Investigation of the technology effects of online travel media on virtual travel experience and behavioral intention

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Abstract:

This study investigates technology affordances of online travel media determining ways of presenting pictorial information and creating the spatial structure of a destination: modality and navigability. To examine the impacts of technology affordances on virtual travel experience, a 2 (modality: still pictures versus panoramic pictures) × 2 (navigability: absence versus presence) between-subjects experiment was conducted with 213 participants. This study found significant effects of modality and navigability on affective and cognitive dimensions of virtual travel experience. Scrutinizing the mediating role of virtual travel experience, the findings explain the psychological mechanism of how modality and navigability influence tourists' behavioral intention.

Keywords: Modality | navigability | virtual travel experience | behavioral intention | visual image

Article:

With technology innovation, online travel media have transformed and diversified ways of presenting pictorial information about a tourist destination. For instance, pictorial information is enriched and reshaped in a virtual environment where tourists can explore and navigate a hyperlinked and multiple-layered web space. As media technology enables tourists to search high-quality and navigable pictorial information, online travel information search is considered to elicit virtual travel experience (Cho, Wang, & Fesenmaier, 2002; Hyun & O'Keefe, 2012). Virtual travel experience refers to the mediated experience of exploring and appreciating the cultural and spatial landscapes of a destination. By adopting advanced media technology (e.g. high-resolution visual images, panoramic pictures, interactive and navigable functions, and three-dimensional (3D) virtual reality), many travel websites have developed various web interfaces to improve the quality of virtual travel experience (Cho et al., 2002; Chung, Han, & Joun, 2015; Jung, Chung, & Leue, 2015).

Each web interface is composed of different types and levels of affordance, which refers to "a particular capability possessed by the medium to facilitate a certain action" (Sundar, 2009, p. 556). Distinguishing the effects of a medium (e.g. technical features of a web interface) and a message (e.g. the content of pictorial information), researchers in media effect studies argue that technology affordances embedded in a web interface have the potential to induce substantial psychological effects on media users' perceptions and behaviors (Reeves & Nass, 1996; Sundar, 2008). According to Sundar (2008), each technology affordance may produce different heuristics (e.g. realism, being there, elaboration, play) influencing the quality of the user experience. Likewise, not only the content of pictorial information, but also the technical aspect of online travel media can determine the quality of the virtual travel experience (Hyun & O'Keefe, 2012; Wu & Chang, 2005).

Conceptualizing virtual travel as "a combination of the geography of the environment and user motion" (Balakrishnan & Sundar, 2011, p. 168), there are two salient technology affordances determining the way of presenting pictorial information of a destination and creating the spatial structure of a virtual environment: modality and navigability. Modality, a technology affordance determining the mode of communication (Sundar, 2008), is related to the way of presenting pictorial information and visual spatiality of a destination (e.g. still picture and panoramic picture). Navigability refers to an affordance determining the degree of user movement control in a virtual environment, such as clicking or dragging to move from point A to point B (2008). For travel websites, modality and navigability are regarded as main technology affordances influencing the quality of the virtual experience.

From the perspective of destination marketing organizations (DMOs) and tourism marketers, an important question is how to create an optimal user interface that produces a positive virtual travel experience and increases behavioral intention to visit and recommend to others. Considering the potential psychological effects produced by a user interface, it is important to understand the relationship between technology affordances and virtual travel experience. Also, because each user interface is composed with various technology affordances (Reeves & Nass, 1996; Sundar, 2008), it is necessary to distinguish different types of technology affordance and understand corresponding effects.

Although two research streams have been developed to understand the impact of online media, there exist several research gaps. One stream comes from media effect studies identifying and articulating the distinctive psychological effects of affordances on user experience (Reeves & Nass, 1996; Sundar, 2008). However, media effect studies have paid less attention to examining the effects of affordance on tourists' experience and behavior. The other stream is from tourism studies supporting that online information search influences the formation of a destination image (Horng & Tsai, 2010; Jeong, Holland, Jun, & Gibson, 2012; Lepp, Gibson, & Lane, 2011) and tourists' decision-making process (Cormany & Baloglu, 2011; Kah & Lee, 2014; López-Bonilla & López-Bonilla, 2013; Michaelidou, Siamagka, Moraes, & Micevski, 2013). However, these tourism studies do not distinguish the effects of technology (medium) and content (message) by adopting an object-centered approach, not a variable-centered approach. Because the object-centered approach treats the multiple attributes of a certain medium as a whole (e.g. TV versus

Internet), it is not possible to distinguish the unique effect of each technology affordance. In a sense that online media have been developed as a heterogeneous form of multimedia (Reeves & Nass, 1996; Sundar, 2008), it is critically important to adopt the variable-centered approach to understand the underlying mechanism of how modality and navigability induce unique effects on tourists' perception and behavioral intention.

More importantly, given that the combination of two or more technology affordances may possibly magnify or offset certain psychological effects (Sundar, 2008; Sundar, Xu, & Dou, 2012), the variable-centered approach enables the detection of the interaction effect of modality and navigability. For instance, the effect of navigability can be stronger or weaker in one particular presentation mode than the other. There has been no study examining the interaction effect of modality and navigability.

In order to fill the research gaps, the purpose of this paper is (1) to examine the psychological effects of modality and navigability on virtual travel experience, and (2) to explain the psychological mechanism of how modality and navigability influence tourists' behavioral intention. Explaining human-computer interactions in the context of virtual travel, media equation theory and media richness theory would provide a fundamental theoretical lens to understand the technology effects of online travel media to enhance the quality of virtual travel experience. The investigation of technology effect on virtual travel experience would articulate key technology attributes of online travel media and examine its substantial psychological effects.

Literature review

In order to understand the effects of technology affordances on virtual travel experience and behavioral intention, this study first conceptualizes the multidimensionality of virtual travel experience. Next, this study proposes the distinctive psychological effect of modality and navigability on the affective and cognitive dimensions of virtual travel experience. Then, the relationship between virtual travel experience and behavioral intention is established.

Affective and cognitive dimensions of virtual travel experience

Traditionally, touristic experience is considered to have both affective and cognitive elements of temporality (Jennings & Weiler, 2006), a tourist moment (Cary, 2004), and the tourist gaze (Urry, 2002). In terms of affect, touristic experience contains positive and negative feelings of being outside of the ordinary daily life and confronting different cultures. At the same time, tourists are consistently involved in cognitive processes of collecting and recognizing markers (a piece of information about the space) to organize their experience (MacCannell, 1989). As symbols or spatial cues, markers can provide tourists with information about the structure of a destination. Similarly, in a virtual environment, tourists can experience emotional and cognitive responses to the mediated experience when exploring, being transported to, and feeling the virtual destination (Jun & Vogt, 2013; Tang & Jang, 2012). In this regard, virtual travel experience is conceptualized as a multi-faceted concept reflecting positive and negative experiential attributes.

