Eye Tracking: Evaluation, Potential and Limitations of Field Applications

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Abstract This chapter evaluates the use of eye tracking in tourism from the perspective of its potential and limitations. It opens with a rationale for the use of eye tracking in tourism, followed by an overview of the use of eye tracking in tourism. Then, the study presents practical tourism examples to show how eye tracking can be used on its own and together with other psychophysiological tools in tourism. The chapter also provides an evaluation of the potential, advantages, limitations and drawbacks of eye tracking.

Keywords Eye tracking · Advantages · Drawbacks · Neuromarketing tools · Tourism

1 Introduction to the Rationale for the Use of Eye Tracking in Tourism

Tourism is an experiential product, and it involves a wide variety of subjective emotions on the part of consumers (Boz et al. 2017; Koc et al. 2017; Shoval et al. 2017). Emotions can be defined as organized psychophysiological reactions of an individual to environmental stimuli (Scherer 2003). As tourism is based on the experiences of tourists, understanding their emotions based on their tourism experiences may not be easy. Traditional self-report methods, such as interviews or

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surveys, although widely used in understanding tourism and various aspects of tourist behaviour (Walters and Li 2017:49–50), appear to lack validity and reliability to a certain extent. These traditional methods assume that the consumers make rational and conscious decisions. In addition to the difficulty in understanding emotions based on the experiences of consumers, tourists may also have motives of which they themselves may be unaware. They may also engage in impression management when responding to the questions of researchers (Koc et al. 2017).

With the advent of a variety of sensor technologies, tourism researchers have begun to adopt psychophysiological tools such as eye tracking, EEG, functional magnetic resonance imaging, face recognition and skin conductance to better understand tourism activities and experiences from a wide variety of perspectives (Kim and Fesenmaier 2017: 18). In addition to their strengths in terms of validity and reliability, psychophysiological tools allow a real-time surveying of subjective emotional experiences, compared with traditional studies that mainly allow a post hoc and self-report study of tourism activities (Kim and Fesenmaier 2015).

A significant proportion of recent research in tourism involving psychophysiological tools has made use of the eye tracking method (Ma et al. 2016: 56–57). The statistical analysis of the fixation period, speed of movement and division of visual attention in eye tracking studies enable the interpretation of what and probably why certain elements in a study (e.g. tangibles in a hotel, a particular aspect of a tourism advertisement or the menu of a hotel restaurant) were gazed upon while others were not. In eye tracking, the observer's eye movement is the focus of interest and serves as a repository of information for exploring a wide variety of issues (Stoetzer 2010: 78).

The eye tracking studies in tourism are wide ranging, and they comprise areas such as destination marketing (Kiefer et al. 2017; Hernández-Méndez and Muñoz-Leiva 2015; Li et al. 2016), website and marketing communications effectiveness (Hernández-Méndez and Muñoz-Leiva 2015; Eidelman and Fakhrutdinova 2016; Scott et al. 2016; Wang and Sparks 2016), usability performance (Cowen 2001; Nielsen and Pernice 2010; Valsplat; 2011; Aldi 2015; Ramos et al. 2016) and purchasing intention (Yang 2012; Shaouf et al. 2016). Below, an overview of eye tracking studies in tourism is provided to explain and evaluate the use of eye tracking.

1.1 The Evaluation of the Effectiveness of Print and Online Materials

Online advertising in tourism and hospitality has become a significant marketing communications tool (Eidelman and Fakhrutdinova 2016). Today, even small- and medium-sized tourism and hospitality establishments have their own websites for marketing communication purposes.

A website or a marketing communications message's effectiveness depends largely on its ability to attract consumers' attention. Attention to the advertisement develops brand awareness, which in turn is believed to influence the attitude towards the brand and purchase intentions of customers (Vryona 2014; Chang and Chang 2014; Muda et al. 2014; Grigaliunaite and Pileliene 2016). Eye tracking can provide detailed information for decision makers in evaluating the efficiency and effectiveness of marketing communications tools and methods.

