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Research Paper

My destination in your brain: A novel neuromarketing approach for evaluating the effectiveness of destination marketing

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ABSTRACT

Emotional reactions to marketing stimuli are essential to tourist destination marketing, yet difficult to validly measure. A neuromarketing experiment was peformed to establish whether brain event-related potentials (ERPs), elicited by destination photos, can be used to evaluate the effectiveness of tourist destination marketing content in movies. Two groups of participants viewed pictures from the cities of Bruges and Kyoto. Prior to viewing the pictures, one group saw an excerpt from the movie *In Bruges*, which positively depicts Bruges' main tourist attractions. The other group saw a movie excerpt that did not feature Bruges (*the Rum Diary*). An early emotional response was osberved to the subsequently presented Bruges pictures for the *In Bruges* group only; no reliable between-group differences were found in ERPs to pictures from Kyoto. In conclusion, EEG-based neuromarketing is a valuable tool for evaluating the effectiveness of destination marketing, and popular movies can positively influence affective destination image.

1. Introduction

Competition for effective destination branding is increasing. As a result, the past decades have seen the development of an entire branch of tourism science devoted to evaluating the effectiveness of the marketing efforts aimed at promoting tourist destinations (e.g. Echtner & Ritchie, 1993; Tasci, Gartner, & Cavusgil, 2007; Yüksel & Akgül, 2007). This paper presents a mainly methodological contribution to this literature in the form of a neuromarketing experiment, in which individuals' responses to destination photos after viewing marketing materials, in this case a popular movie excerpt, are recorded directly from their brains. To the authors' knowledge, the research presented hereconstitutes the first empirical study ever to use neuromarketing methodology in a tourism context.

1.1. Destination marketing

Destination image plays a central role in the tourist decision-making process and is the central construct in destination marketing research (see Baloglu and McCleary (1999), Beerli and Martin (2004), Chon (1990), Echtner and Ritchie (1993), Gallarza, Saura, and García (2002), Morgan and Pritchard (1998)). Destination image is defined as 'the sum of beliefs, ideas, and impressions that a person has of a destination' (Crompton, 1979, p. 18). To avoid confusion with the related concept of destination branding, this paper takes the view of Stepchenkova and Li that'destination images and destination brand associations are essentially two sides of the same coin' (Stepchenkova & Li, 2014, p. 48). Destination image demonstrably affects desirable tourist behavior outcomes, such as visit intention (Zhang, Fu, Cai, & Lu, 2014), attitude toward sport event participation (Kaplanidou & Gibson, 2010), and intent to recommend (Josiassen, Assaf, Woo, & Kock, 2015). Destination image also affects residents' perceptions of place (Stylidis, Sit, & Biran, 2014). In sum, according to Royo-Vela (2009), destination image is crucial to management decisions.

Extensive literature reviews of destination image research are available in the recent tourism literature (e.g. Tasci et al., 2007; Zhang et al., 2014; Stepchenkova & Li, 2014). The critical review of Josiassen et al. (2015) is specifically recommended for its completeness. Instead of re-creating such work here, this paper offers a

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general summary of knowledge about destination image and focuses on the intersection of destination image and emotions.

Potential tourists develop destination images through cognitive and emotional (also called *affective*) interpretations (Baloglu & Brinberg, 1997; Baloglu & McCleary, 1999; Beerli & Martin, 2004; Moutinho, 1987). Together with behavior toward the destination, cognition and affect comprise the three components in the most common current conceptualization of destination image (Tasci et al., 2007). A second common conceptualization, developed by Echtner and Ritchie (1993)), serves to 'provide deeper insight into how each of the components is internalized' in potential tourists (Tasci et al., 2007, p. 199). The cognitive component of destination image is based on the tourist's perceptions, beliefs and knowledge of destination attributes such as attractions and natural resources. The affective image component refers to the emotions elicited by the destination, more specifically the 'emotional responses toward the various features of a place' (Zhang et al., 2014, p. 215). The cognitive component demonstrably influences the affective component, which in turn influences positivity or negativity of the overall destination image (Baloglu & McCleary, 1999; Josiassen et al., 2015). The affective component is more dynamic than the cognitive component, changing in response to destination experience and reflection (Kim, McKercher, & Lee, 2009). Next to these components *overall* destination image refers to 'individuals' overall evaluative representation of a destination' (Josiassen et al., 2015, p. 3). Overall destination image is uniquely powerful as a behavioral predictor (Zhang et al., 2014) and argued to be a separate concept from component-based destination image (Josiassen et al., 2015).

While the bulk of destination image research has focused on the cognitive components, the affective component of destination image has been gaining increasing attention (Bigné Alcañiz, Sánchez García, & Sanz Blas, 2009; Kim et al., 2009; Zhang et al., 2014). This component has generally been measured using self-response psychometric scales, especially Likert-type or semantic differential formats (Baloglu & McCleary, 1999; Zhang et al., 2014), although some advocate a forced-choice dichotomous format (Dolnicar & Grün, 2012) or qualitative methods (Cherifi, Smith, Maitland, & Stevenson, 2014; Govers, Go, & Kumar, 2007; Ryan & Cave, 2005; Stepchenkova & Li, 2014; Stepchenkova, Kim, & Kirilenko, 2014). Regardless of response format, asking participants to report their affective destination image may give useful data (Baloglu & McCleary, 1999; Wencki, Mitas, & Straatman, 2014) but gives at best only a rough sketch of the emotions a potential tourist experiences when confronted with a marketing stimulus or with the destination itself.

According to Tasci et al. (2007), the psychometric approach fits more closely with the cognitive than with the affective component of destination image. At the same time, emotions have been shown to play a crucial role in decision making (e.g. Loewenstein & Lerner, 2003). According to Li and colleagues (Li, Scott, & Walters, 2014, p. 1), 'unconscious emotional responses that can provide unbiased portrayal of individual's initial emotional reactions when exposed to a stimulus have been largely ignored' in the tourism literature. This gap in the literature may largely be attributed to methodological challenges (for discussion, see Li et al., 2014). Emotional responses come and go quickly and possess a complexity that does not always lend itself well to description by a self-response scale on a questionnaire. As a result, direct measurement of such emotional responses, for instance through peripheral electrophysiological methods such as heart rate, skin conductance and facial electromyography (Kim, Kim, & Bolls, 2014), or through eye-tracking methodology (Wang & Sparks, 2014), is only beginning to emerge in the destination marketing literature (see Li et al., 2014, for a review, and Pearce, 2012 for an excellent discussion). Arguably, however, recording emotional responses directly from the brain is potentially the most sensitive physiological measure for assessing the impact of destination marketing stimuli on affective destination image formation. However, before further developing this thought, the role of organic marketing agents such as movies on destination image formation.

1.2. The role of movies in the marketing of destinations

The image of a particular destination is formed in tourists' minds based on a variety of internal processes and external stimuli (Baloglu & McCleary, 1999). External stimuli are usually divided into three types of 'image formation agents', including induced image agents, which comprise commercial activities aimed at marketing a destination; organic image agents, which comprise information without apparent commercial interest in a destination; and previous experiences at the destination (Gartner, 1994; Lee, Lee, & Lee, 2014). Organic image formation is considered especially valuable to destinations, as potential tourists consider information without a clear commercial interest as more trustworthy (Wencki, 2012). In the words of Stepchenkova & Li, 'destination brand cannot be confined to marketer-induced associations only' (Stepchenkova & Li, 2014, p. 59). Thus, destinations increasingly explore marketing avenues through social networks and popular culture, as messages through these channels may be considered less commercially motivated, and thus more veritable, by would-be visitors. One such communication channel is the popular motion picture. The possibility that popular motion pictures induce emotions that influence affective destination image warrants further investigation.

Motion pictures (henceforth movies) have been recognized in the tourism research literature as an important destination marketing channel (Beeton, 2005). Movies are viewed by potential customers as relatively unbiased or trustworthy information sources (Kim & Richardson, 2003). Although various researchers have categorized movies as autonomous (Beerli & Martin, 2004) and organic (Gunn, 1972) image formation agents, there is general consensus that movie audiences do not likely perceive destination information in movies as commercially motivated (Kim & Richardson, 2003). Substantial boosts in visitation and economic impact following releases of relevant movies have been recorded (Bolan & Williams, 2008). On the other hand, the effects of movie portrayals can just as easily be negative (Sönmez & Sirakaya, 2002). Destination marketing organizations are aware of these effects and actively encourage the recording of movies at their destination through, for example, tax incentives. An extensive review of literature about movies as a destination marketing tool is available in Bolan and Williams (2008) and will not be undertaken here.

Instead, this paper highlights an important gap in this literature. Bolan and Williams (2008) theorize that movie content addressing a destination induces a certain image of the destination in the movie audience. This process is specifically believed to be fueled by identification with characters: audiences see a character enjoying a destination on screen and imagine themselves in that situation (Kim and Richardson (2003)). It is not unlikely that this process of identification directly affects the affective component of destination image. However, it has not been empirically demonstrated whether experiencing a positive destination portrayal in a movie changes the emotional reactions to a destination. We propose, asargued in the previous section, that this question is best addressed by measuring such emotional reactions directly from the brain.

1.3. Measuring emotions from the brain

In the emotion literature, two aspects of emotional engagement are usually defined, namely emotional valence (how pleasant or unpleasant the emotion is) and emotional arousal (how calming or exciting the emotion is; Bradley, Greenwald, Petry, & Lang, 1992; Russel, 1980). Emotions are expressed at three different levels: through subjective experience, through expressive behavior, and through physiological changes (Ekman, 1992). An intriguing possibility to study emotional responses to marketing stimuli lies in directly recording the neurophysiological responses (i.e. brain activity) that are associated with the emotional response, since different emotions are associated with distinct physiological patterns (Ekman, 1992).

