The impact of destination images on tourists' decision making

A technological exploratory study using fMRI

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Abstract

Purpose – The purpose of this paper is to explore the influence of destination images on tourists' behavioral intention to select a destination for their next vacation. Most of previous studies investigated this relationship by interacting with tourists during their stay in the destination. However, this research examines the impact of destination images before tourists visit a destination, using functional technological-oriented magnetic resonance imaging (fMRI) approach to track brain activation during the decision to select a destination.

Design/methodology/approach – The proposed model is adopted from the theory of planned behavior. Study participants divide a set of hotel destination images into two groups: attractive and non-attractive destination images. A blocked design experiment was used during fMRI scan to track brain activities resulting from presenting the two groups of images to participants, and record the strength of their intention to visit the attractive destination.

Findings – The level of brain activation at the ventromedial prefrontal cortex (vmPFC) increased when participants were asked to assess the attractive destination images compared with the level of activation for non-attractive ones. Also, the positive attitude toward an attractive destination led to higher intention to visit that destination.

Research limitations/implications – This study enhances the authors' understanding of how tourists analyze destination images to reach a decision on future action. It can also be used to help destination managers define an advertisement strategy that makes their destination more attractive.

Originality/value – Although the literature reports considerable research on destination image and its influence on tourists intention, this is the first exploratory study to use the fMRI technology to investigate tourists' attitude toward destination images.

Keywords Decision-making, Intention, Consumer behavior, Attitude, Destination image, Functional magnetic resonance imaging

Paper type Research paper

Introduction

Numerous studies have pointed out the influence of tourism images on consumer behavior (Andrades-Caldito *et al.*, 2013; Chi and Qu, 2008; Mansfeld, 1992). Tourists make their decisions about visiting a place after they have created a mental picture of the place (Fridgen, 1987). Among researchers, there is a general agreement that destination images have a strong influence on consumers' travel decisions (Andrades-Caldito *et al.*, 2013; Chi and Qu, 2008; Alhemoud and Armstrong, 1996; Ahmed, 1991a). The concept of destination image has been used in tourism research since the early 1960s, and the influence of tourism images on the choice of destination has been considered by many researchers when they develop decision models (Gartner and Hunt, 1987; Ahmed, 1991b;

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Pike, 2007; Leong *et al.*, 2015). There is a broad agreement that the destinations with stronger positive images will have a higher probability of being selected by tourists when they make their decisions (Alhemoud and Armstrong, 1996; Chi and Qu, 2008).

In the tourism context, the image concept has been regarded as an attitudinal construct formed by consumers' perceptual interpretation of knowledge, feelings, and global sense about the destination image. In general, it is measured *after* tourists experience the destination by using surveys (Pantano and Servidio, 2011; Golmohammadi *et al.*, 2011). The underlying dimensions of destination images can include: travel environment, natural attractions, entertainment and events, historic attractions, infrastructure, accessibility, relaxation, outdoor activities, price and value (Chi and Qu, 2008). However, no study has explored the influence of destination image (as a pictorial representation of the place) *before* the tourists visit that destination and experience it. A destination image not only guides the initial stage of destination selection but also influences consumer subsequent behavior in terms of destination loyalty (Chi and Qu, 2008), and after-purchasing behavior (Bigne *et al.*, 2001), such as repeating a visit or recommending the destination to relatives and friends.

From a neuroscience prospective, images are used in many functional magnetic resonance imaging (fMRI) studies, often to investigate products (i.e. brands) evaluation during the consumer decision-making process. Such clinical studies have provided marketing researchers with important findings for better understanding brain reaction to product images. For example, it was found that specific brain regions become more active in response to object processing (Gallagher and Frith, 2003). Later, Paulus and Frank (2003) pioneered the first experiment for choosing explicit bottled brand images (soft drink) compared with bottles filled with water; they suggested that a particular brain region, the ventromedial prefrontal cortex (vmPFC), is important for reaching preference judgments because it shows increased activation during fMRI experiments. To support previous research findings, a study by Deppe *et al.* (2005) proposed that vmPFC is vital in the processing of emotions during consumer decision-making when comparing brands. Koenigs and Tranel (2008) found that any damage to the vmPFC impacts the ability of an individual to integrate information in the decision-making process.

The fMRI is used occasionally to investigate consumer behavior in the marketing domain, but for the tourism industry, no study has explored tourist behavior in selecting holiday destinations. To further elucidate the role of the vmPFC in identifying tourist preference, therefore, in particular for selecting a hotel destination, an fMRI experiment was performed to show how tourists evaluate the attractiveness of different hotel images, to reach a decision on selecting their next hotel vacation.

As previous research studies focus mainly on exploring the influence of destination image on tourists' behavior after they visit the destination (Pantano and Servidio, 2011; Golmohammadi *et al.*, 2011; Chi and Qu, 2008), this study aims to fill the gap in our understanding of how tourists evaluate a destination before making the decision to visit it. In this study, real pictures representing the destination were presented to tourists during fMRI decision-making experiment, to monitor brain activations resulting from tourists' attitude toward the presented images. Understanding how tourists respond to actual destination images before they visit the tourism destination would enable us to determine factors that influence their selection decision. Such factors can be used by destination marketers to develop better advertisement strategies, to improve the

attractiveness of the tourist destination and encourage tourists to make it their first choice for the next vacation.