Statistics of average duration time, number of saccades (a quick, simultaneous movement of both eyes between two or more phases of fixation in the same direction), heat maps and first fixation path displays have often been used in eye tracking studies in tourism. Ghosh and Bhatnagar (2013) proposed that although click rate is an important metric that is frequently used for measuring the effectiveness of banner ads, eye tracking can provide substantially more detailed information for decision makers.

Scott et al.'s (2016) eye tracking study found that the block advertisements perform better in attracting and retaining attention compared with the text advertisements. It appears that textual information should be presented in a more concise manner to promote comprehension. The human eye is attracted to large print advertisements with short lines of text, regardless of its position in the advertisement. If there is a large amount of text in an advertisement, viewers seem to read mainly the large print text (Boz 2015).

Hernández-Méndez and Muñoz-Leiva (2015) used eye tracking to determine and compare the effectiveness of online advertising on so-called e-tourism 2.0 sites including travel blogs, travel social forums and Tripadvisor. The study mainly aimed to measure the influence of the elements of a banner (i.e. text or image) and the type of banner (e.g. animated versus static) on the attention of potential customers. The study revealed that slightly fewer fixations were made on the text compared with the image element of the banner. However, there were no differences in terms of the duration of fixation on static banners and animated banners.

Most of the research on tourists' visual processing behaviour in tourism focused particularly on the advertising effectiveness of destination marketing materials that influence tourists' purchase intentions. For instance, Li et al.'s (2016) study investigated the advertising effectiveness of tourism photographs with embedded text. The images with embedded text tended to attract participants' visual attention more than other forms of messages. It was also found that images with a single text message attracted participants' visual attention more than the messages with multiple text messages.

Pan and Zhang (2010) used eye tracking methodology to examine the effects of images in the online hotel decision-making process. The results of their study showed that the participants spent more time per fixation on text-only hotel alternatives compared to the hotel options with images. As text-only hotel messages require more cognitive effort on the part of tourists, they tend to be harder to evaluate. Images in marketing communications messages help tourists reduce their cognitive load and thus enable them to view more hotel options.

The study of Wang and Sparks (2016) offers insights for image selection in tourism marketing communication messages and highlights the importance of considering image characteristics and tailoring images to specific markets. Wang and Sparks' (2016) study particularly investigated the influence of low- versus high-arousal images and natural versus built images on the attention paid to tourism images, and they also explored whether this influence differs across tourist groups.

Aesthetic characteristics of websites can be examined by collecting eye movement data. Hao et al. (2015) explored the visual appeal of hotel websites to Chinese Generation Y tourists. The results showed that Generation Y customers had relatively longer fixations on large main pictures instead of normal-sized pictures and relatively shorter fixations on textual information. Web pages of hotel websites with large main pictures and little text appeared to be more visually appealing to Chinese Generation Y tourists.

Another study carried out by Pan et al. (2013) examined the attention paid by consumers to hotels listed on online travel websites. The customers tended to engage more on the hotel marketing materials when the display list was not exhaustive and when the message was accompanied by images rather than text-only.

1.2 The Usability Studies of Websites

Ramos et al. (2016) found that online presence and the quality of websites were of paramount importance for tourism businesses. A website's performance can be evaluated based on its functionality, product information, interactivity, navigation, reservation, payment, management and layout. Krug (2005) defined website usability as the degree that comfort guests had when they used the website. An eye tracking tool appears to be a reliable tool for exploring various aspects of the usability of websites and hence for designing efficient and effective websites (Cowen 2001; Nielsen and Pernice 2010; Valsplat 2011).

In another usability study by eye tracking, Aldi (2015) investigated the usability of the booking procedure on individual hotel websites located in the city of Lugano, Switzerland. The study revealed some of the potential factors that lower a website's usability.