Emotional brain responses have been extensively measured with the two major neuroimaging methods: functional magnetic resonance imaging (fMRI; for reviews see e.g. Cabeza and Nyberg (2000), Davidson and Irwin (1999), Phan, Wager, Taylor, and Liberzon (2002)) and electro-encephalography (EEG; for reviews see Hajcak, Weinberg, MacNamara, and Foti (2012), Olofsson, Nordin, Sequeira, and Polich (2008)). Thus, there is a clear view on which aspects of fMRI and EEG signals are indicative of emotional engagement. In this work, we focus on EEG as a neuroimaging method.

EEG signals are based on the fact that brain activity operates by minute changes in electrical potential that travel from one nerve cell to another across the networks of the brain. An EEG recording system is a device consisting of very sensitive electrodes (usually mounted in a cap) and an amplifier that records the tiny electrical potential changes over time that are produced by brain activity from multiple locations on a research participant's scalp. The raw, untreated EEG signals contain neural activity originating from many sources in the brain, and as such are not very informative with respect to specific cognitive or affective processes in the brain. However, presentation of stimuli such as photos induce reliable changes in the EEG signal, and when the EEG is averaged over a number of repeated presentations of, say, (a category of) photos, the part of the EEG that is related to the processing of those photos (called events, hence the term Event-Related Potential, or ERP) can be separated from the brain activity that is not related to processing these photos. Typically, a number (20–40) of stimuli from one and the same category need to be presented for the ERP signal to properly emerge from the noise (the ongoing overall EEG signal). For an accessible introduction to EEG, ERPs, and ERP research techniques, the reader is referred to the excellent textbook by Luck (Luck, 2014).

ERP waveforms representing electrical potential (voltage) changes at the scalp (see, e.g. Figs. 2, 4 and 6) are characterized by a succession of peaks and troughs (called ERP components) that reflect the emotional and cognitive brain activity elicited by the stimuli. Five decades of active ERP research (for a comprehensive review see, e.g. Luck, & Kappenman, 2011) have characterized in detail which ERP components are sensitive to specific aspects of cognitive and emotional processing. Sensitivity is defined here as a change in the shape of the ERP signal: typically, different components in the ERP become larger or smaller when the properties of stimuli are experimentally manipulated. When ERPs are compared for emotionally neutral and emotionally valenced (either positive or negative) pictures, three major ERP components are typically modulated as a result of emotional valence and/or arousal (for reviews, see Luck and Kappenman (2011), Olofsson et al. (2008)):

(1) The N1 component is a negative peak in the ERP that reaches its (negative) maximum approximately 100 ms after picture onset. It is largest at midcentral electrodes (located at the middle of the head). A larger N1 peak typically shows up on the graph for positively and negatively valenced stimuli compared to emotionally neutral stimuli). The larger N1 for emotionally valenced stimuli has been interpreted as reflecting increased early attentional capturing of the emotional content in a visual stimulus.
(2) The P2 component is a positive peak in the ERP that immediately follows the N1, and that peaks at around 180 ms after picture onset. It has a widespread scalp distribution, and a larger P2 is commonly observed after emotionally valenced (either positively or negatively) compared to neutral stimuli.
(3) At somewhat longer latencies (from 300 ms onwards after stimulus onset), there is a succession of positive-going ERP components that we will, for the sake of simplicity, subsume here under the heading of Late Positive Potentials (LPP; see Hajcak et al., 2012, for an excellent review of the different late positives observed under different conditions). The LPP starts at around 300 ms poststimulus, and lasts until approximately 1000 ms (so, one second) after the onset of the picture. It is higher for emotionally salient compared to neutral stimuli, and is often interpreted as reflecting the arousal component of emotional salience rather than the valence component. The LPP has a widespread scalp distribution, but is largest over the back of the head.

The general aim was to establish whether the emotional ERP components described above can be used as a tool to evaluate the effectiveness of destination marketing materials in coupling a positive emotion to a destination.

1.4. Neuromarketing

The term *neuromarketing* is said to be first coined by Ale Smids in 2005 (for a brief historical overview, see Belden (2008)), in order to describe the field of research concerned with the application of neuroscience technology to the traditional goals and questions of interest of the marketing industry. Since then, this subfield at the intersection of consumer psychology and neuropsychology has grown quickly (for an excellent review, see Ariely, & Berns, 2010), with over 757,000 hits for the term ‘neuromarketing’ in the search engine Google as of January 11th, 2016. Neuromarketing research has progressed in two directions: neuromarketing proper, consisting of applications of current neuroscientific knowledge to make approximate predictions about individuals' responses to marketing materials, and a more fundamental field of research often referred to as neuroeconomics (for review, see Loewenstein, Rick, & Cohen, 2008), aimed at uncovering brain circuits that are specific to consumption decisions (sometimes rather blatantly referred to as *the buy button*, see Wells, 2003). In the present paper the focus is on the former.

A potential drawback of present neuromarketing research is that it is mostly based on functional magnetic resonance imaging (fMRI) technology, which is expensive and requires participants to dress in a hospital gown, lay still on a narrow table, and wear earplugs while stimuli are beamed through a projection headset. Participants can only interact with stimuli by pressing one of two buttons, one held in each hand. Furthermore, fMRI has a relatively poor temporal resolution (of a few seconds at best, as it is based on the notion that blood oxygenation levels in the brain are a valid proxy for neural activity).

EEG constitutes a more accessible alternative for neuromarketing research. EEG recording systems are widely available, and the costs for purchasing and operating such a system are only a fraction from that of fMRI systems. Furthermore, EEG allows participants to sit and view stimuli in a relatively natural manner while recording reactions in the brain at a very high (millisecond) temporal resolution. In a sense, EEG records mental actions truly in the moment that they occur. A disadvantage of EEG is that it does not allow a three-dimensional view into the brain, recording only from its surface. This makes it problematic (but not impossible, see e.g. Pascual-Marqui, 1999, for an authorative review of neural source localization methods) to relate the recorded signals directly to neural activity in specific brain structures. Another disadvantage of EEG is that modulations of the ERP relating to positive and negative emotions are very similar (for reviews, see Hajcak et al. ,2012, and Olofsson et al., 2008), which necessitates additional evidence for qualifying emotional responses as being related to either positive or negative emotional valence. All in all, however, the relatively natural setting of EEG and its superior time resolution makes it useful for neuromarketing research. It is surprising, then, that reports of EEG-based neuromarketing studies are rare in the scientific literature (although some studies have recently emerged, see e.g. Handy, Smilek, Geiger, Liu, & Schooler, 2010, Nazari, Gholami Doborjeh, Amanzadeh Oghaz, Salehi Fadardi, & Amir Amin Yazdi, 2014, and Vecchiato et al., 2011).

To the authors' knowledge, no application of neuromarketing methods to the assessment of destination marketing materials, nor indeed to other aspects of tourism exists. Yet, experimental neuromarketing approaches using EEG, in particular, hold promise to sharpen the tourism industry's understanding of how marketing materials affect potential consumers.

1.5. The present study

The purpose of the present study is to examine the effect of a popular movie with destination marketing content on emotional responses to tourist destination pictures by directly measuring ERP component changes from the brain.

In brief (see Section 2 for a full description of the experimental design) the study compared the ERPs triggered by a photos of the tourist destination Bruges in two groups of participants. One group of participants (the experimental group) watched an excerpt of the movie *In Bruges* immediately prior to the viewing the pictures. In this movie excerpt, the tourist attractions of the Belgian city of Bruges feature prominently. A protagonist lavishes praise on the beauty of the destination and savors the pleasure of being a tourist there. Movies such as *In Bruges* are produced in cooperation with destination marketing organizations, intentionally highlighting positive aspects of their respective destinations, and are widely seen as examples of destination marketing investments (Beeton, 2005). The other group of participants (the control group) watched an unrelated movie excerpt immediately prior to viewing the pictures (the movie *the Rum Diary*, which plays against the background of the Caribbean island of Puerto Rico, but does not praise tourist attractions or activity in the same explicit way). Thus, the viewing of the *Rum Diary* excerpt formed a control condition, allowing us to contrast the emotional effects of watching destination marketing content within a movie to watching an emotionally similar movie without such explicit destination marketing content. In addition to pictures of Bruges, both groups viewed pictures of an unrelated tourist destination, matched by type (the Japanese city of Kyoto: a medieval city destination and UNESCO World Heritage site, as Bruges is, yet visually quite different from Bruges).

The study hypothesized that watching the movie excerpt from *in Bruges* would be instrumental in coupling a positive emotion to Bruges as a tourist destination. As a result, larger N1, P2, and LPP components were expected in the ERPs to pictures from Bruges for the experimental group, as compared to the ERPs recorded from the control group. Second, it was hypothesized that this effect would be specific to the pictures of Bruges. Therefore, no ERP differences were expected in response to the pictures from Kyoto between the two groups.

2. Methods

2.1. Participants

A criterion non-probability sample of 32 university students (8 male, 24 female, age range 18–26) participated in the experiment. The students were selected according to standard criteria for EEG research. According to these criteria, all participants were right-handed and had normal or corrected-to-normal vision and hearing. None of them were on psychoactive medication, or had a history of neurological trauma. None of them had previously seen the movie*In Bruges*, or had visited the city of Bruges in the past 10 years, preventing strong emotional effects of recognizing a place they had already visited. The participants signed a written informed consent form before the EEG experiment started. The data from two participants (one from each group) were excluded from further analysis because of excessive artifacts in the EEG recordings (see Section 2.6).

The final sample thus consisted of 30 participants, 8 male, 22 female, age range 18–26 (experimental group: 3 male, 12 female, age range 18–24; control group: 5 male, 10 female, age range 18–26). Participants were randomly assigned to one of the two groups (an experimental group, $n=15$, and a control group, $n=15$), which rules out the possibility of having systematic between-group differences in (potentially) relevant background variables. The study was conducted in accordance with the declaration of Helsinki.