Capturing both affective and cognitive dimensions, this study conceptualizes virtual travel experience with spatial self-location, affective engagement, disorientation, and a spatial mental model. Three dimensions (spatial self-location, affective engagement, and disorientation) are related to affection, and one (spatial mental model) represents cognition. Related to a sense of being there, spatial self-location refers to an individual's feeling of being part of the mediated environment and forgetting about the immediate space (Balakrishnan & Sundar, 2011; Cho et al., 2002). Affective engagement means an individual's emotional attachment to the moment of exploring a destination in a virtual environment (Flowerday & Schraw, 2003). Referring to a feeling of distraction or dizziness, disorientation reflects the negative affection when exploring a virtual environment (Zhang, Appelman, Choi, & Han, 2013). A spatial mental model means a tourist's level of understanding of the spatial structure of a virtual environment by recognizing markers that convey the information of the destination (Balakrishnan & Sundar, 2011).

Impact of modality on virtual travel experience

Modality refers to an affordance shaping the mode of communication (input and output of information) or the presentation of a message, such as text, audio, picture, and video (Sundar, 2000). Urry (2002) posits that tourists are primarily dependent on their vision when experiencing the landscapes of a destination. Hence, although travel media have been developed as a multimedia platform, it is not surprising that the presentation mode of pictorial information plays a fundamental role in conveying the experiential quality of a destination (MacKay & Fesenmaier, 1997; Wearing, Stevenson, & Young, 2010). Ever since photography was introduced in the 19th century, there have been various ways of presenting pictorial information (Jacobs, 2004). Recently, online travel media have been offering new platforms to (re)construct pictorial information in a virtual environment (Kim & Richardson, 2003; Tussyadiah & Fesenmaier, 2009). Whereas traditional travel media present still pictures as the primary presentation mode in magazines, brochures, and postcards, online travel media are using seamlessly integrated visuals to portray the landscapes of a destination (e.g. virtual reality simulations, 3D virtual environments, 360° panoramic pictures, and video clips).

For travel websites, one recent interesting aspect of modality is the pervasive use of panoramic photography. Panoramic photography refers to a technique of presenting pictorial information with a prolonged field of vision (Jacobs, 2004). Using specialized equipment and computer programs, 360° panoramic pictures can entirely capture and portray the spatial information of a particular landscape (Jacobs, 2004). One 360° panoramic picture fully rotating a visual field contains the same amount of information as several still pictures capturing different angles of a landscape. By extending tourists' viewing angle and connecting each segment of pictorial information, 360° panoramic pictures provide an approximate reality of looking around a landscape. Hence, for online travel marketing, a higher level of modality, such as seamlessly integrated visual images, video clips, and 360° panoramic pictures, becomes a cost-efficient substitute for real travel experience (Cho et al., 2002; Tussyadiah & Fesenmaier, 2009). Although studies have supported that pictorial information in travel media substantially influences tourists' destination image formation (Cormany & Baloglu, 2011; MacKay & Fesenmaier, 1997), it is not yet clear how the mode of presenting pictorial information is related to the virtual travel experience. To compare the effects of different presentation modes, modality in this study is operationalized as the type of photography used to present the visual information of a tourist destination: still pictures and 360° panoramic pictures.

Researchers in media effect studies postulate that the psychological effects of technology affordance should be considered in multiple aspects because a single technical feature can produce both positive and negative user experiences (Balakrishnan & Sundar, 2011; Reeves & Nass, 1996; Sundar, 2008). For instance, moving or animated images can be beneficial to increase the level of attention but may also cause a feeling of dizziness. From this perspective, the unique effects of modality on four dimensions of virtual travel experience are separately proposed in the following.

Modality is an important technology affordance that influences the quality of the virtual travel experience because it has the potential to induce the "being there" heuristic (Sundar, 2008, p. 81). Media richness theory posits that a richer communication mode can increase a sense of realism (Daft & Lengel, 1984). Huang, Backman, Backman, and Chang (2016) also propose that a higher level of modality (e.g. 3D virtual reality) is considered to produce a stronger immersive user experience than a lower level of modality (e.g. two-dimensional photography). In a similar way, panoramic pictures providing richer spatial information with the connected visuals of landscapes may evoke the "being there" heuristic, which possibly leads to a higher sense of being located in the mediated environment than is the case with still pictures. Thus, the effect of modality on spatial self-location is hypothesized as follows: H1a:

Panoramic pictures of a tourist destination will lead to a greater spatial self-location than still pictures.

Novelty and exploration have been regarded as an important motivation factor fulfilling pleasure in a travel experience (Bello & Etzel, 1985). Presenting vivid and hyper-realistic visual images, newly developed modality technologies influence individuals' affection (Sundar, Narayan, Obregon, & Uppal, 1998). Related to users' affective response to advanced media technology, Sundar (2008) proposes that a higher level of modality can increase a positive feeling and immersion by producing "coolness" or "novelty" heuristics. A new type of presentation mode providing richer travel information (e.g. augmented reality) becomes a useful tool to elicit a positive attitude (Chung, Lee, Kim, & Koo, 2017). In a sense that panoramic photography is a relatively new and still evolving technical feature applied to online travel media, panoramic pictures may provoke a more immersive experience than still pictures. H1b:

Panoramic pictures of a tourist destination will lead to a greater affective engagement than still pictures.

When processing pictorial information, people focus on visual images on screen. When the visual images are moving, people's eyes need to follow them. In this case, a moving focal lens may produce the negative feelings of dizziness (Zhang et al., 2013). In their experiments, Kuze and Ukai (2008) found that users, especially less experienced one, feel dizziness and nausea when tracking moving images or following a focal lens. Similarly, Sundar (2008, p. 81) argues that a higher level of modality has the potential to elicit the "distraction" heuristic. In the real world, humans feel dizziness or nausea when their eyes track fast moving subjects. By applying the laws of physics to a media environment, the media equation theory suggests that looking at moving images on screen can also cause a feeling of dizziness (Reeves & Nass, 1996). Locating moving objects in a 3D space, stereoscopic 3D-TV viewing would produce the negative feelings of discomfort and sickness compared to traditional 2D TV viewing (Brunnström, Wang, Tavakoli, & Andrén, 2017). Because 360° panoramic pictures are created by a full rotation of a vision field, it is necessary to follow a moving focal lens to see the entire image of panoramic pictures. Compared to the static viewpoint of still pictures, the moving images of a landscape in panoramic pictures may cause a higher level of distraction or dizziness. H1c:

Panoramic pictures of a tourist destination will lead to greater disorientation than still pictures.

For the cognitive dimension of virtual travel experience, modality is evidently related to the formation of a spatial mental model (Reeves & Nass, 1996; Wirth et al., 2007). Researchers in media effect studies postulate that motion on the screen has the power to change the cognitive dimension of a virtual experience (Balakrishnan & Sundar, 2011; Reeves & Nass, 1996). As motion is an essential characteristic of the real world, Reeves and Nass (1996, p. 219) argue that motion on the screen increases users' attention and memory by inducing "a visual orienting response". In addition, the extension of the field of vision helps users to better understand the spatial structure of a virtual environment (Balakrishnan & Sundar, 2011). Similarly, media richness theory posits that a higher level of presentation mode may establish a better setting for approximate reality to provide accurate communication information (Daft & Lengel, 1984). Because of the enhanced cognitive attention on moving images and the seamless connection of pictorial information, users of panoramic pictures can more easily understand and interpret the spatial structure of a virtual environment than users of still pictures. H1d:

Panoramic pictures of a tourist destination will lead to a greater spatial mental model than still pictures.