1.3 Understanding Consumer Behaviour

Penz et al.'s (2017) eye tracking study test investigated potential tourists' level of awareness of eco-labels in hotel accommodation, together with certifications of tour operators when they are presented along with other information on a website. They also explored how eco-labels awareness influenced the perception of the website. According to Penz et al. (2017), the awareness of labels had a positive influence on the overall perception of a website.

In another eye tracking study, Aicher et al. (2015) measured the influence of rating symbols (stars and scoring) on the evaluation of hotels by the customers. The findings showed that customers placed more importance on rating symbols than textual information. The participants concentrated mainly on rating symbols and largely overlooked the text. The study concluded that the participants regarded the symbols as an important parameter when making a booking decision. The main motivation behind customers' behaviour was to be able to have a quicker overview of the hotels evaluated.

Noone and Robson (2014) examined hotel customers' use of both firm- and user-generated online content during the phases of browsing and deliberation. The research involved the measurement of fixations of participants on various booking portals. The findings of the study showed that the visual behaviour of the participants differed for hotels participants merely browsed and hotels that were in the consideration set. During the browsing phase, while the participants fixated mainly on the name of the hotel and the price, in the deliberation phase, participants fixated more on the images, information about the location, descriptions and user ratings.

2 The Potential of Eye Tracking in Tourism and Application Examples

Eye tracking can be used not only for measuring visual (text or image) processing but also for measuring auditory processing (listening) (Conklin and Pellicer-Sánchez 2016). This means that eye tracking, when combined with other psychophysiological tools, can measure the influence of a wide variety of factors relating to the 7Ps of a tourism service (i.e. product, price, place, promotion, physical evidence, process and people). Based on the perception of various stimuli regarding the 7Ps of tourism service, marketing managers can develop and design their 7P strategies (See Fig. 1). For instance, Boz et al. (2017) showed how eye tracking, together with EEG, can be used in developing pricing strategies for tourism and hospitality businesses. In another eye tracking study, Boz et al. (2016) found that hospitality managers had a positive bias towards more attractive job applicants even for backstage positions at hotels. On the other hand, Taskın et al. (2017) used eye tracking to measure customers' perceptions of risk on various tourism products/destinations in conflict-ridden destinations.

This means that eye tracking, perhaps when combined with another psychophysiological tool (EEG—Electroencephalogram, HRV—Heart Rate Variability, GSR—Galvanic Skin Response) can be used for measuring almost any marketing and management aspect of tourism service (ranging from destination marketing to branding and from the perception of a particular service process to the perception of a particular channel of distribution). Eye tracking with other psychophysiological tools such as EEG, HRV (Heart Rate Variability), GSR (Galvanic Skin Response) can provide an opportunity to triangulate data.