2.2. Stimulus materials

The final stimulus materials consisted of two movie excerpts, and four sets of 40 pictures. One movie excerpt (henceforth *In Bruges*) consisted of the first 11 min and 42 s of the movie *In Bruges*, and was chosen as an example of destination marketing embedded within a popular movie. The other movie excerpt (henceforth *The Rum Diary*) consisted of a 9 min and 23 s section of the movie *The Rum Diary*, starting at 14 min and 30 s from the onset of the movie, and was chosen to approximately match the *In Bruges* clip on genre (dark comedy founded on criminal characters), emotional valence, and arousal (see Section 2.3) without embedding persuasive destination marketing messages, as *In Bruges* did. Note that the two movie excerpts did not have exactly the same length. It was decided to cut off the movie excerpts at the end of a particular scene, which is the most natural cut-off point. Stopping clips at other moments to achieve the same length could have been experienced as (emotionally) jarring.

The picture stimuli consisted of four different sets of 40 photos. Two sets of photos were obtained from the online media repository, Wikimedia Commons. Only public-domain photos from the repository were used. One set consisted of photos from the city of Bruges, while the other set consisted of photos from the city of Kyoto. Both sets contained pictures of outdoors scenes and buildings that are characteristic of the respective cities reflecting typical stock photography used in destination marketing materials. Both sets of pictures were rescaled to optimally fit into a frame of 600 by 600 pixels, while maintaining aspect ratio. Further, for each set the luminance was adjusted so as to be equal to each other, as well as to the remaining two sets of photos.

These two remaining sets of 40 pictures were taken from a standardized database of pictures, the so-called International Affective Picture Set (IAPS), that has been very extensively rated with behavioral measures (questionnaires) on emotional engagement (Lang, Bradley, & Cuthbert, 2005). One set was created with IAPS pictures matched for emotional valence and arousal to the destination pictures (henceforth IAPS matched), and another with very positively valenced IAPS pictures (henceforth IAPS positive). The IAPS photos depicted either natural scenes, artifacts, food, or animals. These two IAPS sets were included in the experiment as a control, in order to verify that we replicate standard emotion effects in our specific set of participants and our specific EEG recording setting. The approach of testing emotional responses in the brain against such IAPS subsets has a substantial precedent in the neuropsychological literature (for reviews, see Hajcak et al., 2012, and Olofsson et al., 2008).

2.3. Pre-test

A behavioral pre-test was performed of the stimulus materials that were used in the EEG study in order to assess the emotional salience (on the dimensions of emotional valence and arousal) of those stimulus materials. Thus, we identified experimental conditions of destination pictures that were as homogenous as possible (across the different experimental picture categories) in terms of emotional salience, so as to make sure that any condition differences we obtain in the EEG data as a result of watching a destination movie cannot simply be explained in terms of initial self-reported differences in valence and arousal.

This behavioral pre-test was conducted with a criterion non-probability sample of 55 undergraduate students. Characteristics of the pre-test sample such as age and field of study were similar to those of the EEG experiment sample. Participants were seated in a classroom, and were shown the stimulus materials by projector. They were asked to rate the emotional valence and the emotional arousal for each picture by filling in a paper questionnaire. The procedure was identical to the standard rating procedure used in creating the IAPS database (Lang et al., 2005). Pictures were shown on screen for 6 s, and participants were given another 6 s to fill in their ratings for each picture on a nine-point scale, using self-assessment manikins, anthropomorphic figures that portray emotional valence and arousal (Lang et al., 2005). The participants thus rated 60 photos from Bruges, and 40 photos from Kyoto, presented in random order. Subsequently, participants rated the two movie clips on emotional valence and arousal, using the same procedure. Data from 8 participants were discarded from further analysis because more than 40% of the ratings were not filled in. The remaining 47 participants (mean age 21, age range 18–26) only occasionally missed a rating.

For each picture, the average rating across the 47 participants was computed separately for valence and for arousal. Ratings were then averaged for both sets. The ratings for the pictures of Bruges and of Kyoto were quite similar (see Table 1). From the 60 pictures of Bruges, a subset of 40 pictures was selected that optimally matched with the ratings of the Kyoto pictures in terms of self-reported valence and arousal. The resulting set of stimuli to be used in the EEG experiment thus consisted of 40 pictures of Bruges, and 40 pictures of Kyoto, that were matched for valence and arousal (valence: paired-samples $t_{39}=0.746$, $p=0.460$; arousal: paired-samples $t_{39}=0.212$, $p=0.833$). Subsequently we selected 40 pictures from the IAPS database with similar valence and arousal ratings (the IAPS matched set), as assessed with independent-samples *t*-tests (Bruges – IAPS matched valence: $t_{78}=-0.375$, $p=0.708$; Bruges – IAPS matched arousal: $t_{78}=0.151$, $p=0.880$; Kyoto – IAPS matched valence: $t_{78}=-1.24$, $p=0.219$; Kyoto – IAPS matched arousal: $t_{78}=-0.09$, $p=0.929$). In a final step we selected 40 pictures from the IAPS database with a higher positive valence and higher arousal as compared with the other three sets (the IAPS positive set), as assessed with independent-samples *t*-tests (Bruges – IAPS positive valence: $t_{78}=-15.11$, $p<0.001$; Bruges - IAPS positive arousal: $t_{78}=-4.35$, $p<0.001$; Kyoto – IAPS positive valence: $t_{78}=-15.43$, $p<0.001$; Kyoto – IAPS positive arousal: $t_{78}=-4.41$, $p<0.001$; IAPS positive – IAPS matched valence: $t_{78}=18.16$, $p<0.001$; IAPS positive – IAPS matched arousal: $t_{78}=4.27$, $p<0.001$). Mean valence and arousal ratings for both IAPS sets are also given in Table 1.

For the two movie clips, the pretest data (rated by 43 out of the 47 participants) indicated that both movie clips were emotionally neutral and moderately arousing.

Table 1
mean (SD) valence and arousal ratings for the four sets of 40 pictures.

Stimulus set	Valence rating[a]: mean (SD)	Arousal rating[a]: mean (SD)
Bruges pictures	4.95 (0.96)	3.35 (0.79)
Kyoto pictures	4.78 (1.02)	3.30 (0.86)
IAPS matched pictures	5.02 (0.74)	3.31 (0.89)
IAPS positive pictures	7.44 (0.40)	4.22 (0.99)
In Bruges movie clip	4.83 (1.86)	4.04 (2.30)
The Rum Diary movie clip	5.85 (1.53)	5.43 (2.14)

[a] Ratings for the Bruges and Kyoto sets are based on our pretest data; ratings for the two IAPS sets are based on the published ratings from the IAPS database (Lang et al., 2005).

2.4. Design and procedure

In the actual EEG experiment, after having read the written instructions and given their informed consent, participants were prepared for the EEG recordings, and were familiarized with the EEG lab and equipment. They were seated in a dimly lit and sound-attenuating room, approximately 1.50 m in front of a computer screen. Participants were instructed to sit in a relaxed position, and to refrain from excessive head, body and eye movements (including eye blinks), in order to avoid generating electrical artifacts (noise) that would be picked up by the EEG recording system. They then viewed one of the two movie clips: participants in the experimental group viewed the movie excerpt from In Bruges, while the control group viewed the movie excerpt from the Rum Diary. After a 5–10 mins' break, the participants then viewed the 160 picture stimuli (four sets of 40 pictures) in eight blocks of 20 pictures each. Order of presentation of the pictures was randomized for each participant separately. A schematic of the experimental design is given in Fig. 1.

Preceding each picture, a plus sign (white color on black screen) appeared in the center of the screen for 1000 ms, indicating that a new picture was upcoming, and then the picture was presented for 3000 ms. The picture then disappeared, and three asterisks appeared in the center of the screen for 2000 ms, indicating that the participants were allowed to blink. Participants were instructed to refrain from blinking in the crucial time

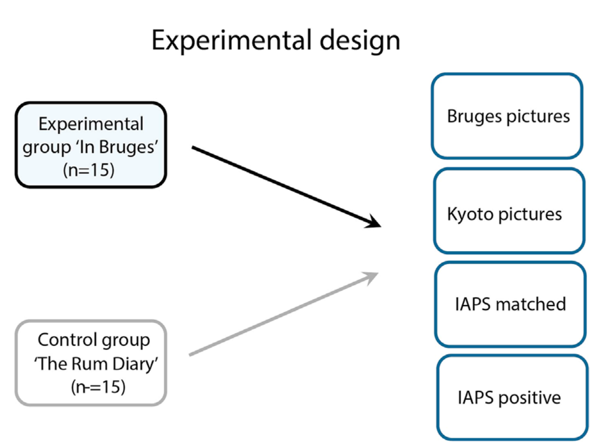

Fig. 1. Schematic of the experimental design. The 30 participants were randomly assigned to two groups. The experimental group (n=15) first saw the movie excerpt*In Bruges*, the control group (n=15) first saw the movie excerpt *The Rum Diary*. Both groups then viewed 40 pictures in four different categories, in random order.

periods, because this produces strong artifacts (noise) in the EEG signals. At the end of each block, the word pause appeared on the screen, indicating that the participants could take a mini-break. The mini-break ended when a participant pressed a button on a button box in front of them, after which a new block started.

Participants had no other task than to passively view all stimulus materials, and the experimenter monitored the EEG signals throughout the experiment to ensure that participants were indeed viewing the stimulus materials.

2.5. EEG recordings

The EEG signals were fed into amplifiers, amplified in a frequency range between DC and 102 Hz (which is the typical frequency range of EEG signals), and digitized at a sampling rate of 512 Hz. EEG signals were recorded from 63 locations on the scalp using active Ag–AgCl electrodes (BioSemi, Amsterdam, The Netherlands) mounted in an elastic cap, and two additional electrodes placed at the mastoids (behind the ears). All recorded signals were stored on a computer hard disk for offline analysis. Electrodes were evenly distributed across the scalp, using standard scalp locations as defined by the extended International 10–20 system (Jasper, 1958). The resulting electrode configuration is displayed in Fig. 2. Two additional electrodes served as an electrical reference (Common Mode Sense [CMS] active electrode) and ground (Driven Right Leg [DRL] passive electrode). The data from two electrodes (P9 and P10; not shown in Fig. 2) were discarded from further analysis. Electrode P9 did not function properly, and electrode P10 was situated too close to the neck muscles to record proper brain signals (the electrical activity from muscles interferes with the electrical activity originating from the brain). Therefore, data analysis proceeded with a final set of 61 electrodes.