Impact of navigability on virtual travel experience

Navigability is an affordance that determines the degree of users' movement in a web interface (Sundar, 2008). Because online travel media construct navigable web structures with hyper-linked webpages and multilevel layers, tourists can browse and explore a virtual environment. From the perspective of human–computer interaction, Balakrishnan and Sundar (2011) conceptualize navigability based on the 2D concept of navigation: travel and way-finding. Travel refers to physical movement from one location to another location, and way-finding represents the cognitive process of finding the way to a designated location. Corresponding to the dimensionality of navigation, Balakrishnan and Sundar (2011) articulate two aspects of navigability: traversibility and guidance. Reflecting the dimension of travel, traversibility is defined as the level of controlling a user's movement and viewpoint in a virtual environment. In online travel media technical features such as arrows to move forward or backward, clicking to transport into a different landscape, or mouse dragging to spin a user's viewpoint, are associated with traversibility. In terms of way-finding, guidance indicates the level of scaffolding, which helps tourists understand the structure of a virtual environment and to find directions. Technical features of guidance in online travel media include map functions or indicators of a user's current and designated location.

Researchers have proposed that recognizing or using navigability can influence media users' perceived quality, attitude, and behavior (Balakrishnan & Sundar, 2011; Sundar, 2008; Sundar et al., 2012). The mere presence of visual cues of navigability (e.g. navigation buttons and arrows) is capable of generating certain types of heuristics (e.g. browsing, elaboration, scaffolding, and prominence), which influence the perceived quality of information and the virtual experience (Sundar, 2008). In addition to the visual cue effect, researchers have examined actual use effect in a sense that media users can experience the full potential of navigability features by using them (Sundar et al., 2012; Wu, 2010). When exploring navigable web interfaces, media users tend to consider information search for tangible retail products (e.g. computers and clothing) more enjoyable and immersive than non-navigable web interfaces (Fiore, Kim, & Lee, 2005; Suh & Chang, 2006; Wu & Chang, 2005). Similarly, for online travel media recognizing and/or actually using navigability features would enrich the virtual travel experience. Hence, navigability in this study is operationalized as the existence of technological features that provide the possibility of controlling users' movement and providing guidance functions in a virtual environment. The impacts of navigability on dimensions of virtual travel experience are proposed in the following.

Empirical studies have supported a positive impact of navigability on virtual travel experience (Balakrishnan & Sundar, 2011; Hyun & O'Keefe, 2012). Particularly for spatial self-location, navigability may have the power to produce the feeling of being there (Balakrishnan & Sundar, 2011; Hyun & O'Keefe, 2012; Sundar, 2008). Navigability features would positively influence tourists' perception of movement when recognizing the possibility of movement or actually moving around in a virtual environment. Because navigability can increase the sense of exploring and moving around, tourists may develop a feeling of being located in a virtual environment. Also, when using navigability features, tourists can experience a sense of control. Studies on video gaming and virtual reality have supported the argument that a sense of control is a central element in producing a feeling of being in a virtual environment (Klein, 2003; McMillan & Hwang, 2002). Hence, presence of navigability is expected to enhance tourists' spatial self-location by allowing them to control their movement. H2a:

Presence of navigability will lead to a greater spatial self-location than absence of navigability.

The presence of navigability provides users with a broader scope of choices and control over their movement in a virtual environment (Balakrishnan & Sundar, 2011; Sundar, 2008). According to the enhanced affective engagement model, the existence of choice positively influences media users' affective engagement in completing a required task (Cordova & Lepper, 1996; Flowerday & Schraw, 2003; Schraw, Flowerday, & Reisetter, 1998). Similarly, media flow theory posits that users' level of control and the corresponding immediate feedback can lead to a flow-like experience of being fully immersed in a given activity (Sherry, 2004). Empirical evidence supports that user control increases an individual's emotional engagement when using media (Flowerday & Schraw, 2003; Schraw et al., 1998). For online travel media, navigability inherently involves a certain level of freedom to control users' movement in a virtual environment. Thus, presence of navigability is expected to enhance tourists' affective engagement in using online travel media. H2b:

Presence of navigability will lead to greater affective engagement than absence of navigability.

Navigability is related to users' power to manage the volume of information process by changing the steering angle of visual images or controlling a moving focal lens on screen. For instance, the presence of navigability allows users to control the degree of changing a visual field and the speed of looking around a landscape. Using navigability features, tourists can decide on the speed with which a focal lens moves, fast or slow, as they explore in a virtual environment. Synthesizing recent studies on video gaming, Crick (2010) argued that a higher level of control in first-person visual mode reduces the feeling of dizziness while increasing the sense of presence and affective engagement. Thus, this study hypothesizes that navigability may reduce tourists' feeling of disorientation. H2c:

Presence of navigability will lead to lesser disorientation than absence of navigability.

Navigability is also related to the cognitive dimension of virtual travel experience. Related to spatial mental modeling, navigability provides the flexibility of processing the amount of pictorial information. Using navigability features, tourists can better understand the spatial structure of a destination by spending more time on things they are interested in (Balakrishnan & Sundar, 2011). In addition, because navigability is the action-oriented technical feature that requires a certain level of attention to control, tourists may pay more attention to their movement when exploring a virtual environment (Reeves & Nass, 1996). According to the enhanced cognitive engagement model, the existence of choice is positively associated with an individual's attention to a given learning activity (Flowerday & Schraw, 2003). The increased attention will positively influence the level of understanding the spatiality of a virtual environment. By providing the possibilities of focusing on particular pictorial information, navigability may increase tourists' spatial mental model. H2d:

Presence of navigability will lead to a greater spatial mental model than absence of navigability.

Relation between virtual travel experience and behavioral intention

Researchers have suggested that there is a positive relation between virtual travel experience and tourists' behavioral intention to visit and recommend to others (Hyun & O'Keefe, 2012; Kang & Gretzel, 2012). Affect transfer models suggest that particular emotions and feelings generated from the mediated experience are transferred to an individual's attitude toward a product or service (Homer, 2006; Machleit, Allen, & Madden, 1993). Similarly, in tourism settings, there is empirical evidence supporting a positive relation between the emotional perception of touristic experience and behavioral intention (Lee, Lee, & Choi, 2011; Lee, Yoon, & Lee, 2007). In their study on the communication processing models of online travel information, Tang and Jang (2012) assert that affective dimensions of experiencing a travel website are positively associated with tourists' attitude toward a destination and behavioral intention to visit. In this regard, this study proposes that the affective dimensions of virtual travel experience (i.e. spatial self-location, affective engagement, and disorientation) may have substantial effects on behavioral intention to visit and to recommend to others. H3a:

Greater spatial self-location will lead to greater behavioral intention.