Literature review

Research during the past three decades has demonstrated that image of a place is a valuable concept in understanding the destination selection process of tourists. Many studies have focused on the relationship between destination image and consumer behavior (Andrades-Caldito *et al.*, 2013; Chi and Qu, 2008; Pike, 2002; Milman and Pizam, 1995, Ahmed, 1994). There is broad agreement that destination image represents a consumer's overall perception or impression of a destination after he/she experienced it (Baloglu and McCleary, 1999; Fakeye and Crompton, 1991), or the psychological representation of a place (Alhemoud and Armstrong, 1996). It is, therefore, reasonable to assume that an image will have an impact on consumers' behavior when they shop for a tourist destination (Baloglu and McCleary, 1999). In the tourism industry, many researchers have investigated the importance of understanding forces that influence image development (Andrades-Caldito *et al.*, 2013; Ahmed, 1996; Kotler *et al.*, 1993).

Dichter (1985) defined image as an overall impression developed as an outcome of the assessment of individual attributes that contain cognitive and emotional components. This view is supported by other studies, suggesting that destination image involves both cognitive and affective factors (Moutinho, 1987; Milman and Pizam, 1995). Previous studies showed that image construct has two evaluation components, cognitive and affective. The cognitive evaluation reflects the knowledge about a destination's characteristics, whereas affective evaluation denotes the feelings toward a destination image. Both cognitive and affective evaluations are interrelated, resulting in overall image formation of that destination. Dobni and Zinkhan (1990) suggested that a perceptual experience is shaped through consumers' rational and emotional interpretations, and proposed that an image is affected by both stimulus components and the characteristics of the consumer.

Baloglu and McCleary (1999) conducted a study to identify the things that influence image development. They developed a model of image formation and studied the forces guiding the formation of a destination image. Their research finding emphasizes that a destination image is formed by both stimulus factors and tourist characteristics. The results of their investigation provide insights into how images of destinations should be developed, based on implementing strategic marketing programs for creating attractive tourism destination images. Later, Bigne *et al.* (2001) found a positive relationship between destination image and perceived quality and satisfaction, leading, in turn, to higher intention to revisit the destination and recommend it to others. In their study, the overall image construct was measured using a single measurement item because the focus of the study was to examine the relationship between destination image and other variables, rather than analyze the image construct itself. However, a single measurement item of destination image may not capture the total individual attitude toward the destination (Echtner and Ritchie, 1991).

Chi and Qu (2008) studied the impact of destination image on destination loyalty, which includes repeated purchasing and word-of-mouth (WOM) recommendations; they used 53 destination items across various dimensions to describe the destination image. They found that destination image had a significant influence on tourist satisfaction and subsequently on destination loyalty. The positive attitude toward the overall image of a

destination was embraced by study participants, leading them to make an optimistic evaluation of their experience during the stay. On the other hand, it also increased their intention to repeat the same experience and recommend it to others.

When consumers start planning for their next vacation, many of them use online tourism Web sites to find an attractive destination (Bigne *et al.*, 2001). By navigating through the Web site, images about the destination start to form in the consumer's mind about the nature and quality of the destination (Phelan *et al.*, 2013). Subsequently, based on the final evaluation, the consumer makes a decision to select a particular destination, or navigate further. A good Web site, therefore, is one of the most important tools managers can use to build an attractive image for their business. Marketing managers have to make a vital decision when it comes to selecting what should be included in their Web site. Although using Web sites is widespread practice in the tourism industry, there is considerable debate on what should be included in Web sites to make them most attractive and encourage consumers to make the decision to select a particular destination.

The fMRI technique started to enter the marketing domain in the early 2000s, when studies began to confirm the importance of the vmPFC region in human decision-making (Fellows and Farah, 2005; Hsu *et al.*, 2005). From a marketing perspective, this issue is important to understanding the stimulations that cause more brain activation than other stimulations during the process of decision-making. Yoon *et al.* (2006) performed fMRI experiments to explore whether semantic judgments of images of products and humans are processed in the same brain regions. They found that individuals analyze descriptive judgments on product images differently than they process judgments on human images. Their research outcome stresses the concept of brand personality, and demonstrates that human brain uses different regions to process brand images.