Vertical eye movements were monitored by placing additional electrodes in a bipolar derivation above and below the right eye, and horizontal eye movements were monitored by placing additional electrodes in a bipolar derivation on the outer canthi of both eyes. These electrodes measured electrical activity originated from eye movements (the so-called electro-oculogram, or EOG), and were used in the offline analysis to detect whether or not participants were refraining from eye movements and were actually watching the computer screen. Recording parameters for the EOG electrodes were the same as for the EEG electrodes.

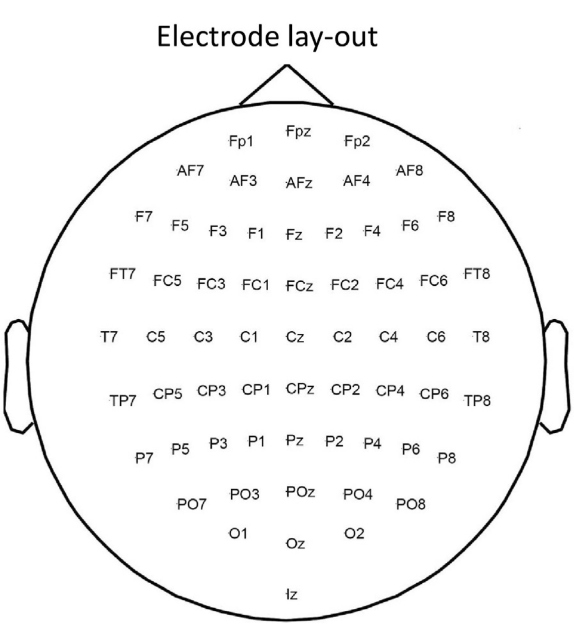

Fig. 2. Electrode configuration and electrode labels used in the experiment.

2.6. EEG data analysis

Data analysis was performed with the software package Brain Vision Analyzer (Brain Products GmbH, Germany). EEG was rereferenced off-line to an average of left and right mastoids and bandpass filtered (0.01–30 Hz, 48 dB/octave), which is a standard procedure for extracting the frequency band that is relevant for ERPs (Luck, 2014). For all of the 61 EEG electrodes, the raw data were segmented into time segments of 1200 ms around picture onset, consisting of a 200 ms prestimulus interval (used for computing a baseline level of EEG amplitude for each segment) and a 1000 ms poststimulus interval in which the response to each picture could be measured. These segments (typically called trials in EEG research) represent time intervals moments of a little over a second when each participant first saw each photo. Then all segments were visually inspected for eye movement, muscle, and other artifacts that may have contaminated the true EEG signal, and segments containing artifacts were discarded from further analysis (11.2% of all the segments on average, which constitutes a typical amount for this type of EEG studies). The remaining segments were free of artifacts, and contain only true EEG activity. The number of discarded segments was equally distributed over the four picture categories and the two groups, as the number of remaining, artifact-free segments did not differ for the four different categories of pictures: $F_{3,\ 84}=0.49$, $p=0.690$, nor did this interact with the between-subjects factor group: $F_{3,\ 84}=1.51$, $p=0.217$).

For each participant, the segments were then averaged for the four different picture categories separately. This resulted in ERPs, at 61 electrode positions, for each picture categories and each participant. These participant averages constitute the input for the statistical analyses (see below). Finally, the data were averaged across participants, separately for both groups. These grand averages constitute the input for the graphical representation of the data (Figs. 3–8).

2.7. Statistical analysis

For the statistical analyses based onthe *a priori* hypotheses, the mean within-participant amplitude change was extracted relative to the 200 ms prestimulus baseline interval of the following ERP components for each EEG channel and each condition: N1 (average amplitude in a time window of 80–120 ms after picture onset), P2 (175–225 ms after picture onset), and the late positive potential (LPP: 450–950 ms after picture onset). In order to test the set hypotheses, *t*-tests were then used to compare the amplitudes for each component between groups (independent-samples *t*-tests) and picture categories (dependent-samples *t*-tests).

Three main comparisons were focused upon. First, as a control analysis, it was verified whether the data replicate the classical emotional ERP effect (larger N1, larger P2 and larger LPP for valenced vs. neutral pictures; Hajcak et al., 2012). To this end one-sided, paired-samples *t*-tests were performed on all EEG channels separately for the N1, P2 and LPP components observed in the IAPS matched vs. the IAPS positive picture sets. In other words, tests were made to determine if there was a difference in the signal in each electrode on the cap at N1, P2, and LPP moments between matched and overly positive photos. This analysis was performed on all participants, i.e. collapsed across the two experimental groups.

Second, to verify the hypothesis that watching the movie excerpt from *In Bruges* would be instrumental in coupling a positive emotion to Bruges as a tourist destination, the study compared the N1, P2 and LPP components elicited by the Bruges pictures separately for the *In Bruges* group and *The Rum Diary* group. According to the study hypothesis, larger N1, P2 and LPP components were expected for the Bruges group compared with the Rum Diary group. One-sided, independent-samples *t*-tests were therefore performed on all EEG channels separately for each component.

Third, to verify the hypothesis that the effect of watching the movie excerpt from *In Bruges* is specific for the Bruges pictures, this same analysis was repeated, but now for the N1, P2 and LPP components elicited by the Kyoto pictures. For this analysis, no differences in the amplitude of these components between the groups was expected.

Note that in the statistical analyses the researchers were faced with the problem that they had to perform 61 *t*-tests (one for each electrode), which yields a multiple-comparison problem that inflates the overall type-I error. Applying a Bonferroni or equivalent correction would lead to an exceedingly low alpha level (0.0008 in case of a Bonferroni correction). In the authors' view, this is an overly conservative statistical approach, leading to an excessive increase in type II errors. Using repeated-measures ANOVAs to solve the multiple-comparisons problem, as recommended by Luck (2014), where electrodes are grouped into four quadrants, assumes that ERP components are broadly distributed within one (or several) quadrants, which is not the case for the components currently under study (P2 and LPP). Other forms of multiple-comparisons correction, such as the non-parametric approach described by Maris and Oostenveld (2007) are biased towards effects that have a widespread scalp distribution, and would be overly conservative for the current data. A multiple comparisons correction was therefore implemented by determining (based on the binomial probability of $p=0.05$ for a type-I error) the number of *t*-tests that would be significant by chance alone. As the binomial probability of observing seven or more type-I errors in 61 *t*-tests is $p=0.032$ (that is, well below an overall alpha of 0.05), this logic led to the multiple-comparisons-corrected criterion that for each pair-wise comparison between categories of picture stimuli, a minimum of seven channel-level, uncorrected *t*-tests have to be significant at $p<0.05$ in order to reach the conclusion that there is a significant difference between categories.

In addition, a second, neurophysiological criterion was used: if significant *t*-tests cluster together topographically (that is, on adjacent locations on the scalp), they are likely to be caused by one and the same underlying neural generator (brain process), which adds to the likelihood that a real effect is being observed, rather than a type-I error.

3. Results

3.1. The experimental effect: Bruges pictures for experimental vs. control groups

The ERP waveforms for the Bruges stimuli, computed separately for the two experimental groups, are displayed in Fig. 3. Visual inspection of this figure suggests that the N1 and LPP components are larger for the experimental group compared with the control group as hypothesized, while the P2 appears to be of similar size for both groups.

The statistical analysis of the N1 (Fig. 4, left hand panel) indicates that the N1 is significantly larger in the experimental group for a cluster of eight channels around midcentral and right posterior electrodes as hypothesized. The binomial probability of observing eight or more type-I errors out of 61 tests is $p=0.011$, which is well below an alpha level of 5%. Furthermore, there is a clear topographical clustering, which lends further support to the

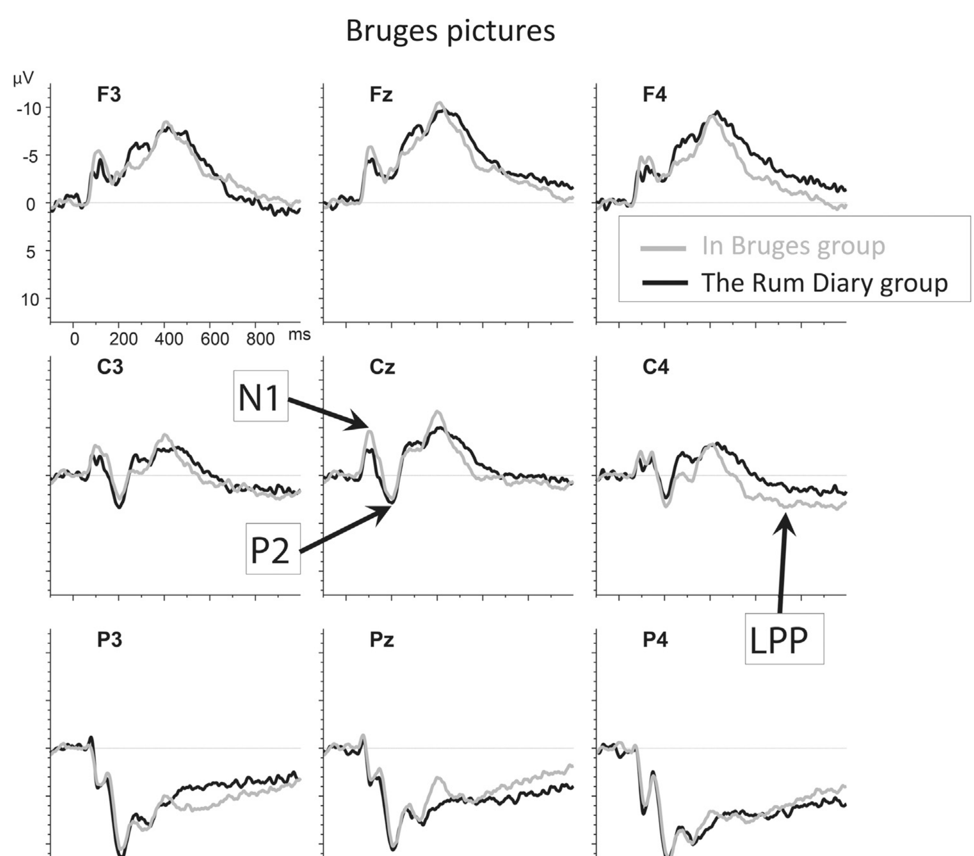

Fig. 3. Grand average Event-Related Potential (ERP) waveforms at selected channels in response to pictures of Bruges, separately for the two groups. The peaks and troughs corresponding to the N1, P2 and LPP components of the ERP are indicated with arrows on channels where they are most easily identified.