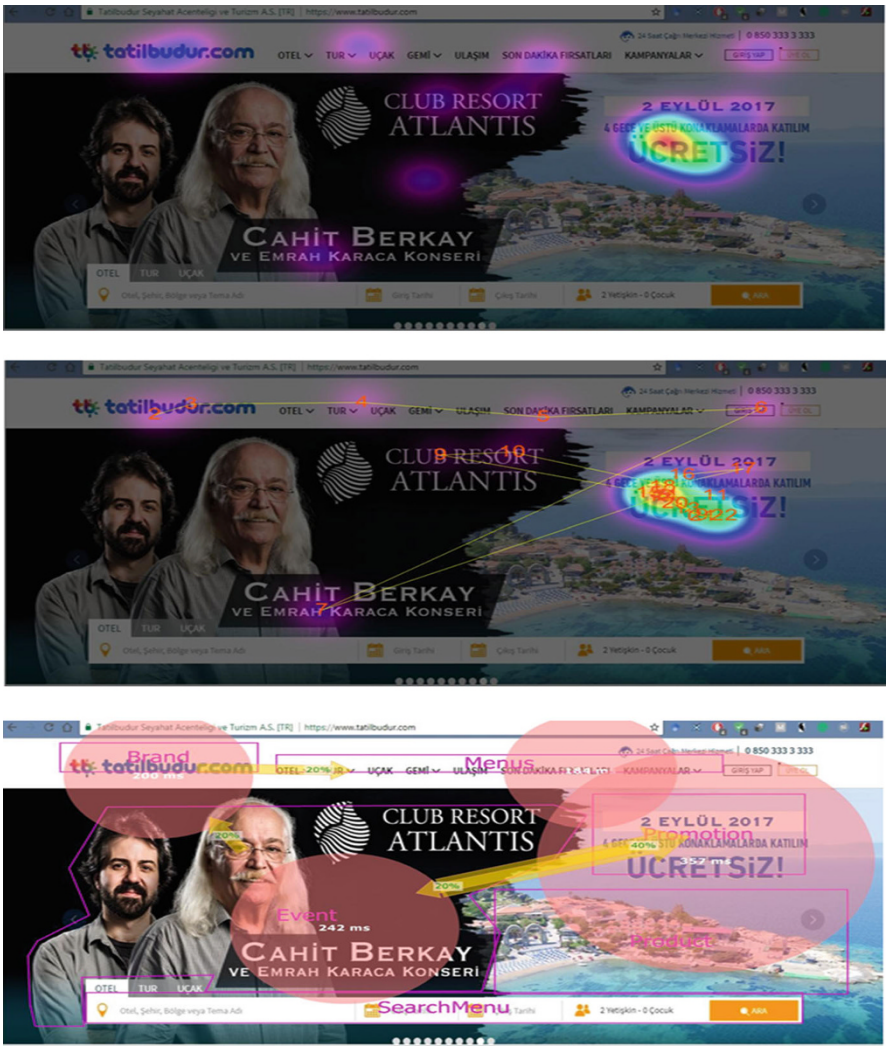

Fig. 1 Heat map, saccades and scan path analyses

In Fig. 1, an example of the application of eye tracking is presented. In this example, the heat map, saccades and scan paths are shown for a holiday resort advertisement in Turkey on an online holiday website (www.tatilbudur.com). In the first part of Fig. 1, a heat map is shown which illustrates the fixations of the viewers of this online advertisement. In the online advertisement, the potential visitors are offered an incentive of a free entry to a concert by two musicians. The photos of two musicians are placed on the left of the visual image, while the name of the resort hotel is placed in the middle. In the upper right section of the message, the free concert is shown, and on the lower right, the air view image of the resort is shown.

The heat map analysis shows that the viewers focused most on the word free (ÜCRETSİZ in Turkish), followed by the name of the resort hotel for risk reduction purposes.

The scan path analysis in the middle of Fig. 1 shows the fact that viewers first gazed at the brand name of the resort hotel, followed by a last-minute opportunity to look at the menu and login icon. After gazing at the top section of the online advertisement, the viewers gazed at the section where the names of the musicians and then the name of the resort hotel were written. Then, the viewers gazed at the expression free. However, the viewers of the advertisement did not appear to focus on the hotel. In this particular advertisement, the musicians and the promotion appear to be more important than the features of the actual tourism product, i.e. the hotel.

The third section in Fig. 1 shows the duration of eye fixations on various parts of the marketing stimuli. The viewers fixed their gazes on the expression free for a duration of 357 ms, the name of the online company (Tatilbudur) for 200 ms, the menu items for 184 ms and the activities for 242 ms. The analysis also shows that the viewers overlooked the search icon. This may mean that the place of the search icon was incorrect. Likewise, as the hotel's air view photo was ignored, this may also mean that it was incorrectly placed in the advertisement.

In Fig. 2, another example of an eye tracking method application on a holiday website (www.tatilbudur.com) is provided. The top image presents the region of interest results of the viewers who viewed this advertisement. The top image shows the duration of the fixation to a specific part of the advertisement. The sections of the advertisement and the duration that viewers fixed their gazes were as follows:

- First Product (Hotel)—1932 ms
- Second Product (Hotel)—195 ms
- Third Product (Hotel)— 1082 ms
- Last Reservations—1043 ms
- Whole Destinations—0 ms

The analysis also provides data as to how viewers use the website. The fixation on the latest reservations can be seen as an effort-reduction strategy where customers had a look at the holidays purchased by other customers previously.