In addition, there is mounting evidence that the vmPFC region processes basic information about the relative importance of alternatives, predicting an explicit role for this region in elucidating decision-making behavior of an individual in selecting a specific option. To confirm the importance of this region in the decision-making process, Fellows and Farah (2005) found that any damage to this region can cause adverse effects on the behavior of the consumer, in particular, reduced ability to make good judgments and difficulty in choosing between alternatives. A subsequent study by Santos *et al.* (2011) explored the role of vmPFC in assigning preference to everyday brands, where they separated stimuli (images) into different categories: positive, indifferent, and fictitious brands; then, they examined the associated brain activities in the vmPFC before and after the decision-making process. They found that vmPFC was more active after the selection process than during the decision process. This study is the first attempt to explore the ability of fMRI to track brain activation during the process of evaluating destination images, and find the relationship with a tourist's intention to visit a destination.

fMRI technology in consumer behavior research

As the long-term success of a company depends in part on maintaining consumers, the marketing literature has investigated extensively the factors underpinning consumer behavior to select specific products and services (Bansal *et al.*, 2005; Lemon *et al.*, 2002). However, recent advances in neuroimaging technology, particularly fMRI technology,

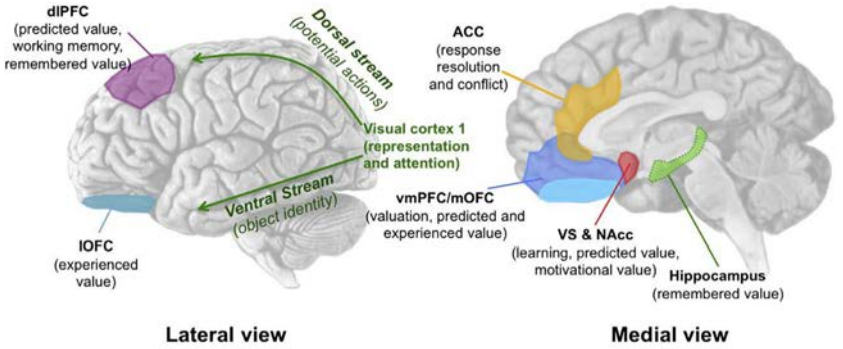
have motivated several studies to explore consumer behavior from the neuroscience prospective (Paulus and Frank, 2003; Schaefer *et al.*, 2006; Klucharev *et al.*, 2008). These studies concentrated on determining the relationship between certain stimuli and specific response regions in the consumer brain, to obtain a better understanding of how consumers perceive, mentally process, and make decisions toward assessing brands (Santos *et al.*, 2011; Yoon *et al.*, 2006).

McClure *et al.* (2004) applied behavioral taste tests during an fMRI experiment to explore the brain responses that relate the behavioral preference for Coke and Pepsi. They found coherent brain activities in the vmPFC that connected with individuals' behavioral preferences for these drinks. By examining the influence of brand image on choosing a drink and the related brain responses, they found that brand knowledge for one of the drinks had a significant impact on behavioral selection and on the measured brain activities. They proposed a primitive model that connects reward-related brain responses to stated behavioral preferences, to gain a better understanding of data interpretation. Subsequently, Chib *et al.* (2009) proposed that the brain uses a common region, inside the vmPFC, as a decision value framework when making decisions between primarily different types of rewards. This specific region was associated with the individual's value for each group of goods (food, non-food consumables and monetary gambles).

Reimann *et al.* (2011) assessed several studies that use fMRI technology to explore consumer behavior, many of which established a positive correlation between brain responses at the vmPFC and the positive attitude toward selecting a brand preference. Then, Plassmann *et al.* (2012) offered a detailed evaluation of past and current studies on consumer neuroscience and its potential applications for academics and managers. They found that fMRI technology is a powerful technique for studying consumer psychology related to decision-making, due to the high sensitivity of brain responses to stimuli. By combining research findings from different studies, they determined the brain regions that reflect brain responses to different stimuli used in the consumer decision-making, and found that the vmPEC was responsible for product evaluation during the fMRI experiment, as shown in Figure 1.

Previous studies show mounting evidence that suggests that the vmPFC region processes basic information about the relative value of options, anticipating an explicit role for this region in explaining decision-making behaviors of consumers. Thus, any harm to this region of the brain can have adverse effects on the behavior of the individual, resulting in diminished capability to make good judgments and difficulty in choosing between alternatives (Fellows and Farah, 2005). To test whether the brain can distinguish between product and human images, Yoon *et al.* (2006) conducted fMRI experiments to explore whether semantic judgments about products and humans are processed in a similar fashion. They discovered that consumers process descriptive judgments on products in a different way than they process judgments on humans, a result that highlights the brand personality notion and demonstrates how our brain uses distinct regions to evaluate brands.

Venkatraman *et al.* (2012) drafted a research agenda for integrating fMRI technology to implement market segmentation, based on segregating the fMRI data into distinct groups with different demands, to postulate important information that supports the conventional segmentation data. Previous consumer neuroscience studies concentrated on identifying the impact of marketing information on marketing effectiveness, and



Source: Figure adopted from Plassmann *et al*. (2012)
Notes: ACC (anterior cingulate cortex); dlPFC (dorsolateral prefrontal cortex); lOFC (lateral orbitofrontal cortex); mOFC (medial orbitofrontal cortex); NAcc (nucleus accumbens); vmPFC (ventromedial prefrontal cortex); VS (ventral striatum)

Figure 1.
Determining brain regions involved in consumer decision-making

studying how variations in the demonstration of marketing stimuli change brain responses (Kenning and Plassmann, 2008). These findings provide marketing managers who are concerned with defining the factors that underpin consumer selection of their products and the optimal marketing strategies that increase consumer retention and encourage new customers with the information needed to adopt their products (Klucharev *et al.*, 2008).