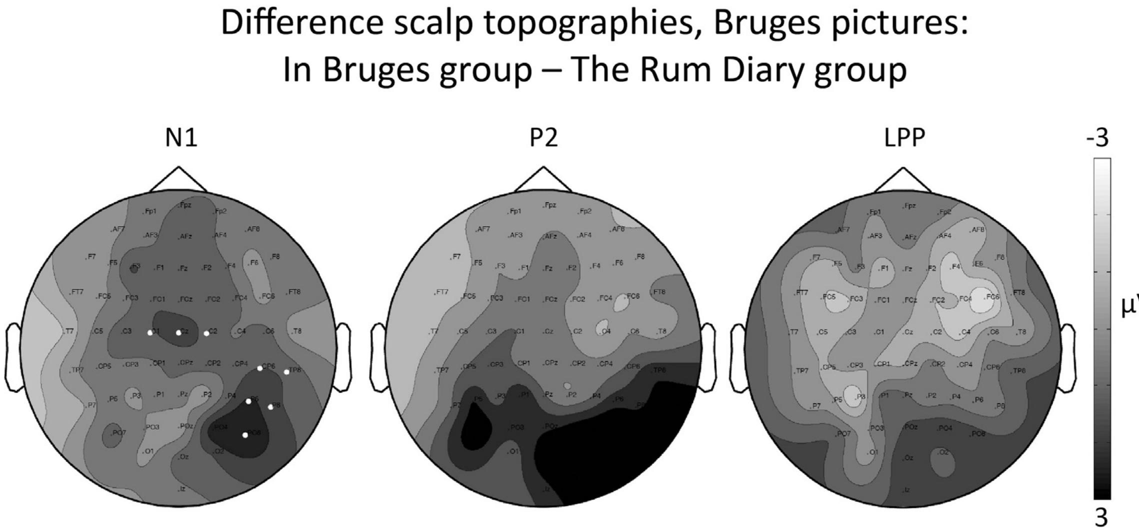

Fig. 4. Difference scalp topographies (Bruges group – Rum Diary group) of the ERPs elicited by the pictures of Bruges, for three ERP components. White dots indicate significant channel-level *t*-tests ($p < 0.05$, uncorrected).

conclusion that we observe a significant difference in N1 amplitude between the two groups in response to Bruges pictures. For the P2 and LPP however (middle- and right-hand panels of Fig. 4), the hypothesized statistically significant differences between the two groups was not observed.

3.2. *Specificity of the experimental effect: Kyoto pictures for experimental vs. control groups*

The ERP waveforms for the Kyoto stimuli, computed separately for the two groups, are displayed in Fig. 5. Visual inspection of this figure suggests that there are, as hypothesized, no clear differences between the two groups for the Kyoto pictures. There is at best a faint hint at a larger N1 for the In Bruges group, and one or two channels display a somewhat larger LPP for the In Bruges group. No effects seem to be present for the P2.

Lack of an effect of experimental condition on reactions to the Kyoto pictures is confirmed by the statistical analyses (see Fig. 6). For the N1 component (left-hand panel of Fig. 6), *t*-tests are significant for three isolated channels. As the binomial probability of observing

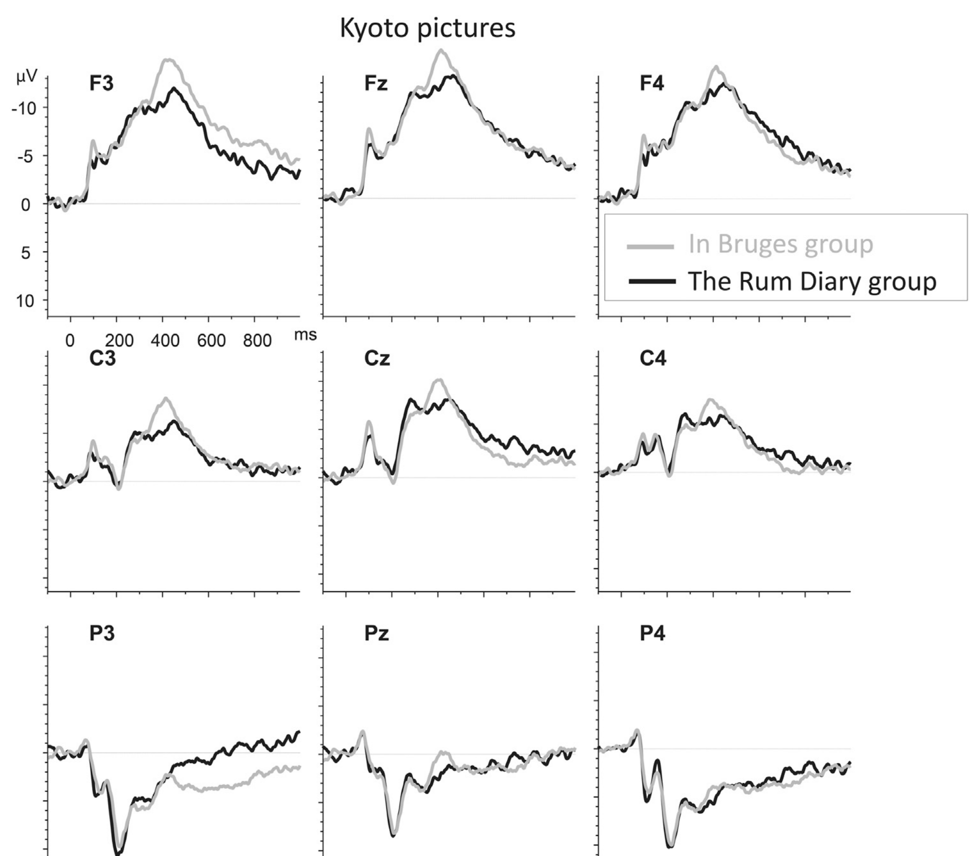

Fig. 5. Grand average Event-Related Potential (ERP) waveforms at selected channels in response to pictures of Kyoto, separately for the two groups.

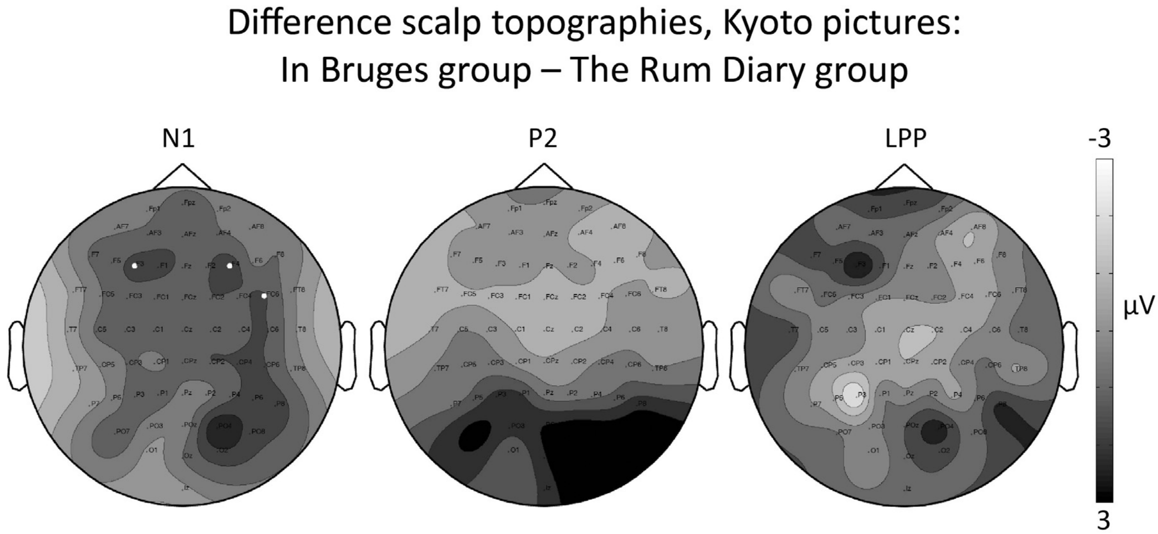

Fig. 6. Difference scalp topographies (Bruges group – Rum Diary group) of the ERPs elicited by the pictures of Kyoto, for three ERP components. White dots indicate significant channel-level *t*-tests ($p < 0.05$, uncorrected).

three or more type-I errors is $p=0.594$, and in addition there is an absence of a clear topographic clustering of the effects, it can be concluded that there is no significant difference in N1 between the Kyoto and Bruges stimulus sets for the Rum Diary group.

For the P2 and LPP components,no significant differences between the two groups was observed.

