACTIONS4	0.862		
Enjoyment		0.922	0.704
Enjoyment → ENJOYMENT1	0.890		
Enjoyment → ENJOYMENT2	0.921		
Enjoyment → ENJOYMENT3	0.758		
Enjoyment → ENJOYMENT4	0.816		
Enjoyment → ENJOYMENT5	0.801		
Attitude Change		0.850	0.661
Attitude Change → ATTITUDE_CHANGE1	0.868		
Attitude Change → ATTITUDE_CHANGE2	0.927		
Attitude Change → ATTITUDE_CHANGE3	0.609		
Visit Intention		0.944	0.848
Visit Intention → VISIT_INTENT1	0.928		
Visit Intention → VISIT_INTENT2	0.932		
Visit Intention → VISIT_INTENT3	0.902		

Table 10
Study 2: Correlations and square roots of AVE.

	Correlation				
	(1)	(2)	(3)	(4)	(5)
(1) Self-Location	**0.854**				
(2) Possible Actions	0.698	**0.840**			
(3) Enjoyment	0.435	0.432	**0.840**		
(4) Attitude Change	0.525	0.522	0.627	**0.813**	
(5) Visit Intention	0.160	0.159	0.191	0.125	**0.921**

Note: Square roots of AVE in the diagonal; AVE = average variance extracted.

are also represented in this study (about 34% are 45 years or older). A majority of participants make less than £60,000 annually. A quarter of participants (25%) have tried VR before the experience. Contrary to Study 1, most participants in Study 2 (89%) have visited the destination before being exposed to this study. Data from Study 2 are presented in Table B2 in Appendix B. The analysis was performed using the same approach as in Study 1 (covariance-based SEM with MLM).

7.1. Findings

Based on several criteria, it can be suggested that the measurement model in this study is adequate. As presented in Table 9, all factor loadings are above 0.6 and the AVE values of all latent variables are above the cutoff point of 0.5 (Hair et al., 2010). Therefore, convergent validity was supported. The CR values of all latent variables are above the cutoff criteria of 0.7 (Hair et al., 2010). Further, the values of square roots of AVE of all latent variables, which are presented in the diagonal of Table 10, are larger than the correlations between the corresponding variable and any other variables. This demonstrates that discriminant validity is supported. The fit indices are above the thresholds of 0.9 (Hu & Bentler, 1999): CFI = 0.945 and TLI = 0.935. The value of RMSEA (0.071) indicates moderate fit (Hu & Bentler, 1999) and the value of SRMR (0.087) is below the threshold of 0.09 (Hu & Bentler, 1999).

The structural model is illustrated in Fig. 3. The paths from VR Presence as a second-order variable to its two first-order variables are significant (Presence → Self-Location = 0.838, $p = 0.000$; Presence → Possible Actions = 0.833, $p = 0.000$). Presence has a significant positive effect on Enjoyment of VR participation ($\beta = 0.519$; $p = 0.000$; $R^2 = 0.270$; $p = 0.000$), providing support for H1. Both Presence and Enjoyment have significant positive effects on attitude change (Presence → Attitude Change = 0.567, $p = 0.000$; Enjoyment → Attitude Change = 0.116, $p = 0.000$;

$R^2 = 0.403$; $p = 0.000$), supporting H2 and H3. This indicates that 40% variation in the Post VR attitude change can be attributed to variations in VR presence and enjoyment. Finally, a significant positive effect of Attitude Change on Intention ($\beta = 0.305$; $p = 0.000$) was also identified ($R^2 = 0.093$; $p = 0.000$), providing support for H4. The low R^2 value, however, indicates that only extremely small portion of variation in visit intention to the national park (less than 10%) can be explained by Post VR attitude change.