In Fig. 3, another example of an eye tracking method application on a holiday website (www.tatilbudur.com) is provided. The top image presents heat map data of the viewers who viewed particular hotel advertisements. The analysis shows that the viewers tended to focus on the discounts. The analysis also shows that the participants tended to focus more on the visual parts of the message compared with the textual parts of the message.

In terms of the fixation, the participants tended to fixate first on the image in the middle of the advertisement, second on the latest reservations and then on the most expensive option in the advertisement.

A scan path analysis of eye tracking data shows the search–fixate–search sequence. While a straight scan path is optimal with short fixation time at the target, a longer-lasting scan path denotes a less effective or inefficient search (Poole and

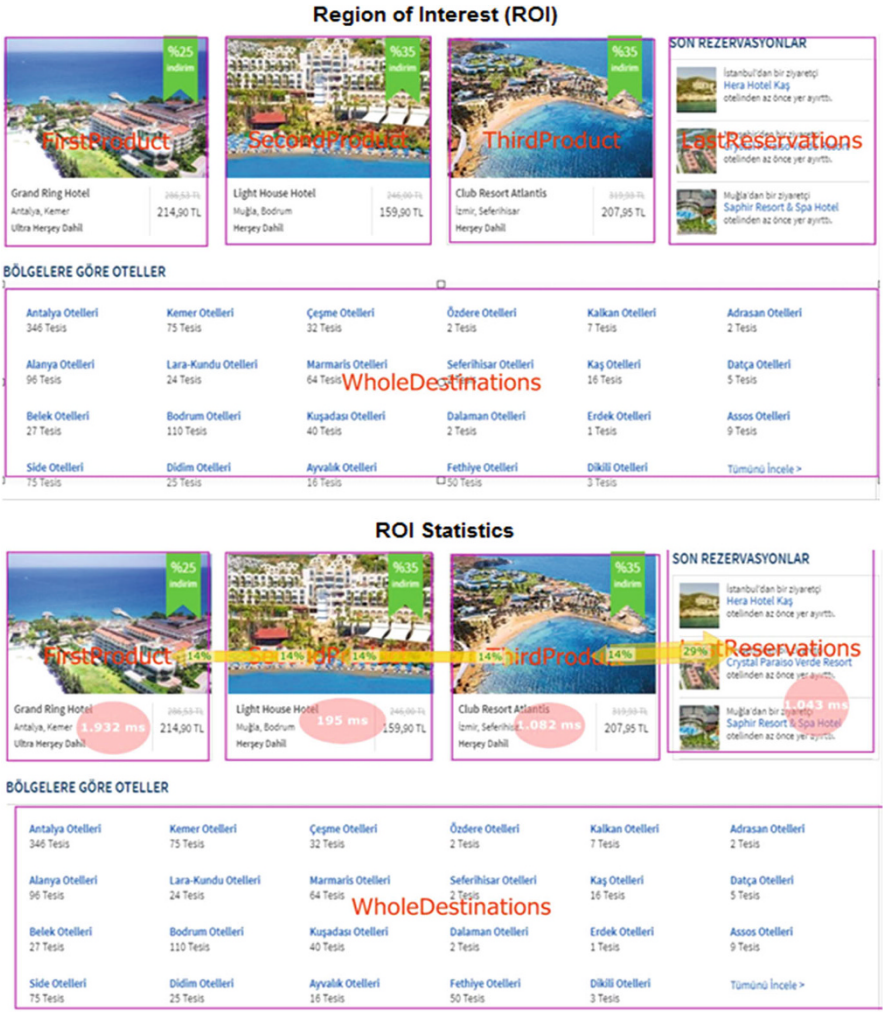

Fig. 2 Region of interest analysis

Ball 2005). In the example shown in Fig. 4, it can be seen that the participants appeared to concentrate first on the satisfaction evaluations of other customers who stayed in a hotel. Participants tended to fixate first on other customers' evaluation of the room, followed by food.