H3b:

Greater affective engagement will lead to greater behavioral intention.

H3c:

Greater disorientation will lead to lesser behavioral intention.

Tourism researchers have suggested that the cognitive process of evaluating a tourism product or service is a primary determinant for satisfaction and behavioral intention (Lee et al., 2011, 2007). When exploring a travel website, cognitive elaboration of using high-quality information has a positive impact on attitude and behavioral intention (Tang & Jang, 2012). Hence, this study assumes that comprehensive understanding of a destination (spatial mental model) is positively related to behavioral intention. Figure 1 illustrates the proposed relationships of technology affordances, four dimensions of virtual travel experience, and behavioral intention. H3d:

Greater spatial mental model will lead to a greater behavioral intention.

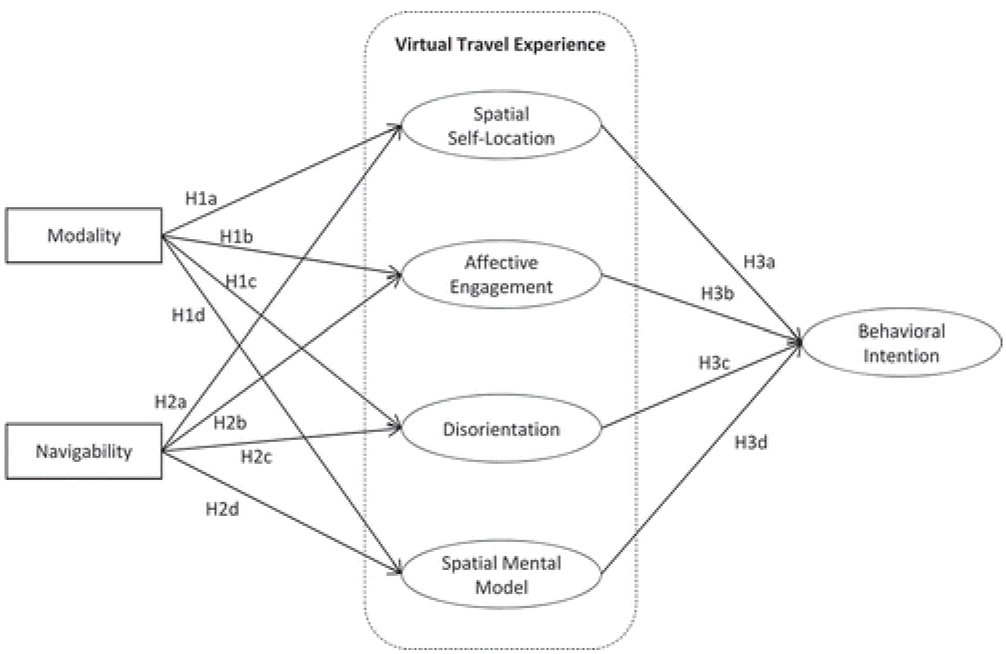

Figure 1. Proposed relationships of technology affordances, virtual travel experience, and behavioral intention. H: hypothesis.

Method

Research design

In order to examine the proposed relationships of technology affordances, virtual travel experience, and behavioral intention, a 2 (modality: still pictures versus panoramic pictures) × 2 (navigability: absence versus presence) between-subjects experiment was designed. This study took place in a computer-laboratory at a large university in the United States (US).

Participants

Initially, 218 participants were recruited from undergraduate classes in exchange for extra course credit. After excluding five cases due to non-adherence to the instructions or a large portion of missing data, 213 individuals aged 18–26 years ($M = 20.28$, $SD = 1.23$) were used for analysis. There were more female ($N = 157$, 73.71%) than male participants ($N = 56$, 26.29%).

Stimuli

In order to create the stimulus materials, a virtual travel web application (from www.airpano.com) portraying the visual landscapes of Easter Island, Chile, was used (Figure 2). This web application contains a map of the island and 13 360° panoramic pictures taken of actual sites (e.g. Moai statues, quarries, and other natural environment). With built-in navigability features, tourists can navigate and explore different touristic sites by either mouse-dragging or clicking navigation buttons on the map and pictures.

Figure 2. Snapshots of the stimuli (map of Easter Island and a still picture of a location).

Manipulation

Modality was manipulated by converting 13 panoramic pictures into 52 still pictures ($13 \times 4 = 52$) to maintain the same amount of visual information of the destination. For instance, participants in the still pictures condition watched 52 still pictures whereas participants in the panoramic pictures condition watched 13 panoramic pictures. Navigability was manipulated by disabling (absence of navigability) or enabling navigability features (presence of navigability). Participants in the absence of the navigability condition passively watched automatically rotating pictures, while participants in the presence of the navigability condition were allowed to use a mouse to click or drag to move around or see different angles of the sites.

In order to examine the effects of modality and navigability, different web interfaces were created for four conditions (condition 1 = still pictures and absence of navigability; condition 2 = still pictures and presence of navigability; condition 3 = panoramic pictures and absence of navigability; condition 4 = panoramic pictures and presence of navigability). All participants were instructed to use a demonstration of a new travel website to explore the island. They were asked to explore all 13 places marked by Moai icons (Table 1). In condition 1, participants watched still pictures that were automatically changed every 5 seconds. Participants in condition 2 were able to click icons they wanted to see in order, and were then told to use arrows to see different angles of each site with four still pictures. For condition 3, participants watched 13 panoramic pictures that automatically changed and rotated for 20 seconds. Participants in condition 4 were allowed to click icons they wanted to see in order, and were then able to click or mouse-drag to see different angles of each site with a panoramic picture. After creating the stimuli, a pilot test with five participants for each condition was conducted to identify and resolve potential issues with regard to the stimuli.

Table 1. Results of confirmatory factor analysis for the virtual travel experience dimensions and behavioral intention.

Item	**FL**[a]	**t**	**SE**
Spatial Self-Location			
I felt like I was actually there on the island.	.91	NA[b]	NA
I felt as though I was physically present on the island.	.86	16.26	.06
It seemed as though I actually took part in action on the island.	.81	14.84	.06
Affective Engagement			
I appreciate the choices I got to make in this study.	.85	NA	NA
I liked what I was asked to do in this study.	.74	12.00	.08
I was highly motivated to participate in this study.	.71	11.49	.08
I enjoyed participating in this study.	.69	11.06	.07
I could easily identify with what I see.	.64	9.96	.09
I felt I had a great deal of control in this study.	.61	9.29	.09

I tried really hard in this study.	.44	6.47	.10
Disorientation			
I felt I had a headache.	.89	17.48	.05
I felt dizzy.	.88	NA	NA
I felt nauseous.	.81	15.00	.04
I had eyestrain.	.75	13.23	.06
Spatial Mental Model			
I was able to imagine the arrangement of the sites on the island very well.	.78	10.00	.09
I had a precise idea of the spatial surroundings on the island.	.74	9.64	.09
I was able to make a good estimate of how far apart things were from each other on the island.	.72	NA	NA
I was able to make a good estimate of the sizes of objects on the island.	.57	8.63	.10
I still have a concrete mental image of the island.	.57	7.48	.08
Behavioral Intention			
I would recommend the tourist destination I viewed on the website to a friend.	.87	NA	NA
I would say positive things about the tourist destination.	.84	15.05	.05
I would visit the tourist destination I viewed on the website.	.82	14.64	.06
I would seek more information about the tourist destination I viewed on the website.	.73	12.37	.06