Although consumer neuroscience research has grown considerably in the past decade, both in the business domain and academic research, its use is still restricted among marketing and consumer behavior scholars. This limited diffusion is due to several factors as follows:

- accessing the technology requires mutual coordination with clinical researchers who own the technology;
- the cost of performing several studies to test a model may be too high for social sciences funding agencies; and
- familiarity of consumer researchers with neuroscientific methods is limited, posing a challenge for most researchers to appropriately assess its value.

However, conducting more consumer behavior studies using fMRI technology will provide concrete evidence of its value in understanding the process by which the human brain evaluates stimuli to reach a decision. The role of this technology in hospitality and tourism research has not been previously explored; therefore, there is a need to fill this gap in knowledge and enhance our understanding of brain responses when tourism stimuli are used.

fMRI technology

Continuous improvements in fMRI technology and its capabilities have made brain imaging more appealing for consumer researchers by augmenting their understating on how the brain reacts to different advertisement stimuli. fMRI enables researchers to measure brain activities directly and determine the exact location of their source. It is

considered better than conventional measurement techniques, for example, questionnaire surveys, because it confirms the existence of an internal incident at the neurological level, and produces a better understanding of underlying processes. The fMRI technology is based on placing the participant inside a powerful magnet, where their head is inserted into a radio frequency coil that submits and receives the waves, as demonstrated in Figure 2.

During an fMRI scan, the participant is presented with a set of stimuli to record their brain response. The changes in blood oxygenation in the brain that occur in response to neural activity are detected. When a brain area becomes more active, it consumes more oxygen, and to supply this increased demand for oxygen, blood flow to the active region increases. This change in a specific region causes variations in local magnetic properties, leading to small differences in the MRI signal from the blood, depending on the degree of oxygenation. As blood oxygenation varies according to the levels of neural activity, these differences can be used to detect brain activity. This form of MRI is known as blood oxygenation level-dependent imaging. Based on this mechanism, fMRI is able to produce activation maps showing which parts of the brain are involved in a response to a stimulus. Readers can get further information about fMRI technology from the study by Huettel *et al.* (2008).

Theoretical framework and research hypotheses

Tourist motivation and needs can be considered the main drivers of tourist behavior and the destination selection (Fodness, 1994). They are defined as sociopsychological forces that induce a consumer to select a particular action or alternative. Tourists' desires to participate in tourism activities are normally related to the needs for relaxation, knowledge and to develop social relationships (Charters and Ali-Knight, 2002; Fodness, 1994). Hsu *et al.* (2009) found that motivation has a direct effect on attitude toward visiting the destination, which means that motivation stimulates a tourist's attitude toward certain behaviors. Ajzen (1991) described attitude as psychological tendencies influencing an individual to act in a certain manner, after evaluating a particular behavior.

There is broad consensus that attitudes consist of cognitive, affective and behavioral components (Solomon *et al.*, 2006). The cognitive component is the evaluation made in

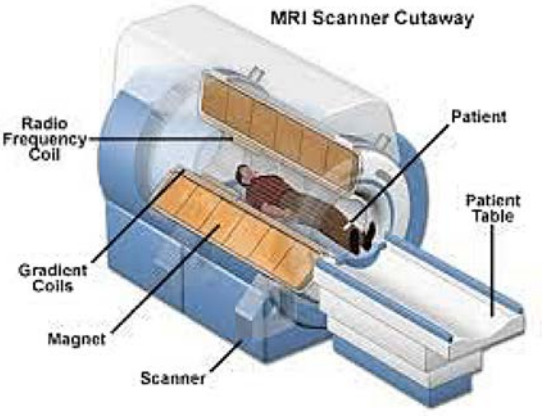


Figure 2.
Components of the MRI scanner

forming an attitude based on knowledge and beliefs about a destination; the affective component is a psychological response expressing the feelings of a tourist toward a destination; and the behavioral component is the physical indication of the tourist's intention to visit a destination. The theory of planned behavior is broadly employed to investigate tourist attitudes (Ajzen, 1985); it has been used to argue that tourist attitude significantly affects behavioral intention (Ajzen and Driver, 1992). Subsequently, more empirical studies were carried out to confirm the positive relationship between tourists' attitude and their behavioral intention (Hrubes *et al.*, 2001; Bamberg *et al.*, 2003). Researchers (Forgas, 1995, 2001; Zajonc, 1980) have agreed that affective evaluation depends on cognitive judgment of destination image, and the affective responses are developed as a function of the cognitive ones.