7.2. Discussion

As with Study 1, the results from Study 2 also provide support for the hypothesized model (see Table 11). The sense of presence during VR experience significantly leads to enjoyment of VR participation, supporting Hypothesis 1. Presence's influence on post VR attitude change is positive and significant, supporting Hypothesis 2. The positive effect of enjoyment of VR experience on post VR attitude change is also significant, although with less magnitude than the VR presence, supporting Hypothesis 3. Finally, the relationship between post VR attitude change and visit intention is significant, albeit resulting in a small R^2 value. This supports Hypothesis 4. In summary, these results demonstrate the effectiveness of VR for tourism marketing as VR induces the sense of presence, leading to enjoyment, which affects positive attitude change that contributes to visit intention. Further, the indirect effects of VR presence and enjoyment on visit intention were calculated (see Table 12). Specifically, a significant positive indirect effect of VR presence on visit intention, by way of post VR attitude change, was found. Other indirect effects, although smaller in magnitude, were also significant. The total effects of VR presence on post VR attitude change is 0.569; while total effects on visit intention is 0.191.

From the results, it can be observed that the Satorra-Bentler corrected Chi-square value is quite large (Chi-square = 673.059; df = 146), which is likely due to large sample size ($N = 724$). As suggested in previous research, with large sample size, the chi-square values will be inflated (statistically significant), thus might erroneously implying a poor data-to-model fit (see Schumacker & Lomax, 2004). However, the relative Chi-Square value (Chi Square/degree of freedom ratio) in this study is smaller than the suggested ratio of 5:1 as a rule of thumb for a reasonable fit (Marsh & Hocevar, 1985; Schumacker & Lomax, 2004).

7.3. An alternative model

In order confirm the significance of post VR attitude change as a
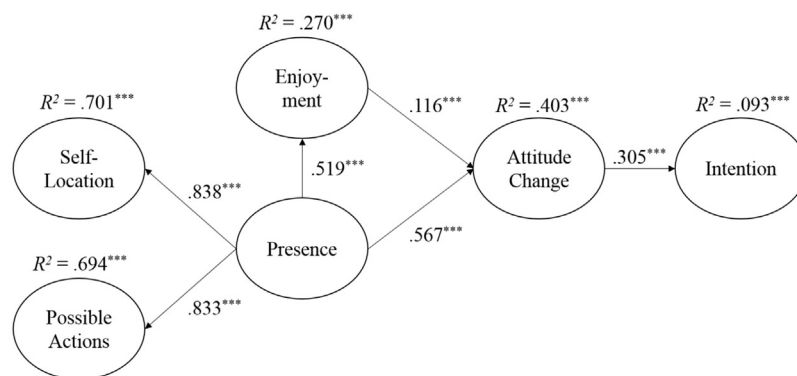
Model Fit Criteria: AIC = 23347.085; BIC = 23635.927; Sample-size Adjusted BIC = 23435.883; Chi-square = 673.059; df = 146; p = .000; RMSEA = .071 (90%: .065 - .076); CFI = .945; TLI = .935; SRMR = .087; N = 724

**Fig. 3.** Study 2: The structural model.

Table 11
Study 2: Hypothesis testing.

Hypotheses	Path Coefficients	Support for Hypotheses
H1: Presence → Enjoyment	0.519 (0.000)	Supported
H2: Presence → Attitude Change	0.567 (0.000)	Supported
H3: Enjoyment → Attitude Change	0.116 (0.003)	Supported
H4: Attitude Change → Visit Intention	0.305 (0.000)	Supported

Table 12
Study 2: Direct and indirect effects.

	Direct Effects	Indirect Effects
Presence → Enjoyment	0.519 (0.000)	
Presence → Attitude Change	0.567 (0.000)	
Enjoyment → Attitude Change	0.116 (0.003)	
Attitude Change → Visit Intention	0.305 (0.000)	
Presence → (Enjoyment) → Attitude Change		0.060 (0.002)
Presence → (Attitude Change) → Visit Intention		0.173 (0.000)
Presence → (Enjoyment) → (Attitude Change) → Visit Intention		0.018 (0.004)
Enjoyment → (Attitude Change) → Visit Intention		0.035 (0.005)
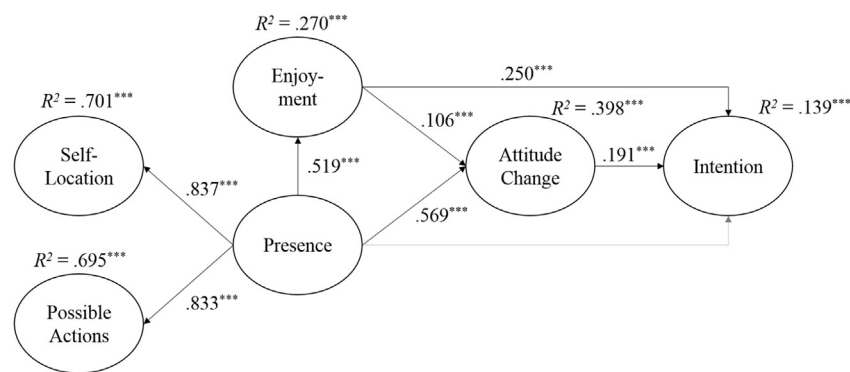
Model Fit Criteria: AIC = 23314.791; BIC = 23612.803; Sample-size Adjusted BIC = 234612.409; Chi-square = 642.265; df = 144; p = .000; RMSEA = .069 (90%: .064 - .075); CFI = .948; TLI = .938; SRMR = .069; N = 724