Note. [a] FL = factor loading, t = t-value, SE = standard error; b t-values for parameters fixed at 1.0 for identification purposes were not available (NA)

Measures

A post-experimental questionnaire was used to measure participants' touristic experience in the virtual environment, including spatial self-location, affective engagement, disorientation, and spatial mental model and behavioral intention to visit and recommend. For spatial self-location, three items (e.g. "I felt as though I was physically present in this place") were adopted from the Spatial Presence Questionnaire (Vorderer et al., 2003). Derived and modified from Flowerday and Schraw (2003), 11 items were used to measure affective engagement (e.g. "I enjoyed participating in this study"). Operationalized as the degree of dizziness felt during the exploration, disorientation was measured with four items (e.g. "This web interface made me feel dizzy") from Zhang et al. (2013). Spatial mental model was measured with five items (e.g. "I was able to imagine the arrangement of the sites in this place very well") derived from the Spatial Presence Questionnaire (Vorderer et al., 2003). In terms of behavioral intention (e.g. "I would visit the tourist destination I viewed on the website"), four items were adopted from the work of Zeithaml, Berry, and Parasuraman (1996). All items for spatial self-location, affective engagement, disorientation, spatial mental model, and behavioral intention were measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). This study also measured prior knowledge of a destination as a control variable that may influence behavioral intention by using three items (previous experience, familiarity, and expertise) derived from Kerstetter and Cho (2004). A full list of the items from each measure can be viewed in Table 1.

Procedure

Individuals were invited to participate in this study by signing up for one of 50 time slots from May to August 2013. Randomly assigned to one of the four experimental conditions, each time slot was independently operated with 2–10 participants. Upon their arrival at the computer laboratory, participants were asked to fill out a consent form and pre-experimental questionnaire with paper and pencil recording their demographic information. Then they were briefed about the overall experimental procedure and instructed that they would be either watching or exploring a demonstration of a new travel website. Then, basic information about the destination was given: "You will explore Easter Island in Chile. Easter Island is famous for its 887 monumental statues, called Moai. This island is a UNESCO world heritage site." The instruction to use each web interface was delivered to participants by the same researcher. Then, participants experienced the assigned web interface using one of the desktop personal computers in the laboratory (full screen on a 17-inch monitor). Participants in conditions 1 and 3 (M = 390.00 seconds, SD = .00) spent more time exploring the given web interface than participants in condition 2 (M = 347.50 seconds, SD = 75.73) and 4 (M = 366.48 seconds, SD = 57.01). After they finished exploring the web interface, participants were asked to fill out a post-experimental online questionnaire using Qualtrics Online Survey software.

Results

The data were screened for normality and missing values. Based on the shape of the histogram and the range of kurtosis (|<|10) and skewness (|<|3), the variables followed a normal distribution (Kline, 2011). Less than 5% of the data was missing (.0–.9%); thus, missing values were not considered a problem and substituted with an expectation-maximization procedure (Tabachnick & Fidell, 2000).

Spatial self-location, affective engagement, disorientation, spatial mental model, and behavioral intention were measured in this study. A confirmatory factor analysis was conducted to examine reliability and validity of the five dimensions. Based on model fit indices (χ^2 = 520.064, df = 220, p = .000; RMSEA = .082, 90% CI = .075-.089; NNFI = .91; CFI = .90), the initial measurement model had a marginally acceptable model fit (Hu & Bentler, 1999). However, after four items in affective engagement were eliminated iteratively because the modification indices showed that one item had an unacceptably weak factor loading less than .4 (Kline, 2011) and three items had high correlations of errors (Kline, 2011), the model fit of the final measurement model was substantially improved (χ^2 = 404.064, df = 220, p = .000; RMSEA = .063, 90% CI = .056-.070; NNFI = .92; CFI = .93). All factor loadings (λ = .57–.91) were statistically significant (see Table 1).

As shown in Table 2, each construct had a high composite reliability (CR) (.83–.90) and acceptable average variance extracted (AVE) (.44–.73). Discriminant validity was also confirmed as each measure had a higher value of AVE than the square of the inter-correlation between corresponding measures (Fornell & Larcker, 1981).

Table 2. Correlations, composite reliability, AVE, Mean, and SD.

	SSL	**AE**	**DIS**	**SMM**	**BI**
SSL	1.00				
AE	.44	1.00			
DIS	-.17	-.39	1.00		
SMM	.48	.52	-.31	1.00	
BI	.52	.60	-.27	.43	1.00
CR	.89	.84	.83	.90	.89
AVE	.73	.44	.70	.49	.67
Mean	4.54	5.56	2.23	5.07	5.60
SD	1.32	.86	1.36	1.04	1.13

SSL: spatial self-location; AE: affective engagement; DIS: disorientation; SMM: spatial mental model; BI: behavioral intention; CR: composite reliability; AVE: average variance extracted; SD: standard deviation.

In order to examine the effects of modality and navigability on the dimensions of virtual travel experience, a series of 2 (modality) × 2 (navigability) analyses of covariance (ANCOVAs) was conducted (Table 3). Regarding the potential effects on virtual travel experience, variances for age, gender, exploration time, and prior knowledge were statistically controlled. Among the three items measuring prior knowledge, only two items capturing familiarity and expertise were used to create a construct because there was no participant who had actually visited Easter Island. Because familiarity/expertise was substantially positively skewed, a new construct (x`) was created; x` = log10(x) (Tabachnick & Fidell, 2000).

Table 3. Results of two-way ANCOVAs on virtual travel experience.

	Sum of Squares	**df**	**F**	**Sig.**
Spatial self-location				
Modality	12.55	1	7.73	.00**
Navigability	5.48	1	3.38	.07
Modality * Navigability	8.23	1	5.07	.03*
Age	1.84	1	1.13	.29
Gender	2.40	1	1.48	.23
Exploration time	1.35	1	.83	.36
Prior knowledge	.70	1	.43	.51
Affective engagement				
Modality	2.08	1	2.97	.09
Navigability	2.83	1	4.03	.05*
Modality * Navigability	3.32	1	4.73	.03*

Age	.20	1	.29	.59
Gender	.00	1	.00	.95
Exploration time	.41	1	.58	.45
Prior knowledge	2.63	1	3.74	.05
Disorientation				
Modality	70.12	1	48.15	.00***
Navigability	7.09	1	4.87	.03*
Modality * Navigability	1.69	1	1.16	.28
Age	2.74	1	1.88	.17
Gender	17.83	1	12.24	.00*
Exploration time	.00	1	.00	.96
Prior knowledge	.89	1	.61	.44
Spatial mental model				
Modality	4.02	1	3.91	.05*
Navigability	10.18	1	9.89	.00**
Modality * Navigability	.00	1	.00	.97
Age	.46	1	.45	.50
Gender	1.82	1	1.77	.19
Exploration time	.00	1	.00	.94
Prior knowledge	3.53	1	3.43	.07

*p < .05; **p < .01; ANCOVA: analysis of covariance.