3.3. *Control analysis: IAPS matched vs. IAPS positive*

The ERP waveforms for the IAPS matched and IAPS positive picture sets, collapsed across the two experimental groups, are presented in Fig. 7. A visual inspection of this figure indicates a clear presence of the N1, P2 and LPP components. Further, Fig. 7

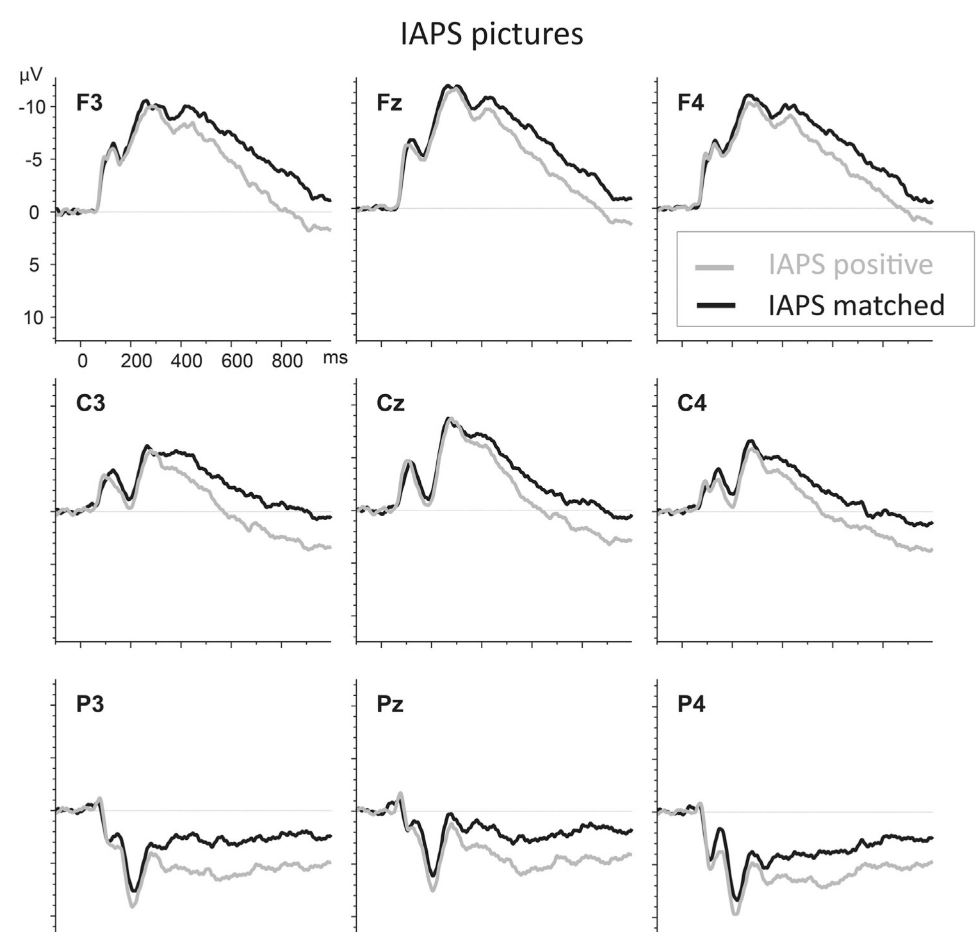

Fig. 7. Grand average Event-Related Potential (ERP) waveforms at selected channels in response to the two differently valenced IAPS picture sets (IAPS matched, IAPS positive). Data from the two groups (In Bruges, the Rum Diary) are averaged for this comparison.

suggests that the N1 is similar across the two picture sets, whereas the P2 and LPP components appear to be larger for the IAPS positive pictures.

The statistical analyses (summarized in Fig. 8) confirm this effect. For the N1 (left-hand panel of Fig. 8), none of the single-channel *t*-tests were significant. For the P2 (middle panel) and LPP (right-hand panel), a large majority of the single-channel *t*-tests is significant, convincingly demonstrating larger P2 and LPP components for the IAPS positive pictures compared with the IAPS matched picture set as expected.

4. Discussion

An EEG-based neuromarketing experiment was performed to establish whether event-related potentials (ERPs) can be used as a tool to evaluate the effectiveness of tourist destination marketing in coupling a positive emotion to a destination. Specifically, based on the importance of affective destination image and use of popular movies as marketing tools, the study investigated whether a popular movie segment has immediate effects on individuals' responses to destination pictures. The specific destination marketing material used was a segment from a movie with embedded positive portrayals of a medieval urban UNESCO World Heritage Site, the medieval city of Bruges. Two groups of participants viewed pictures from Bruges and an unrelated though similar destination (Kyoto), pictures from the IAPS database that were matched in terms of valence and arousal, and IAPS pictures that were strongly positively valenced. Prior to viewing the pictures, one group saw an excerpt from the movie *In Bruges*, which depicts the main tourist attractions from Bruges in a positive way. The other group of participants saw an unrelated movie excerpt (a few scenes from*The Rum Diary*). The results show that (1) the study replicates the commonly reported effect of viewing positively valenced pictures of the destination, namely larger P2 and LPP components for more positively valenced IAPS pictures; (2) pictures from Bruges elicit a larger N1 component in the*In Bruges* group than in *Ihe Rum Diary* group; (3) no statistically reliable between-group differences were observed in the ERPs elicited by pictures from Kyoto.

Sinceconvenience sampling was used, the study did not explicitly control for the number of males and females in the sample. This may raise the issue of gender differences in the induction of emotional responses. Although gender differences in EEG affective responses have been observed previously, they are state- and domain-dependent (see e.g. Bradley, Codispoti, Sabatinelli, & Lang, 2001), and there was no reason to expect that modulations of the affective response as a result of watching a destination movie would be dependent on gender. However, this is an empirical question that might be addressed in subsequent studies.

While the P2 and LPP components that show sensitivity in the control analysis on the IAPS pictures are commonly associated with emotional valence and arousal, respectively (Hajcak, Dunning, & Foti, 2009), the modulation of the N1 component that was observed in response to the Bruges pictures in the Bruges group indicates that this group is sensitive to the emotional content of the Bruges pictures. The N1 component has been interpreted as reflecting early increased visual processing of emotional content, and is more generally sensitive to the emotional content in visual stimuli (e.g. Keil et al., 2001; Weinberg & Hajcak, 2010; see Hajcak et al. (2012) for a review). Thus, the findings support the overall prediction that watching the positive destination portrayal of Bruges in the experimental movie clip induced a positive emotional response to pictures of this destination in the brain activity of participants that watched this movie excerpt. This effect was specific, as it was not observed in participants who watched a control movie, nor did the effect occur in response to pictures of a different destination. It appears that the positive messages about Bruges embedded in the first 10 minutes of *In Bruges* constitute emotionally effective marketing content, and an EEG neuromarketing experiment is a useful research approach to measure this effect.

It should be noted that the study observed two qualitatively different types of emotional modulations: for the *In Bruges* group an emotional modulation of the N1 component was observed, while for the standard contrast between neutral and positively valenced IAPS pictures modulations of P2 and LPP components were observed. While the latter effects are commonly interpreted as a standard effect of emotional valence (Hajcak et al., 2012), the results of this study raise the question of why qualitatively different effects were observed for the Bruges contrast and for the IAPS contrast. One crucial difference between the two comparisons is that for the IAPS contrast the study compared emotionally neutral stimuli to positively valenced stimuli (as indexed by the IAPS norms based on behavioral data), whereas in the Bruges contrast emotionally neutral stimuli were compared with each other (as indexed by the behavioral pre-test data), which are truly neutral in one case (for the *The Rum Diary* group) and emotionally 'invigorated' in the other case (for the *In Bruges* group). Therefore, it is not unreasonable in the Bruges contrast to expect effects that are qualitatively different from a standard valence effect. As said,

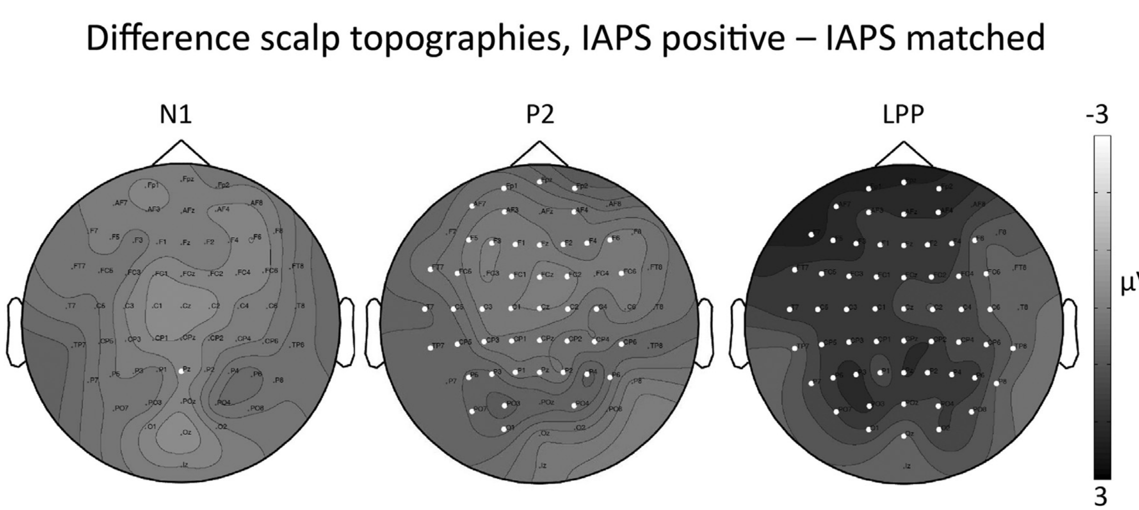

Fig. 8. Difference scalp topographies of the contrast IAPS positive – IAPS matched, for three ERP components. White dots indicate significant channel-level *t*-tests ($p < 0.05$, uncorrected).

in keeping with the literature (Hajcak et al., 2012) the N1 effect for the Bruges contrast was interpreted as a stronger attentional capture owing to the increase in emotional salience.