Fig. 4. Study 2: An alternative model.

consequence of presence and to test if there are direct effects of VR presence and VR enjoyment on visit intention, an alternative model was tested. As can be seen in Fig. 4, a positive direct effect of VR enjoyment on visit intention was identified ($\beta = 0.250$; $p = 0.000$), with a slightly larger magnitude compared to that of Post VR attitude change. However, the direct effect of VR presence on visit intention was not identified. Therefore, it can be confirmed that the effect of the sense of presence during VR experience on visit intention is mediated by post VR attitude change. Compared to the main model, the R^2 value of visit intention increases in the alternative model ($R^2 = 0.139$, $p = 0.000$), indicating that the alternative model better explains the variance in visit intention. That is, the sense of being in the virtual environment directly results in more positive attitude toward the environment. On the other hand, the significant effect of VR enjoyment on visit intention demonstrate the role of hedonic experience with technological device in instilling behavioural intention. That is, the inflated sense of pleasure and/or excitement during a virtual walkthrough leads to positive intention for an actual walkthrough. Considering that 25% of participants have tried VR and 89% have visited destination before, the model was run for the different groups of participants (prior use of VR, prior visitation to destination) to further explicate the role of novelty. However, no significant differences were identified.

8. General discussion

This study hypothesized that the sense of presence during a VR experience with a tourism destination will lead to positive consequences, which include positive VR experience from enjoyment of VR participation and, importantly, an increased level of preference, liking, and interest in the tourism destination, which leads to visit intention. The results of two studies, conducted in with different stimuli (i.e., cities and national parks) among participants with varied characteristics (i.e., students and festival goers), support all hypotheses. Firstly, significant support was found for VR presence as a second-order variable consisting of self-location and possible action, as suggested in Wirth et al.'s (2007) measures of spatial presence. Self-location denotes the sense of locating the self in the virtual environment, which is consistent with the definition of personal presence (Heeter, 1992) or self presence (Lee, 2004), although it is not about perceiving the existence of virtual self in the virtual environment, but about being part of the virtual environment. To some extent, this can support the concept of arrival (Kim & Biocca, 1997), as participants feel present in the city or national parks depicted in VR. Possible Actions denote the immersive nature and affordances of the virtual environments, which is consistent with the definition of physical presence (Lee, 2004) and environmental presence (Heeter, 1992). Importantly, it is about participants

recognizing the action-supportive information from the virtual environment; the virtual environment conveying its situated affordances (Schuemie et al., 2001).

Secondly, the significant effect of presence on enjoyment of VR confirms the positive value of VR as a hedonic experience. This is consistent with Shafer et al. (2011), Sylaiou et al. (2010), and Weibel et al. (2008). However, this study shows the direct effect that the sense being in the tourist city or the national park has on the feeling of pleasure while doing the virtual walkthrough. Meanwhile, Weibel et al. (2008) found the effect of presence on enjoyment to be mediated by the perceived state of flow in the context of playing video games. In the context of virtual museum, Sylaiou et al. (2010) only demonstrated positive correlations between presence and enjoyment. Therefore, this study contributes to a better understanding of the causal relationship between the two experiences in VR that involves interactions with tourism destinations, with enjoyment being the consequence of the sense of presence.