*The authors thank Tatilbudur.com and Human Behavior Lab—Praxeology (Neuromarketing Lab, www.hblab.org) for granting permission to use the website visual materials in the case study.

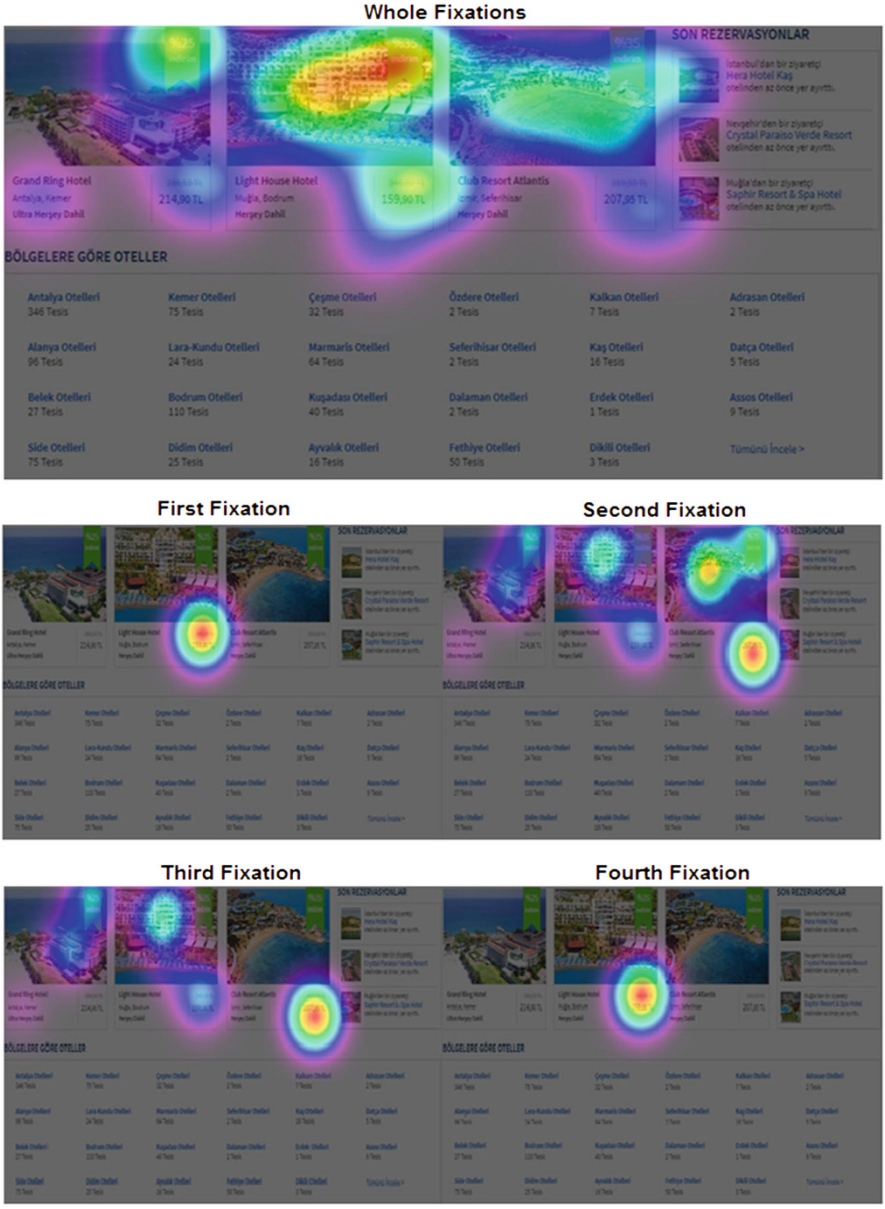

Fig. 3 Heat map analysis

Fig. 4 Scan path analysis

3 Combining Eye Tracking with Other Neuromarketing Tools

While eye tracking on its own can measure participants' gazes in terms of what they looked at and for how long they looked at it, combining eye tracking with other psychophysiological tools (neuromarketing tools) can enable the measurement of how participants felt when they looked at a specific marketing stimulus. As mentioned above, combining eye tracking with other neuromarketing tools can enable the collection of data regarding customers' responses to almost all stimuli regarding the 7Ps of services marketing.

For instance, the use of Facial Electromyography (fEMG) by placing sensors on the skin can measure the muscle activity of two main muscle groups associated with emotional reactions and valence. While the corrugator supercilii group (pyramidal muscle close to the eye) is associated with frowning, the zygomaticus major muscle group (starting from the cheekbone and extending to the corner of the mouth) is associated with smiling (Magnée et al. 2007; Larsen et al. 2003). Emotional valence is a scale of mood state, ranging from more positive to more negative (Burgess 2016).

On the other hand, when combined with eye tracking, HRV can enable the collection of motivational responses in the form of increases or decreases in attention levels of the participants when they look at a particular marketing stimulus (Carroll and Anastasiades 1978).

Galvanic Skin Response (GSR) can also be used together with eye tracking to measure electrodermal activity (EDA). Electrodermal activity is a property of the human body, causing variations in the electrical characteristics across the skin

(Ekman and Friesen 1975; Ekman 1989) and showing psychological or physiological arousal (Gouizi et al. 2011) when exposed to a particular marketing stimulus. Figure 5 shows the combined use of eye tracking with other neuromarketing tools. In the first image in Fig. 5, a heat map analysis of the viewers is shown. In the second and third images, EEG data show the measurement of emotions when viewers viewed