In relation to the destination marketing literature, the findings further specify the destination image formation model proposed by Bolan and Williams (2008). This model suggests that audiences organically sense portrayals of destinations in movies, affecting their image of these destinations. This model was specified with the finding of an immediate positive emotional effect, with positive portrayals of a destination in a movie priming distinct positive emotional reactions to pictures of that destination. In short, a positive movie portrayal contributes to an immediate positive change in affective destination image, a novel contribution to our understanding of popular movie portrayals as information source antecedents (Josiassen et al., 2015) or organic image formation agents (Gunn, 1972).

Under the framework of Echtner and Ritchie (1993), the present study comprises a measurement of a single psychological attribute of destination image—the positive emotional reaction to pictures of Bruges. While further research would be useful to connect this component to functional attributes such as overall destination image (Josiassen et al., 2015) or self-congruity (Zhang et al., 2014), it has been shown that emotional reactions have the strongest influence on overall destination image (e.g., Baloglu & McCleary, 1999).

The fact that the effect of *In Bruges* was demonstrably limited to pictures of Bruges and excluded pictures of Kyoto extends the literature on effects of marketing materials on destination image. Our findings specify the possibility that affective destination image 'would apply then to a specific destination and others like it' (Tasci et al., 2007, p. 210), possibly including destinations that look similar but clearly *not* destinations of the same type that happen to look quite different (in this case, Kyoto). Either the affective image modification from a movie such as *In Bruges* applies only to a specific destination – *not* including others like it – or the resemblance of related destinations has to be closer, perhaps including visual resemblance as well. Kyoto is the same type of destination as Bruges (urban medieval heritage site), but looks different. *In Bruges* might lead to positive emotional reactions to other medieval cities of the former Low Countries which have a closer visual resemblance to Bruges, such as Amsterdam or Antwerp. This possibility certainly warrants further investigation.

This finding also constitutes a major methodological contribution to existing research of destination marketing in two ways. First, while most destination marketing research uses cross-sectional designs to test for differences in reactions, preferences, and intentions *between* participants, an experiment such as this one tests for differences in reactions *within* participants based on their exposure to marketing materials. Having said this, it should be noted that the present experimental design is only partly within-participants, and the crucial comparison was a between-participant comparison; in future work, using a fully within-participants design, by probing the emotional brain responses to pictures both before and after exposing participants to destination marketing materials, is advocated. As such, within-participant designs assess the effect that marketing materials actually have to change potential visitors' destination image (e.g. Kim et al., 2009; Lee et al., 2014). Furthermore, when paired with a control group chosen by random assignment, a within-participant design comprises an experiment, which is known as the most internally valid research design in the social sciences (e.g. Trochim & Donnelly, 2005). In contrast, cross-sectional studies are plagued by intervening variables that may explain observed effects. Long questionnaires meant to exhaust possibilities of such intervening variables place a burden on participants, threatening validity in other ways. To illustrate this problem, a comprehensive review of destination image literature by Josiassen et al. (2015) lists 15 possible antecedents to destination image formation. As a potential solution to this issue, over a decade ago, Sönmez and Sirakaya recommended that 'experimental studies that isolate the impact of a single-image factor on destination choices and understand the role of images in decision-making processes would enhance the body of knowledge in the area of image research' (Sönmez & Sirakaya, 2002, p. 14), although few such studies have been conducted since. Our findings highlight the persistent value of this recommendation.

The second methodological contribution of this study to research on destination marketing is the direct measurement of emotional responses from the brain as they occur. Emotional reactions to marketing materials and related concepts, such as destination image (Dolnicar & Grün, 2012) and tourists' emotions during their visit (Mitas, Yarnal, Adams, & Ram, 2012), are usually measured by self-response questionnaires and thus necessarily involve some recall. The resulting scores appear to be somewhat valid and reliable, but are inevitably distorted by recall error and the cognitive filtering/appraisal of emotional processes. More generally, 'issues of both internal and external validity of destination image research might be at risk due to an overreliance on self-administered surveys for which the researcher has limited control' (Tasci et al., 2007, p. 216). When recorded directly from the brain, as in our study, such response effects do not distort the recorded data.

This study demonstrates that direct recording of brain activity is a feasible and useful method for measuring emotional reactions to destination marketing material. With the advent of portable EEG units in backpacks (Ng & Chan, 2005, is just one of the many examples), it is plausible that recording from the brain could also be feasible and useful in measuring reactions to the destination itself, potentially linking the effectiveness of destination marketing materials with on-site experience (Lee et al., 2014), although there is an inevitable tension between moving towards increasingly naturalistic settings on the one hand, and tight experimental control on the other hand.

The study findings also extend existing neuromarketing literature in two ways. The use of electroencephalography (EEG) measurement is not very common in neuromarketing research, with functional magnetic resonance imaging (fMRI) being favored, despite its high costs and inferior temporal resolution. The usefulness of measuring EEG rather than fMRI signals to measure emotions in a neuromarketing context is a novel approach that proved effective in the present study.

The use of EEG as opposed to fMRI also holds promise for extending neuromarketing approaches to products and industries where fMRI research costs render such technology inaccessible. This issue touches many tourism businesses. Destination marketing organizations, for example, often have small budgets paid for from public sources. Often several sources (taxes, subsidies) must be cobbled together for the marketing budget for a single destination. Under such budgetary conditions, an fMRI study is not justifiable, but as we have demonstrated, an EEG study is. The same is true for tour operators, who compete on price over thin margins in an active, dynamic, consumer-empowered market place.

4.1. Conclusion, and implications for future research

This paper has shown subsecond emotional responses to destination stimuli that are stronger after having seen a related destination movie. The fact that these responses are so fast (the N1 effect arises between 80 and 120 ms after picture onset) is a clear indication that these responses are truly unconscious/ emotional, and not rational/cognitive in nature, as conscious cognitive processes typically take longer to develop in the EEG (roughly from 400 ms onwards).

The question of how long this increase in emotional response lasts is a different one. For that, the experimental design needs to be reconsidered. Participants saw a destination movie (either related or unrelated to Bruges), and after some 5–10 min (the exact time lag depends on the length of the break we allowed participants between the two parts of the experiment) they saw a series of pictures from that same (or a different) destination. It is thus demonstrated that the emotionally 'invigorating' effect of the movie on subsequent, related destination pictures lasts for at least some 5–10 min. This is admittedly a very short time period. However, the effect measured is the momentary reaction to destination photos: just the sort of stimulus a potential tourist sees on websites of travel organizations next to buttons to book and buy. The emotional decisions to click those buttons form quickly, based on emotions, according to the literature reviewed here. An interesting next question though (which has not been addressed here, but which is empirical in nature) is exactly how long this effect would last. For that, an experimental design is needed in which participants are tested at different time intervals after having viewed the movie (say 10 min, and 1, 5 and 10 days), so that it can be established whether, and if so how rapidly the effects that we presently observe after 5–10 min decay.

In sum, this study demonstrated an increase in emotional reactions to pictures of Bruges following the prime of an *In Bruges* excerpt. Emotions are known predictors of purchase behavior. It can be concluded that an EEG-based, experimental neuromarketing approach to study the effectiveness of destination marketing is viable.

The study did not, however, test purchase behavior or visit intention among the participants. A natural follow-up to the present study would include a behavioral component that assesses such purchase intentions or some other form of conative or behavioral preference, termed destination image consequences in Josiassen et al. (2015). This would establish linkages between these three variables (marketing material, reactions in the brain, purchase behavior) and determine whether observe brain activity signatures can be observed that reliably predict not only that a subject feels triggered by certain marketing materials, but is likely to buy the marketed (destination) product.

Likewise, it should be noted that this study only measured short-term changes in emotional responses to destination images, that is, a few minutes after the movie excerpts were viewed. Future research should be aimed at verifying the temporal persistence of the influence of organic destination movies on those emotional responses.

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References

Ariely, D., & Berns, G. S. (2010). Neuromarketing: The hope and hype of neuroimaging in business. *Nature Reviews Neuroscience*, *11*(4), 284–292. http://dx.doi.org/10.1038/nrn2795.

Baloglu, S., & Brinberg, D. (1997). Affective images of tourism destinations. *Journal of Travel Research*, *35*(4), 11–15.

Baloglu, S., & McCleary, K. W. (1999). A model of destination image formation. *Annals of Tourism Research*, *26*(4), 868–897.

Beerli, A., & Martin, J. D. (2004). Factors influencing destination image. *Annals of Tourism Research*, *31*(3), 657–681.

Beeton, S. (2005). *Film-induced tourism*. Clevedom, England: Channel View Publications.

Belden, S. R. A. (2008). Science is culture: Neuroeconomics and neuromarketing: Practical applications and ethical concerns. *Journal of Mind Theory*, *0*(1).

Bigné Alcañiz, E., Sánchez García, I., & Sanz Blas, S. (2009). The functional-psychological continuum in the cognitive image of a destination: A confirmatory analysis. *Tourism Management*, *30*(5), 715–723.

Bolan, P., & Williams, L. (2008). The role of image in service promotion: Focusing on the influence of film on consumer choice within tourism. *International Journal of Consumer Studies*, *32*(4), 382–390.

Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering pictures: Pleasure and arousal in memory. *Journal of Experimental psychology: Learning, Memory, and Cognition*, *18*(2), 379.

Bradley, M. M., Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: Sex differences in picture processing. *Emotion*, *1*(3), 300.

Gunn C. (1972). *Vacationscape: Designing Tourist Regions.*. Bureau of Business Research, University of Texas, Austin, TX.

Cabeza, R., & Nyberg, L. (2000). Imaging cognition II: An empirical review of 275 PET and fMRI studies. *Journal of Cognitive Neuroscience*, *12*(1), 1–47.

Cherifi, B., Smith, A., Maitland, R., & Stevenson, N. (2014). Destination images of non-visitors. *Annals of Tourism Research*, *49*, 190–202.

Chon, K.-S. (1990). The role of destination image in tourism: A review and discussion. *Tourism Review*, *45*(2), 2–9.