In terms of spatial self-location, the results revealed a reliable main effect for modality (F = 7.73, df = 1, $p < .01$). Spatial self-location was significantly higher in the condition of panoramic pictures (M = 4.79, SD = 1.35) compared to the condition of still pictures (M = 4.30, SD = 1.25). Thus, H1a was supported. The main effect for navigability was marginally significant (F = 3.38, df = 1, $p = .07$). Interestingly, the interaction on spatial self-location was significant (F = 5.07, df = 1, $p < .05$). As depicted in Figure 3, when panoramic pictures were presented, spatial self-location was higher in the presence of the navigability condition (M = 5.16, SD = 1.23) than in the absence of the navigability condition (M = 4.39, SD = 1.37). However, when still pictures were presented, there was no significant difference between participants in the absence or presence of the navigability condition, showing that H2a was partially supported. Control variables were not significant.

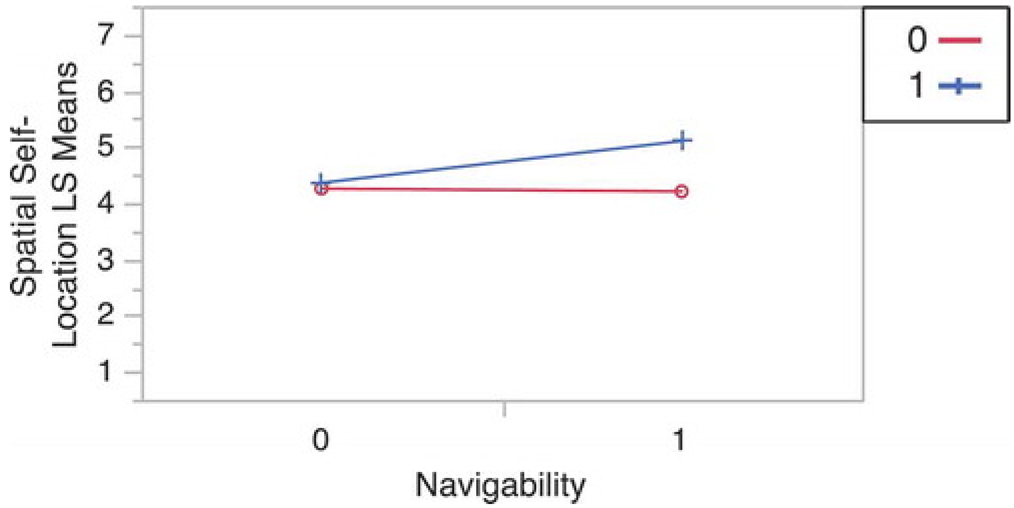

Figure 3. Interaction effect of modality and navigability on spatial self-location. 0 = still pictures; 1 = panoramic pictures.

The results for affective engagement revealed that the main effect for modality (F = 2.97, $p = .09$) was marginally significant (H1b was not supported), and the main effect for navigability (F = 4.04, df = 1, $p < .05$) was significant, supporting H2b. Participants in the presence of the navigability condition (M = 5.71, SD = .84) reported a higher affective engagement than those in the absence of the navigability condition (M = 5.41, SD = .86). Similar to spatial self-location, the interaction on affective engagement was significant (F = 4.73, df = 1, $p < .05$). As shown in Figure 4, when panoramic pictures were presented, affective engagement was higher in the presence of the navigability condition (M = 5.73, SD = .73) than in the absence of the navigability condition (M = 5.19, SD = .87). However, when still pictures were presented, there was no significant difference between participants in the absence or presence of the navigability condition. Control variables were not significant.

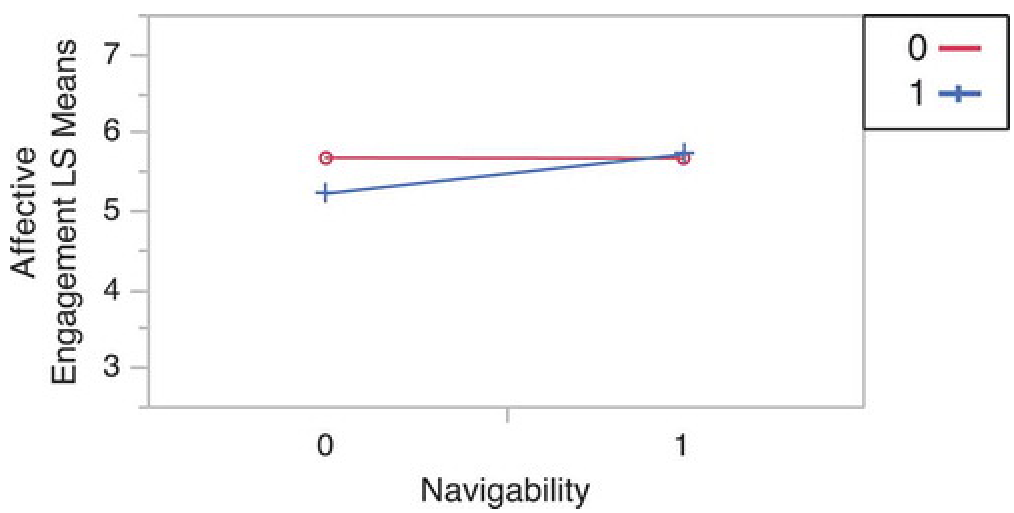

Figure 4. Interaction effect of modality and navigability on affective engagement. 0 = still pictures; 1 = panoramic pictures.

With regard to disorientation, the results revealed that the main effect for modality (F = 48.15, df = 1, $p < .01$) as well as the main effect for navigability (F = 4.87, df = 1, $p < .05$) were significant. Both H1c and H2c were supported. Participants viewing panoramic pictures (M = 2.76, SD = 1.52) felt more disorientation than those viewing still pictures (M = 1.71, SD = .94). However, the presence of navigability (M = 1.99, SD = 1.13) significantly reduced participants' feeling of disorientation compared to the absence of navigability (M = 2.49, SD = 1.56). The interaction effect was not significant. Among control variables, only gender had a significant effect (F = 12.24, df = 1, $p < .01$). Female participants (M = 2.37, SD = 1.41) reported a higher level of disorientation than males (M = 1.84, SD = 1.14).

In terms of the spatial mental model, the main effects for both modality (F = 4.02, df = 1, $p < .05$) and navigability (F = 10.18, df = 1, p < .01) were significant, supporting H1d and H2d. As predicted, the spatial mental model was higher in panoramic pictures (M = 5.19, SD = 1.00) than in still pictures (M = 4.95, SD = 1.07). Also, participants reported a higher spatial mental model in the presence of navigability (M = 5.29, SD = .96) compared to the absence of navigability (M = 4.84, SD = 1.08). However, the interaction and control variables were not significant.