In this study, the theory of planned behavior is used as a foundation to explain the influence of destination image on tourist attitude, which impacts behavioral intention during the decision-making process to select the tourism destination. The proposed model, as shown in Figure 3, is a simplified version of the theory of planned behavior. The simplified model was chosen because it is more feasible for validation using an fMRI experiment, which is sensitive for complex models, leading to more challenges in interpreting information (Amaro and Barker, 2006). The proposed model has an added component, which is destination image. This proposed modification for the theory of planned behavior does not alter the important foundation of the theory, but adds a variable in an effort to enhance the predictive power in the tourism industry context. Ajzen (1991, p. 199) encouraged such an adjustment to his theory:

> The theory of planned behavior is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behavior after the theory's current variables have been taken into account.

The proposed model was never tested in an fMRI experiment; therefore, a description of how different hypotheses are drafted based on related studies from the body of literature on tourism is presented in the subsequent sections.

The positive influence of a destination image on tourists' attitude can impact their decision-making to select that destination, like motivating them to visit and experience the destination. Hsu *et al.* (2009) suggested that motivation has a direct effect on attitude toward visiting the destination, a relationship that has been widely documented in the tourism literature. In this study, tourists watching attractive images about a destination evaluate these images. As assessing of image attractiveness has an emotional component in terms of feelings toward the image, the vmPFC is expected to experience increased activation during the decision-making process (Tom *et al.*, 2007). In other words, attitude can be considered a psychological tendency to favor or disfavor an entity (Birgelen *et al.*, 2003). The increase in brain activation is a result of images being appealing and interesting for the tourist. Hence, we rationalize that the more attractive the destination images, the greater will be the brain activation in the vmPFC, because of the positive attitude toward these images. Based on this argument, the following hypothesis is proposed:

Figure 3.
The proposed research model

H1. The more attractive the destination images, the greater will be the activation of the vmPFC in making a decision to select this destination.

Based on the theory of planned behavior, the intention to execute a behavior indicates the efforts consumers are willing to make to perform the behavior rather than the actual performance of the behavior (Ajzen, 1991). Previous studies showed a significant correlation between tourist attitude and their behavioral intention (Hrubes *et al.*, 2001; Bamberg *et al.*, 2003), where a positive attitude toward specific destination images increased the behavioral intention, leading a tourist to select this destination over others. In this study, the intention to select a particular destination based on the positive attitude generated from attractive destination images is measured during an fMRI experiment. Therefore, the actual behavior (physical travelling to the destination) remains outside the scope of this study. Considering this debate, the following hypothesis is proposed:

H2. The greater the activation of the vmPFC during the decision process to select a destination, the higher will be the intention to visit this destination.

Methodology

Although previous studies considered brain image as a construct with two evaluation components, cognitive and affective, Baloglu and McCleary (1999) found that the overall image is more likely influenced by affect than by cognitive evaluations. In other words, emotion might have a significant influence when a tourist makes a decision to select a holiday destination based on the overall image assessment. This view is supported by subsequent studies on the impact of emotional appeal on effective advertising, where it was found that appeals to the emotion induced more favorable attitudes toward the Web site and attitudes toward the destination (Lwin and Phau, 2013). Wood (2012) found that emotional model of advertising can lead to greater emotional responses by consumers and more productive decision-making. In this study, the destination images for the fMRI experiment were selected from well-known hotel chains. If the presented destination images meet tourists' preferences, then they will influence tourists' decisions to select that specific destination (Prayag, 2009).

Given that the study was performed using the fMRI technique, that involves complex processes to measure the neural brain signal and complicated methods to analyze images to generate final results, every effort was made to demonstrate information in naive format so that researcher can have a better understanding of the study methodology and its procedures. Most of the technical information either was presented in simple format or referred to in specific references. The different steps illustrated in this process represent a conventional approach for conducting an fMRI experiment.

Pre-experiment preparation

The goal of the pre-experiment session was to define the destination images (stimuli) to be used in the fMRI experiment. Seven participants who often travel to explore new destinations were asked to attend a focus session. Four male and three female participants (average age 25 years) attended the session to help define the attractive destination images, which represent the independent variable in the proposed model. Each participant was provided with a set of images, which were collected from the Internet booking sites for well-known hotel chains. The focus session started by asking

participants to imagine that they were in the process of papering for their summer vacations and they needed to select a destination hotel that fits their needs. They were asked to consider this vacation as a special opportunity to relax and spend a good time. Then, participants were asked to separate the selected images into two groups:

(1) attractive images that had a favorable influence on their decision to select the destination hotel for the summer vacation; and

(2) non-attractive images that had less influence on their decision during the selection process.

Final images were collected and categorized to discuss the logic behind participants' separation process. After detailed discussion, it was found that participants had selected attractive images based on the following general attributes:

- outdoor recreation attractions that helped them to enjoy the stay, supported by swimming pools and gardens;
- travel environments that looked friendly and helpful, supported by customer support services; and
- charming hotel rooms that had bright colors and were well-decorated, supported by flowers and nice views.

These selected attributes are similar to the dimensions that define attractive destination image, as proposed by Chi and Qu (2008).