Crompton, J. L. (1979). An assessment of the image of Mexico as a vacation destination and the influence of geographical location upon that image. *Journal of Travel Research*, *17*(4), 18–23.

Davidson, R. J., & Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences*, *3*(1), 11–21.

Dolnicar, S., & Grün, B. (2012). Validly measuring destination image in survey studies. *Journal of Travel Research*. 0047287512457267

Echtner, C. M., & Ritchie, J. B. (1993). The measurement of destination image: An empirical assessment. *Journal of Travel Research*, *31*(4), 3–13.

Ekman, P. (1992). An argument for basic emotions. *Cognition & Emotion*, *6*(3–4), 169–200.

Hajcak, G., Weinberg, A., MacNamara, A., & Foti, D. (2012). *ERPs and the study of emotion*. *Oxford Handbook of Event-Related Potential Components*. New York: Oxford University Press.

Gallarza, M. G., Saura, I. G., & García, H. C. (2002). Destination image: Towards a conceptual framework. *Annals of Tourism Research*, *29*(1), 56–78.

Gartner, W. C. (1994). Image formation process. *Journal of Travel & Tourism Marketing*, *2*(2–3), 191–216.

Govers, R., Go, F. M., & Kumar, K. (2007). Promoting tourism destination image. *Journal of Travel Research*, *46*(1), 15–23.

Hajcak, G., Dunning, J. P., & Foti, D. (2009). Motivated and controlled attention to emotion: Time-course of the late positive potential. *Clinical Neurophysiology*, *120*(3), 505–510.

Handy, T. C., Smilek, D., Geiger, L., Liu, C., & Schooler, J. W. (2010). ERP evidence for rapid hedonic evaluation of logos. *Journal of Cognitive Neuroscience*, *22*(1), 124–138.

Josiassen, A., Assaf, A. G., Woo, L., & Kock, F. (2015). The Imagery – Image Duality Model : An Integrative Review and Advocating for Improved Delimitation of Concepts. *Journal of Travel Research, (in press)*, http://dx.doi.org/10.1177/0047287515583358.

Kaplanidou, K., & Gibson, H. J. (2010). Predicting behavioral intentions of active event sport tourists: The case of a small-scale recurring sports event. *Journal of Sport & Tourism*, *15*(2), 163–179.

Keil, A., Müller, M. M., Gruber, T., Wienbruch, C., Stolarova, M., & Elbert, T. (2001). Effects of emotional arousal in the cerebral hemispheres: A study of oscillatory brain activity and event-related potentials. *Clinical Neurophysiology*, *112*(11), 2057–2068.

Kim, H., & Richardson, S. L. (2003). Motion picture impacts on destination images. *Annals of Tourism Research*, *30*(1), 216–237.

Kim, S.-B., Kim, D.-Y., & Bolls, P. (2014). Tourist mental-imagery processing: Attention and arousal. *Annals of Tourism Research*, *45*, 63–76.

Kim, S. S., McKercher, B., & Lee, H. (2009). Tracking tourism destination image perception. *Annals of Tourism Research*, *36*(4), 715–718.

Lee, B., Lee, C.-K., & Lee, J. (2014). Dynamic nature of destination image and influence of tourist overall satisfaction on image modification. *Journal of Travel Research*, *53*(2), 239–251.

Li, S., Scott, N., & Walters, G. (2014). Current and potential methods for measuring emotion in tourism experiences: A review. *Current Issues in Tourism*. , http://dx.doi.org/10.1080/13683500.2014.975679.

Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision-making In: R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences*. Oxford: Oxford University Press.

Loewenstein, G., Rick, S., & Cohen, J. D. (2008). Neuroeconomics. *Annual Review of Psychology*, *59*, 647–672.

Luck, S. J. (2014). *An introduction to the event-related potential technique*. Cambridge: MIT press.

Luck, S. J., & Kappenman, E. S. (2011). *The Oxford handbook of event-related potential components*. New York: Oxford University Press.

Maris, E., & Oostenveld, R. (2007). Nonparametric statistical testing of EEG- and MEG-data. *Journal of Neuroscience Methods*, *164*(1), 177–190. http://dx.doi.org/10.1016/j.jneumeth.2007.03.024.

Mitas, O., Yarnal, C., Adams, R., & Ram, N. (2012). Taking a 'peak' at leisure travelers' positive emotions. *Leisure Sciences*, *34*(2), 115–135.

Morgan, N., & Pritchard, A. (1998). *Tourism promotion and power: Creating images, creating identities*. Chichester: John Wiley & Sons Ltd.

Moutinho, L. (1987). Consumer behaviour in tourism. *European Journal of Marketing*, *21*(10), 5–44.

Nazari, M., Gholami Doborjeh, Z., Amanzadeh Oghaz, T., Salehi Fadardi, J., & Amir

Amin Yazdi, S. (2014). Evaluation of consumers' preference to the brands of beverage bymeans of ERP pre-comprehension Component. Paper presented at *the 2014 international conference on Global Economy*, *Commerce and Service Science (GECSS-14)*.
Ng, K. A., & Chan, P. K. (2005). A CMOS analog front-end IC for portable EEG/ECG monitoring applications. *IEEE Transactions on Circuits and Systems I: Regular Papers*, *52*(11), 2335–2347.
Olofsson, J. K., Nordin, S., Sequeira, H., & Polich, J. (2008). Affective picture processing: An integrative review of ERP findings. *Biological Psychology*, *77*(3), 247–265.
Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International affective picture system (IAPS): Technical manual and affective ratings*. NIMH, Center for the Study of Emotion & Attention.
Pascual-Marqui, R. D. (1999). Review of methods for solving the EEG inverse problem. *International Journal of Bioelectromagnetism*, *1*(1), 75–86.
Pearce, P. L. (2012). The experience of visiting home and familiar places. *Annals of Tourism Research*, *39*(2), 1024–1047.
Phan, K. L., Wager, T., Taylor, S. F., & Liberzon, I. (2002). Functional neuroanatomy of emotion: A meta-analysis of emotion activation studies in PET and fMRI. *Neuroimage*, *16*(2), 331–348.
Royo-Vela, M. (2009). Rural-cultural excursion conceptualization: A local tourism marketing management model based on tourist destination image measurement. *Tourism Management*, *30*(3), 419–428.
Russel, A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161–1178.
Ryan, C., & Cave, J. (2005). Structuring destination image: A qualitative approach. *Journal of Travel Research*, *44*(2), 143–150.
Wencki S., (2012). In Bruges-at Bruges: *An experimental investigation of the possible influence of motion pictures on emotions, destination image and the consequential experience at a destination*. Bachelor, NHTV Breda University of Applied Sciences.
Sönmez, S., & Sirakaya, E. (2002). A distorted destination image? The case of Turkey. *Journal of Travel Research*, *41*(2), 185–196.
Stepchenkova, S., & Li, X. R. (2014). Destination image: Do top-of-mind associations say it all? *Annals of Tourism Research*, *45*, 46–62.
Stepchenkova, S., Kim, H., & Kirilenko, A. (2014). Cultural differences in pictorial destination images Russia through the camera lenses of American and Korean tourists. *Journal of Travel Research*. 0047287514535849
Stylidis, D., Sit, J., & Biran, A. (2014). An exploratory study of residents' perception of place image: The case of Kavala. *Journal of Travel Research*. 0047287514563163
Tasci, A. D., Gartner, W. C., & Cavusgil, S. T. (2007). Conceptualization and operationalization of destination image. *Journal of Hospitality & Tourism Research*, *31* (2), 194–223.
Trochim, W. M., & Donnelly, J. (2005). *Research methods: The concise knowledge base*. Cincinnati, OH: Atomic Dog Pub.
Vecchiato, G., Astolfi, L., De Vico Fallani, F., Toppi, J., Aloise, F., Bez, F., & Cincotti, F. (2011). On the use of EEG or MEG brain imaging tools in neuromarketing research. *Computational Intelligence and Neuroscience*, *2011*, 3.
Wang, Y., & Sparks, B. A. (2014). An eye-tracking study of tourism photo stimuli image characteristics and ethnicity. *Journal of Travel Research*. 0047287514564598
Weinberg, A., & Hajcak, G. (2010). Beyond good and evil: The time-course of neural activity elicited by specific picture content. *Emotion*, *10*(6), 767.
Wells, M. (2003). In search of the buy button. *Forbes*, *172*(4), 62–70.
Wencki, S., Mitas, O., & Straatman, S. (2014). Visiting the film: An experiment in German tourists' emotions. *In: Proceedings of the TTRA 2014 international conference: Tourism and the new global economy.*
Yüksel, A., & Akgül, O. (2007). Postcards as affective image makers: An idle agent in destination marketing. *Tourism Management*, *28*(3), 714–725.
Zhang, H., Fu, X., Cai, L. A., & Lu, L. (2014). Destination image and tourist loyalty: A meta-analysis. *Tourism Management*, *40*, 213–223.

Glossary

Affective destination image: Component of the image of a tourist destination that is determined through non-cognitive (i.e. unconscious, affective, or emotional) factors.;
Destination movie: A movie that features a tourist destination, and may be considered to constitute promotional material for that destination.;
Electro-encephalography (EEG): Recordings of electrical activity originating from neural tissue in the brain. Is known for its good temporal resolution.;
Event-related potential (ERP): Part of the EEG signal that is related to experimental events (e.g. the processing of marketing stimuli.;
Functional Magnetic Resonance Imaging (fMRI): Recordings of blood oxygenation levels in the brain, as a proxy for neural activity. Is known for its good spatial resolution.;
LPP: Component of the ERP that is sensitive, amongst others, to emotional arousal;
N1: Component of the ERP that is sensitive, amongst others, to increased attention to emotionally valenced stimuli.;
Neuromarketing: evaluating the effectiveness of marketing stimuli or – campaigns with the aid of neuroscience research methods.;
P1: Component of the ERP that is sensitive, amongst others, to emotional valence.