the marketing stimuli. In the fourth image, a facial recognition device provides data on a viewer's emotions when he views a particular marketing stimulus. The final image shows GSR (Galvanic Skin Response) and HR (Heart Rate) data of a viewer when s/he viewed a particular marketing stimulus. The combined use of eye tracking with other neuromarketing tools can provide data that are more enriched, objective, valid and reliable. By using combined tools, managers may be able to understand customers better and make more efficient and effective decisions regarding the 7Ps of services marketing mix.

4 The Advantages, Potential, Limitations and Drawbacks of Eye Tracking

In the introduction section of the chapter, the drawbacks and limitations of traditional methods were stated. Like most methods or techniques, eye tracking has its limitations and drawbacks as well as its advantages. Below, a summary of the advantages, potential, limitations and the drawbacks of eye tracking is presented.

4.1 The Advantages and the Potential

With the improvements in eye tracking technology over the past few years, eye tracking has become more accessible, allowing a more widespread use of it by researchers (Lahey and Oxley 2016). Eye tracking is one of the fastest consumer data collection methods, and it allows the collection of real-time data. It is also more flexible, easier and cheaper to use compared with other neuromarketing tools. As eye movements are a natural part of perception (e.g. viewing and reading), they can be applied without secondary tasks (e.g. filling out a questionnaire), and eye tracking allows the recording of natural reactions of consumers in their natural habitats (Conklin and Pellicer-Sánchez 2016). While consumers may not be aware of their lower level eye fixations, eye tracking can still enable the recording of a stream of low-level fixations and unconscious eye movements (Lehtinen 2007; Goldberg and Helfman 2011). As stated above, in exploring consumers' perceptions, eye tracking can measure not only visual (text or image) processing but also auditory/verbal processing (listening) (Conklin and Pellicer-Sánchez 2016). Moreover, eye tracking provides high precision and accurate data, as it reduces human error (Reisen et al. 2008) and provides insights in terms of the relationship between cognitive effort and