Pre-scan screening

Four participants from those who attended the pre-experiment session were able to participate in the actual fMRI experiment. They were six males and three females. The demographic variables relating to age and education were collected. The participants were between 22 and 36 years of age and had an average education duration of 16.2 years. All participants were right-handed, and all were native English speakers. For safety, they were examined for fMRI scan fitness by the medical staff. Before the experiment, participants were educated about the fMRI session and the kind of images they would see while lying inside the scanner, and how to record their decision-making during the fMRI experiment. To ensure reliability and accuracy in recording the responses of participants, each participant received a set of training trials for a few minutes before the actual fMRI experiment was run.

Imaging session

The concept of fMRI depends on tracing oxygenated blood in active regions of the brain, with the purpose of estimating the neural activities caused by a stimulus. More detailed description about the principles of fMRI could be obtained from relevant studies (Buxton *et al.*, 1998; Huettel *et al.*, 2008). Brain activations were acquired during fMRI scan using a special pulse sequence to send and receive radio frequency waves to and from the MRI scanner. This pulse sequence was applied during a special fMRI experiment design that controls the way to present different stimuli. In this study, the block design was utilized, which is known for maintaining cognitive engagement during sequential presentation of stimuli within a condition (Amaro and Barker, 2006). The block design offers high statistical power (Friston *et al.*, 1999) and relatively strong brain

signal change related to baseline acquisition (Buxton *et al.*, 1998), when no stimulus is presented.

In this design, trails were grouped together (in time) to reflect different levels of an independent variable (destination images). Experimental conditions of the independent variable were separated into separate blocks (Deppe *et al.*, 2005), each presented for a specific period, as illustrated in Figure 4. In this case, there were two blocks, one includes a group of attractive destination images and the other contains a group of non-attractive destination images. During fMRI scans, participants were presented sequentially with images related to each block, and they were asked to think whether these images were attractive and appealing for the purpose of selecting their coming summer vacation destination. Then, if their attitude toward the destination images was positive, they recorded their intention to visit the attractive tourist destination by pressing the button on a hand-held device. If the participants did not find the destination images attractive, they did not press the button, meaning they recorded no response.

During an actual fMRI scan, the participant lied motionless on a bed in the MRI scanner for approximately 60 minutes. The initial 10-15 minutes were used to collect images of the brain anatomy, which were used to define the region where fMRI data were collected. During the initial stage, participants remained motionless and did not perform any task. Next, the actual fMRI experiment was run using a special program (for details, please see Appendix 1). During the experiment, participants could see different stimuli through a special device, and they recorded their responses using a hand-held button. The baseline data were collected during the resting state when no stimulus is presented (Gusnard and Raichle, 2001).

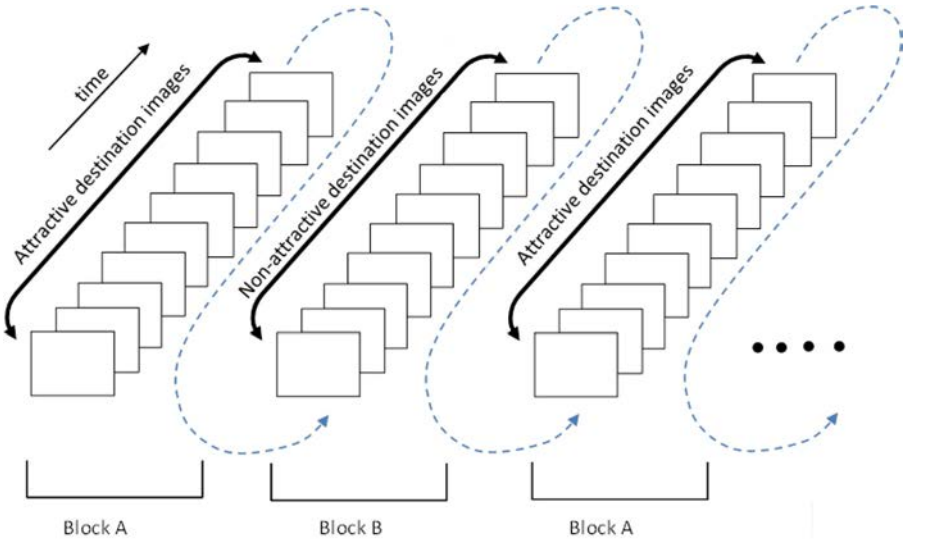


Figure 4.
The block design used in the fMRI experiment

Notes: Block A contains ten attractive destination images and Block B contains ten non-attractive destination images; all images are taken from the pre-experiment preparation; after viewing an image, the participant records his/her response using a hand-held device