In order to examine the relationship between virtual travel experience and behavioral intention, a hierarchical multiple regression analysis was conducted. Control variables (age, gender, major, exploration time, and familiarity/expertise) were included in the first-step model. As shown in Table 4, only familiarity/expertise had a significant positive effect and the effects of other variables were not significant. The five control variables accounted for 5% of the variance in behavioral intention. The second step of the model included the four constructs of the virtual travel experience. Spatial self-location and affective engagement had a significant effect whereas the effects of disorientation and the spatial mental model were not significant. Thus, H3a and H3b were supported. H3c and H3d were not supported. The final model explained 40% of the variance in behavioral intention, an increase of 35% with the inclusion of the four virtual travel experience dimensions.

Table 4. Hierarchical multiple regression model on behavioral intention.

Independent variable	**B**	**S.E.**	**t-value**
Step 1			
Age	.05	.72	.90
Gender	-.10	1.19	1.49
Major	0.04	.18	.23
Exploration time	.00	.11	.14
Familiarity/Expertise	.81	6.43	8.04**
$R^2 = .05$			
Step 2			
Spatial self-location	.26	18.59	23.22**
Affective engagement	.47	22.12	27.63**
Disorientation	-.02	.14	.18
Spatial mental model	.05	.46	.58

R^2 = .40; R^2 Change = .35

*p < .05; **p < .01; LS: least squares

Further, considering the sequential relationships between technology affordance, virtual travel experience, and behavioral intention, the mediating role of virtual travel experience was examined. Based on the interaction effects of modality and navigability on spatial self-location and affective engagement, the mediation effects for these two constructs were tested using moderated mediation models (Hayes, 2013). For spatial self-location, when still pictures were presented, the mediation effect was not significant (indirect effect = .02; CI = -.19 – .20). However, when panoramic pictures were presented, spatial self-location mediated the effect of navigability on behavioral intention (indirect effect = .32; CI = .11 – .55). Similarly, the mediation effect of affective engagement on the relationship between navigability and behavioral intention was significant with panoramic pictures (indirect effect = .37; CI = .16 – .62), but not still pictures (indirect effect = .04; CI = -.19 – .25). The mediation roles of disorientation and spatial mental model were not supported. Given that two constructs of virtual travel experience had a significant mediation effect for the panoramic pictures condition, a multiple mediation model was applied to compare the mediation effects of spatial self-location and affective engagement. By selecting only participants who received panoramic pictures, the mediating roles of spatial self-location and affective engagement on the relationship between navigability and behavioral intention were examined with bootstrapping procedures using 2000 bootstrap samples and bias-corrected confidence intervals. This analysis revealed significant indirect effects for both mediators. The mediation effect for affective engagement was stronger than that for spatial self-location. The results of this study are summarized in Figure 5.

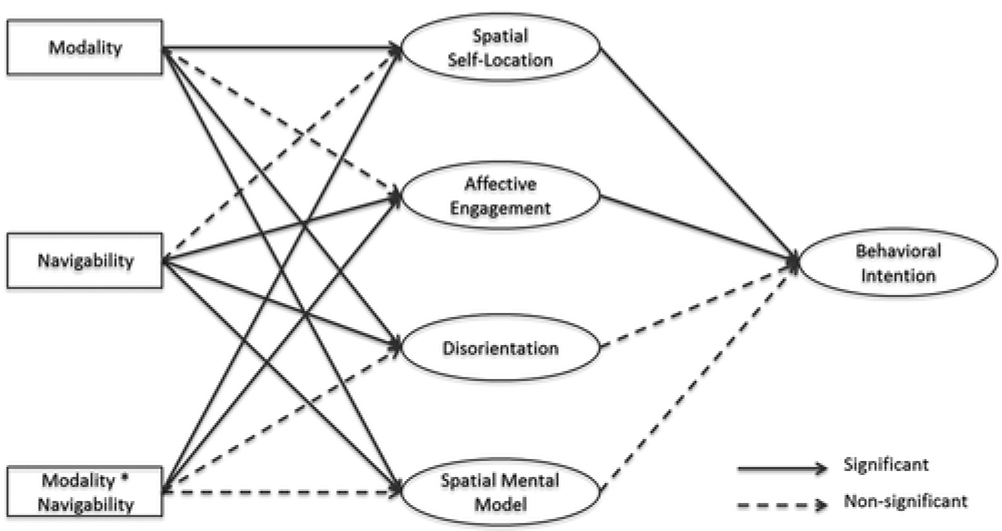

Figure 5. Results of the relationships between modality, navigability, virtual travel experience, and behavioral intention.

Discussion

For online travel media, technology affordances determine how tourists experience the pictorial information of a destination (Balakrishnan & Sundar, 2011; Huang et al., 2016). Focusing on the mode of presenting pictorial information and the possibility of movement in a virtual environment, the purpose of this experiment was to understand the effects of modality and navigability on virtual travel experience and behavioral intention. The distinctive psychological effects of modality and navigability were examined for both affective (i.e. spatial self-location, affective engagement, and disorientation) and cognitive (i.e. spatial mental model) dimensions of virtual travel experience. Furthermore, by scrutinizing the mediating role of virtual travel experience, this study attempted to explain the psychological mechanism of how modality and navigability influence tourists' behavioral intention to visit and recommend to others.

By supporting the effects of affordances on touristic experience, the findings provide theoretical contributions to the tourism literature. First, this study provides empirical evidence that not only the quality or content of pictorial information, but also technical features of online travel media, can elicit substantial psychological effects. As McLuhan (1964) argues, "the medium is the message", this study proposes that the technical form of online travel media influences how tourists perceive the pictorial information of a destination. Consistent with previous research on the technical form of web interfaces and user experience (Hyun & O'Keefe, 2012; Wu & Chang, 2005), the results indicated that several dimensions of virtual travel experience were influenced by affordances in constructing the spatial structure of a destination in a virtual environment. Also, this study adopted the variable-centered approach (Reeves & Nass, 1996; Sundar, 2009) to differentiate the effects produced by modality and navigability. By supporting that each affordance conveys different types of heuristics (Sundar, 2008), the results revealed that the psychological effects of modality and navigability are distinctive depending on the dimensions of virtual travel experience.

For spatial self-location, panoramic pictures provided an enhancement of tourists' feeling of being located in a virtual environment compared to still pictures. In a sense that a richer presentation mode is associated with a higher level of realism, this result is consistent with media richness theory (Daft & Lengel, 1984). More importantly, this study found that the effect of navigability is dependent upon the condition of modality. For instance, the presence of navigability features increased spatial self-location only when panoramic pictures were presented. This result implies that navigability is useful to elicit the "being there" effect for a higher level of presentation mode that constructs a seemingly connected virtual environment. Similarly, this study revealed the interaction effect on affective engagement. With still pictures, affective engagement was high regardless of the existence of navigability features. However, when using panoramic pictures, affective engagement was significantly decreased in the absence of the navigability condition. Because they are unlike still pictures, 360° panoramic pictures inherently involve a moving focal lens and rotating image of a landscape; thus, participants may expect that panoramic pictures contain navigability features. This result suggests that navigability is considered to be a necessary condition for panoramic pictures to elicit participants' affective engagement in a given task.