Thirdly, a significant direct effect of presence on attitude change confirms that the extent to which participants process information in the virtual environment influences changes in liking, preference, and interest in the actual environment. While previous research in advertising identified positive correlations between presence and more favorable attitude toward ad and brand (Choi et al., 2001; Klein, 2003; Li et al., 2001; 2002), this study clarifies that presence indeed leads to attitude change. In this case, the feeling of being part of a city or a park and afforded the action of sightseeing results in more favorable attitude toward the city and the park. Similar result was identified by Hyun and O'Keefe (2012), where presence results in positive virtual destination image. Furthermore, by measuring Post VR attitude change instead of attitude, this study was able to delineate specific role of VR presence on attitude formation.

Lastly, the change in attitude positively leads to visit intention. Those whose preference, liking, and interest in the city or park become stronger (i.e., more favorable attitude) after the VR experience tend to have higher level of visit intention. It is important to note that while in Study 1 the proportion of participants who have visited the destination prior to the VR experience is small, most participants in Study 2 have visited the park. Therefore, the novelty effect of VR might be lacking and its role is more of a reminder rather than product introduction. Further, it is also important to note that the nature of traveling to the cities and the attraction depicted in stimuli is different: traveling to Tokyo or Porto for participants in Hong Kong may require a substantial effort compared to visiting a local national park for participants in the UK. It can be observed that the mean values of visit intention items in Study 2 are positively skewed, indicating that most participants intend to visit the national park in the future. Nevertheless, both studies yielded positive results, indicating that VR presence can be effective to induce intention for first time visitation and/or revisit intention, to visit faraway destinations or domestic tourism attractions. In conclusion, this study demonstrates that VR allows subjective experience in a virtual environment (e.g., virtual walkthrough or sightseeing in a tourist city or a national park) to eventually translate into real behavior (i.e., actual visitation), confirming the persuasive power of VR for tourism marketing.

9. Conclusion and implication

The development of VR platforms and devices for convenient personal use in recent years offers great potential for a widespread consumption of VR tourism content. As suggested in earlier literature, the replication or creation of tourism experiences through VR will greatly impact the tourism industry (Williams & Hobson, 1995). VR development presents research challenges to better understand the effectiveness of VR in providing alternative or surrogate tourism experiences and shaping consumer attitudes toward tourism destinations. Moreover, destination managers are also faced with challenges to make strategic investment decisions in order to leverage VR technology to influence consumers' travel decisions. In order to answer these challenges, this study investigates the sense of presence during VR experience involving virtual walkthrough of tourism destinations and attractions using personal devices. This study contributes to a better understanding of presence and its consequences on user attitudes in experiences involving depictions of real tourism destinations. The results show that presence contributes positively to attitude change toward destinations. That is, a higher sense of presence during VR experiences leads to stronger interest and liking toward the destinations. Therefore, it provides theoretical explanation for the effectiveness of VR in influencing users' response to marketing stimuli, which is helpful for destination marketers justifying investment in VR and empirical support for previous conceptual research suggesting the role of VR in tourism marketing and management (e.g., Cheong, 1995; Dewailly, 1999; Guttentag, 2010; Huang et al., 2016; Williams and Hobson 1995).

Williams and Hobson (1995) suggested that "VR has the potential to revolutionize the promotion and selling of tourism" (p. 425) as it has the ability to offer interactive experience and provide rich data to potential tourists seeking destination information (Guttentag, 2010). Cheong (1995) argued that through VR, potential tourists can "'sample' the delights and have a 'feel' of each destination's atmosphere before making their decision" (p. 419). This study shows how VR users interact with the destination's characteristics, 'feel' the destination's atmosphere, and, thus, sample the destination experience as indicated by the sense of presence. It is reflected in the ability to locate the self in the destination and perceive the affordances of the destination (action possibilities), as significantly found in this study to form the sense of spatial presence in the virtual environment (Vorderer et al., 2004). To justify the effectiveness of VR as marketing tools, this study demonstrates how VR capabilities in inducing the sense of presence actually lead to users having more favorable attitude toward the destinations depicted in VR, which, in turn, affects intention to visit the destinations. Results from two studies, conducted with different groups of participants using different stimuli, consistently support the hypotheses. The consequences of presence on positive attitude change is observed in situations involving experience with faraway tourism destinations (international tourism) as well as local attractions (domestic tourism). No significant differences were found between participants who have visited the destinations depicted in VR and those who have not (in both studies), between participants who have used VR before and those who used it for the first time during the study (in Study 2), and between participants using different VR viewers (in Study 1). Therefore, this study provides empirical evidence from the field of tourism to support previous research suggesting the positive consequences of presence in VR on attitude and behavior (e.g., Choi et al., 2001; Klein, 2003; Li, Daugherty, and Biocca 2002, 2001; Lombard & Snyder-Duch, 2013).