fMRI data analysis

To obtain the final results, a standard procedure of image processing was performed. First, the data were pre-processed to correct motion artifacts because a participant might have moved his/her head slightly during the imaging session. All images of each participant were readjusted to the first image obtained from the same subject, and this was followed by the process of image normalization, registration, and spatial smoothing. More information about these conventional techniques relating to brain image transformation could be explored in typical references (Huettel *et al.*, 2008; Brett *et al.*, 2002). The main analyses of the fMRI images were performed using the *t*-test, based on images collected from each block (indicating their attitude toward selecting a destination). The *t*-test produces a statistical map depending on a significant test computed for every voxel. Then, the statistical values were shifted to the anatomy images to have better visualization of the brain regions, showing greater activities than a certain level of statistical significance. Final results were demonstrated using colored images to demonstrate which brain regions had significant levels of activation. To measure precisely the level of dynamic change, the region of interest in analysis was used by selecting adjacent voxels that have high level of activation during fMRI experiment. This analysis assesses the contrasts only in specified regions rather than across the entire brain, and permits higher sensitivity in recognizing effects by reducing the level of correction required for multiple comparisons. The analysis of functional brain images was conducted using Statistical Parametric Mapping Software (www.fil.ion.ucl.ac.uk/spm).

Results and discussion

To demonstrate the brain response during an fMRI experiment, Figure 5 presents sagittal brain images of the same participant. The yellow areas represent brain regions that have significant activation while being exposed to stimuli compared with other brain regions. The image in the top row shows more brain activities than the image in the second row because the top image was collected when presenting attractive destination images (stimuli), whereas the bottom image was obtained while showing non-attractive destination images. This demonstrates that the vmPFC exhibited increased activation when participants were assessing the attractive destination images, leading to positive emotional response. In other words, participants had a strong disposition to visit attractive destinations when they evaluated the related images and made their decision (Tom *et al.*, 2007). However, when non-attractive destination images were judged by the same participants during the fMRI experiment, they did not find these images appealing, leading to weaker emotional response and less brain activities. This finding is consistent with the outcome from Gusnard *et al.* (2001) when they presented pleasant and unpleasant images during an fMRI experiment and found changes in brain activation at the vmPFC for the participants' attention and emotional responses. For all participants in the present study, the level of brain activation was higher when participants were judging attractive destination images as compared to non-attractive destination images.

Figure 6 shows the level of change in brain activation across all participants, where the region of interest in analysis was used to measure the brain signal intensity from both images presented in Figure 1. The change in signal was presented relative to the base line (during resting state). For the attractive destination images, there is a

Figure 5.
Neural brain activations during fMRI experiment to select a tourist destination

significant main effect for participants who like the hotel as a potential destination for their summer vacation ($p < 0.05$), showing that the higher the attractiveness of the images, the greater the activation of the vmPFC during decision selection. This supports *H1* and confirms previous findings that identify vmPFC as a region for processing a selection decision (Engelmann *et al.*, 2009; Fellows and Farah, 2007).

Figure 6 also shows that greater activation of the vmPFC during the positive attitude toward the attractive destination images indicates the intention to visit this destination, which was recorded by each participant using a hand-held device. On the other hand, the lower activation of the vmPFC region indicates participants' intention not to visit the destination because its images were deemed to be less attractive. This outcome supports *H2*, which suggests that greater activation of the vmPFC means higher intention to visit the destination. Scientifically, it is not clear how the brain exactly analyzes image components to define which image is more attractive than another. However, behavioral attitude was used in this study, during pre-experiment preparation, to determine the images deemed to be appealing and attractive to each individual; then, an fMRI experiment was used to track brain activation and confirm the individual selection of the attractive images – as mentioned earlier, participants identified the following attributes as enhancing attractiveness: outdoor recreation attractions, travel environment and charming hotel rooms.

The related literature on human technology interaction, impact of colors on consumer marketing, designing attractive brand images and effective advertisements contains many studies that have investigated the impact of different image components on making a destination attractive and appealing for consumers (Newman *et al.*, 2004; Skorinko *et al.*, 2006; Deng *et al.*, 2010).

However, this exploratory study did not aim to find a supporting interpretation from these areas of research to develop the focus of the study. This study used the assessment of the overall image attractiveness by an individual tourist based on his/her behavioral attitude, according to what is broadly agreed to in the tourism industry research.

Conclusion and implications

The success of tourism destinations in holiday marketing is determined by their attractiveness over other competing destinations (Dwyer *et al.*, 2000). However, an accurate understanding of destination attractiveness, as perceived by tourists, requires monitoring changing tourists' attitudinal behavior toward different destinations. In addition, Goodall (1990) found that recognizing factors influencing image attractiveness helps marketers to target specific consumer segments, based on consumers' perceptions

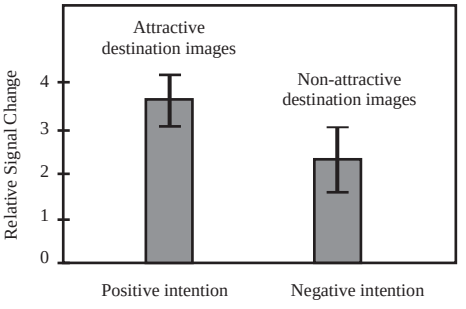


Figure 6.
Level of change of the independent variable relative to baseline

of advertised images. This leads us to define the appropriate advertisement strategy that is based on using destination images that have a positive influence on consumer behavior, affecting a tourist's attitude to select this particular destination to enjoy the next vacation. Using a neuroscience experiment, this exploratory research determined the brain region that influences a tourist's selection of his/her next vacation, based on assessing attractive destination images. This approach was used by the scholar for the first time in the tourism industry, providing a new perspective on how tourists perceive destination images. The method used in this study provides solid evidence that the attractiveness of destination images is based on brain response and not based on direct response from participants.