Given that panoramic pictures produced a greater feeling of disorientation than still pictures, it is important to note that a higher level of modality is not always beneficial to enhancing the quality of virtual travel experience. This finding indicates that panoramic pictures seem to elicit distraction heuristics (Sundar, 2008). However, navigability was useful in reducing the level of disorientation, suggesting that user control is a fundamental feature to reconcile the negative affection of dizziness and distraction for the computer-mediated environment. Interestingly, there was a significant gender difference: female participants felt a higher level of disorientation than male participants. This may be because males tend to have more experience using panoramic images and 3D simulations embedded in video games and other computer tasks (Feng, Spence, & Pratt, 2007; Okagaki & Frensch, 1994).

For the cognitive dimension of the virtual travel experience, this study found that both modality and navigability have significant effects on spatial mental models. More specifically, panoramic pictures were beneficial to better understanding the structure of the virtual environment compared to still pictures. This result supports the argument that motion on the screen (Reeves & Nass, 1996) and the connection of pictorial information (Balakrishnan & Sundar, 2011) in panoramic pictures are helpful in conveying more accurate information about the landscapes of a destination. The presence of navigability features also led to a greater spatial mental model. Providing the possibility of movement, navigability often contains action-oriented technical features (Sundar, 2008). As the enhanced cognitive engagement model argues (Flowerday & Schraw, 2003) and the results of this study suggest, the availability of choice allowed by navigability can increase individuals' attention in a given task and their cognitive ability.

With regard to the current scholarly discourse on the relationships between virtual, imaginative, and corporeal travel (Reijnders, 2011; Urry, 2000), this study's findings provide preliminary evidence that the positive affect of virtual travel experience can be transferred to corporeal travel. More specifically, spatial self-location and affective engagement had significant positive effects on behavioral intention. Many tourism studies have shown that positive affective responses (e.g. emotional value, enjoyment, and satisfaction) elicited by a tourism service/product are strongly associated with tourists' behavioral intention and future behavior (Lee et al., 2011, 2007). Similarly, in the online context, Tang and Jang (2012) argue that the affective dimensions of experiencing travel websites can be easily transferred to an individual's attitude toward a website or destination, and travel intention. Uniquely, this study revealed the moderated mediation effects of modality and navigability on spatial self-location and affective engagement. Only when panoramic pictures were presented, positive affects (spatial self-location and affective engagement) mediated the effect of navigability on behavioral intention. Emphasizing the mediating role of positive affects for a higher modality of presenting pictorial information, this result helps to explain the underlying mechanism of how tourists' behavioral intention is influenced by navigability features.

However, the negative affect and cognitive dimension of virtual travel experience had no significant effects on behavioral intention in this study. In terms of disorientation, although there was a significant difference, the mean scores (M = 1.58–3.14; 7-point scale) in all four experimental conditions were low. In this regard, it is possible that participants might have felt a negligible level of disorientation to influence their behavioral intention. The affective–cognitive model of consumer decision-making (Shiv & Fedorikhin, 1999) posits that an individual's behavior is primarily influenced by the affective responses elicited by a given task if the availability of information is limited. Because participants only spent about 6.5 minutes on average on the given task, which mainly conveyed pictorial information, their behavioral intention could have been strongly influenced by affective responses, not the cognitive processing of recognizing and understanding symbols and spatial cues of a destination. In addition to the effects of virtual travel experience, this study supports previous research by Kerstetter and Cho (2004) that tourists' previous experience with a destination is strongly related to their behavioral intention. Yet, the findings are limited in terms of articulating a threshold when significant effects would occur because there were only two levels of modality and navigability. The student sample may enhance the internal validity of the experiment, but it also weakens the external validity.

This study provides several useful practical implications. First, tourism marketers and DMOs should keep in mind that the technical form of online travel media can induce substantial effects on mediated travel experience and behavioral intention. Modality and navigability are the main technology affordances accelerating visual innovation trends in online travel media. This study shows that modality and navigability shape and enhance the quality of mediated travel experience, providing ways of gazing upon and interacting with spatial and cultural landscapes of a destination. As online travel marketing becomes more competitive, adopting innovative visual technologies (Horng & Tsai, 2010; Lepp et al., 2011; Michaelidou et al., 2013), it is important to understand the pivotal role of modality and navigability in producing a positive touristic experience and increasing behavioral intention. In a sense that users' positive affection (spatial self-location and affective engagement) is significantly related to behavioral intention, newly developed modality, such as 3D virtual reality (VR) or augmented reality (AR), would be beneficial for online travel media to present a destination's visual images. Especially for the millennial generation and technology-savvy tourists, the mediated experience through the lens of AR/VR can be powerful enough to change their perceptions of the destination.

Second, the role of modality and navigability is applicable to the design of visual interfaces. Dissecting and focusing on fundamental technical components, the findings are not limited to the available technologies, but are also applicable to the design of newly emerging technologies, such as VR/AR simulations or near-field communication applications. For website designers or mobile application developers, this study's results suggest that adding new technology attributes is not necessarily beneficial. Instead, the psychological effects of each technical attribute should be considered in terms of multiple dimensions of mediated experience (Reeves & Nass, 1996). Web designers should carefully consider how tourists emotionally and cognitively respond to the different modes of visual images and navigability features when exploring a virtual environment.

Last but not least, it is important to understand and predict the combined effects of two or more technology affordances (Sundar, 2008). Considering the negative feeling of disorientation, a higher level of modality with moving images and a focal lens should be developed with built-in navigability features. For many VR simulations and devices it becomes an important technical agenda to resolve the side effects of nausea, dizziness, and distraction (Freeman, 2016). This study provides a design guideline and empirical evidence showing how navigability features can be utilized to reduce the feeling of disorientation. As more people travel with personal mobile devices equipped with wireless connectivity and the global positioning system (GPS), the findings emphasize the important role of navigability for location-based AR simulations (Chung et al., 2015; Jung et al., 2015). Navigability will broaden the scope of the user experience, synthetically interacting with the physical environments of a destination.

Responding to the emergence of new media technology, future research should be conducted to incorporate more diverse and advanced modes to portray a destination. Building on Balakrishnan and Sundar's (2011) conceptualization of the two dimensions of navigability, future research should be designed to differentiate the effects of technical features associated with traversibility and guidance. In this study, the cognitive dimension of virtual travel experience was self-reported. Considering the functions of the spatial mental model, however, Balakrishnan and Sundar (2011) suggest that there is an evident difference between an individual's perception and his or her actual achievement of spatial information. For instance, individuals tend to be generous when evaluating their perceived understanding of spatial information, even if actual understanding of the given spatial information is poor. Thus, researchers in future studies should examine how modality and navigability relate to the perceived and achieved spatial mental model and how their influence on tourists' behavioral intention differs.

Disclosure statement

No potential conflict of interest was reported by the authors.

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