Despite of the contributions, this study has some limitations, which should be addressed in future research. First, as a result of data collection procedure, the proportion of female participants in Study 1 is way larger than male participants and all of them are younger than 35 years. This generate a concern in terms of representativeness when interpreting the results. However, Study 2, which included more balanced proportion of gender and age groups, also yields the same results. This confirms that the results from Study 1 can be replicated in a different context with a more

representative sample. Nevertheless, future studies applying this model in different contexts will further verify the results. Second, this study uses subjective measurements of VR presence and enjoyment, which are experienced during VR, based on participants' evaluation after VR experience. Therefore, it relies on participants' recall of the VR experience. Even though participants responded to the questionnaire right after the experience, responses may still contain inaccurate information and biases. Future research should include objective measurements of presence and enjoyment, such as using sensors and psychophysiological analysis, to eliminate potential bias. Third, while in Study 1 different groups of participants used different devices and stimuli, the small number of participants using Samsung Gear VR compared to Google Cardboard does not allow for testing a meaningful comparison. Experimental studies testing the model with devices with varying levels of immersive capabilities and content with varying levels of affordances (e.g., stimulating different types of action and interaction) will add to better understand how presence comes about. The same goes for differences between participants with prior experience and those without, in order to explicate the role of novelty in effectiveness of VR experience. Last, this study focuses mainly on the consequences of presence, but not on its antecedents. Future studies focusing on antecedents and different correlates of VR presence will be helpful to inform the design of VR for tourism and better predict the resulting visit intention.

Finally, the results of this study provide destination marketers, travel agents, and other tourism suppliers with validation that VR can be an effective marketing tool. As personal VR devices becomes more accessible to a wider group of consumers, investing in VR technology for tourism marketing can be a good strategy. However, as various tourism destinations have started to embrace this technology, it is important to develop an overall VR experience that is presence-inducing and all around enjoyable in order to make sure the user experience with VR will translate into stronger interest in the tourism destination. The key is to generate VR content that can transport participants to the destination, heighten the senses of being in the virtual environment and suspend sensory stimuli from the actual physical environment.

Another immersive technology application closely related to VR and highly relevant to tourism is augmented reality (AR) (e.g., Jung & tom Dieck, 2017; Tussyadiah, Jung, & tom Dieck, 2017). While VR creates simulated reality for its users (i.e., virtual worlds), AR provides an enhanced version of reality by adding digital information (i.e., sound, video, haptics) to augment the elements of the natural environment. Due to the nature of user interaction and experience with these immersive technologies, the key concept explored in this study, spatial presence, is most appropriate to apply in VR contexts, especially in connection to the notion of suspension of disbelief. In AR experiences, the concept of presence can be relevant in terms of how users perceive the virtual objects to be part of (and interact with) the natural environments. Therefore, this research approach to measuring presence and its behavioral outcomes will not explain experiences with AR to the same extent as with VR. Future studies comparing presence in VR and AR experiences will shed light into this issue.

Acknowledgement

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.tourman.2017.12.003.

Statement of contribution

Iis P. Tussyadiah contributed to conception and research design, data analyses and interpretation, and writing the first draft of the manuscript. Dan Wang contributed to conception and research design, data collection in Study 1, and revision of the manuscript. Timothy H. Jung and M. Claudia tom Dieck, together, contributed to data collection in Study 2 and revision of the manuscript. All authors reviewed the final version of the manuscript.

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