Destination marketers should identify the most influential factors behind making their destination images attractive because such factors have a direct impact on tourists' decision-making process to select their destinations for the next vacation. As tourists use Web sites as the main source of information and related images about the destination (Yilmaz and Tasci, 2013; Reino *et al.*, 2014), advertisement strategy should focus on designing an effective Web site that contains updated information and appealing images demonstrating attractive features of the destination. Such a tempting design could elicit and engage tourists' attention to navigate the site more thoroughly to reach a concrete decision. As emotion exerts a significant effect during the decision-making process to select a particular destination, it is important to enhance the extent of this effect during Web site design. This can be accomplished by including destination images that portray a relaxing environment and friendly atmosphere, and incorporating tourists' prior experience and feedback (Ribeiro *et al.*, 2014; Pantano and Di Pietro, 2013). This could enhance a tourist's level of pleasure and, subsequently, the attitude formation toward selecting a favorable destination.

Measuring the attractiveness of a destination image as perceived by tourists, and its development over time, are important issues in building the accurate marketing strategic for promotion of destinations (San Martín and Rodríguez, 2008). Marketers ought to be aware of what makes their destination attractive in the eyes of tourists, to motivate tourists to select it for the first visit. During a destination visit, tourists need to experience what they have in mind about the destination, to reach an acceptable level of satisfaction. This reflects the notion that tourists would like to get what they see in the destination advertisement, and based on what they made their decision to visit it. If the real experience matches the expectation, tourist satisfaction is achieved, which influences the subsequent evaluation of the vacation and future intentions to revisit it. The positive experience deriving from positive images about the destination would lead to a pleasant evaluation of a destination, causing destination loyalty. If destination marketers ensure that the above-mentioned events are managed properly, the following sequence could be established to achieve success for tourism marketing: destination image → tourist satisfaction → destination loyalty.

Limitation and further research

Although the pioneering research is still in its early stages to know precisely the exact mechanisms by which destination images are processed in the brain, the study findings collectively suggest that the decision-making process to analyze an attitude toward attractive destination images triggers brain regions in the vmPFC.

Marketing studies often characterize brand images by a set of solid attributes. Zhang and Markman (2001) explained that consumers inspect product attributes for their preferences based on alignable differences (common between two alternatives) and ignore non-alignable differences (unique to one alternative). Other studies related decision-making to the conjoint analysis of product attributes, instead of the analysis of every attribute separately. The foregoing discussion explains why the process of evaluating different product images could be considered more complex, as the brain is overwhelmed by processing various types of information to compare, assess and, finally, reach a decision to choose a particular selection. Therefore, future studies should explore the impact of other variables that could influence image perception. For example, the colors and combination of colors used in an image have a direct impact on consumer perception of brands and products (Bottomley and Doyle, 2006; Skorinko *et al.*, 2006).

Most tourism studies on destination image measure the attitude of tourists during their visit to the destination or after the visit. However, in this study tourists' attitude was measured before they visit a destination, enabling them to use their memory and background knowledge to evaluate destination images (Maguire *et al.*, 1999). As the vmPEC is a part of the brain system that stores information about past experience (Bechara *et al.*, 2000), it is not clear what would be the real impact on the vmPEC of the participants's knowledge about the destination, or what they heard about it from the social network. It would also be interesting to use an fMRI experiment to explore the influence of WOM on selection decisions.

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Further reading

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Appendix 1

fMRI protocol

In the fMRI experiment, participants lie still on their back inside the MRI scanner, where a special coil is used to detect the brain signal during the experiment. During presenting stimuli the level of blood oxygenation in the brain starts to change in response to neural activation, consuming more oxygen and changing blood flow to the active region. Such changes lead to variations in magnetic properties of specific areas, which can be detected though the MRI signal. The final fMRI images contains information about brain regions that have extra activation as a response to a stimulus. The fMRI experiments were performed using a 3T GE body scanner (General Electric. Milwaukee, Wl) with high performance gradient system (50 mT/m amplitude and 200 T/m/s slew rate). The scanner was equipped with head coil and display device to present stimuli. The fMRI actual scan was applied using gradient echo spiral pulse sequence (TR 3,000 ms, TE 50 ms, 20 cm FOV, 3.6 mm slice, 36 slices). Before each fMRI run, 13 dummy scans were acquired to allow for equilibration of signal. During the fMRI run, each image was presented for 3,000 ms, with interstimulus interval of 3,000 ms.

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