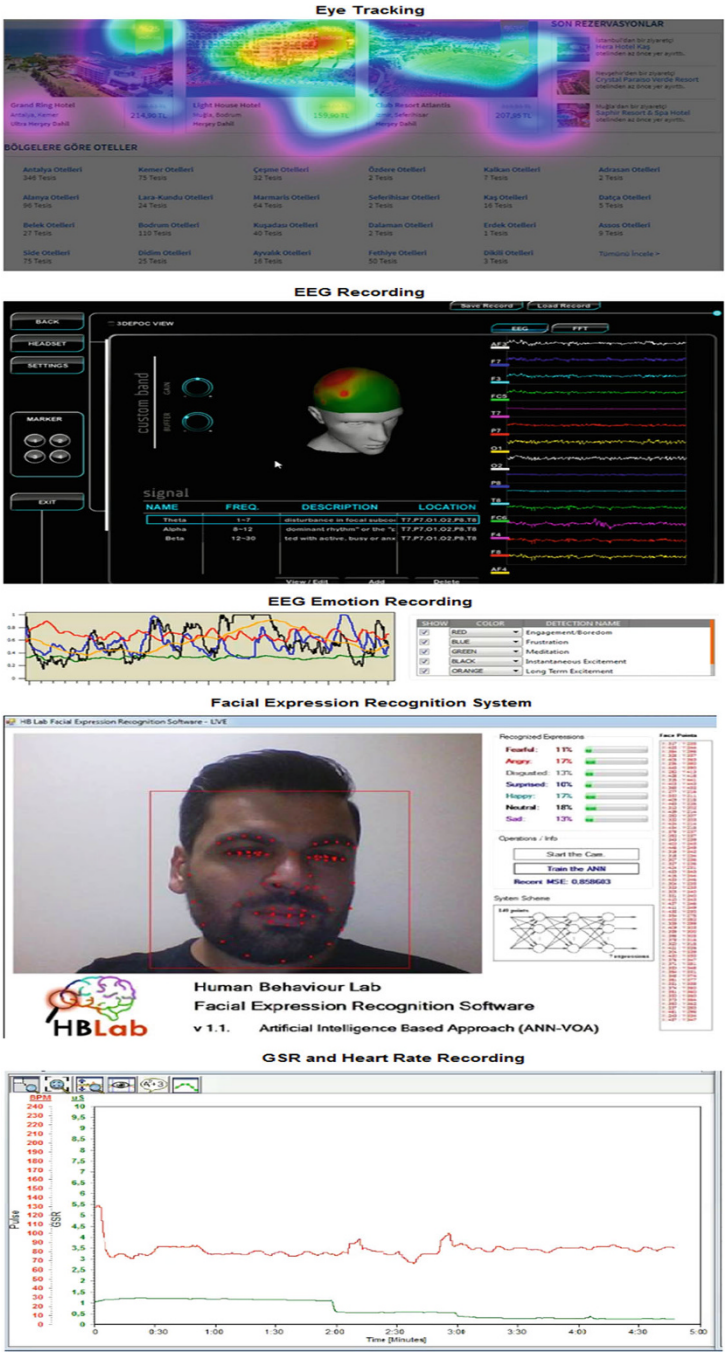

Fig. 5 Combining eye tracking with other neuromarketing tools

eye movement (O'Brien 2006). Furthermore, as consumers can be exposed to actual stimuli/materials, eye tracking can enable the collection of more reliable, valid and applicable data (Heuer 2009).

4.2 The Limitations and Drawbacks

Although eye tracking can be widely used across a wide variety of areas, it would be a mistake to assume that it can be applied to all tourism, marketing and management research. For instance, eye tracking allows only the drawing of quantitative conclusions (Müller-Spitzer et al. 2014).

Moreover, eye tracking equipment and software are expensive (Reisen et al. 2008), and researchers need to invest a significant amount of time to learn how to use the eye tracker device, prepare a procedure, collect, analyse and interpret data. The data collected in eye tracking research can be substantial and the handling of data can be extremely time consuming (Dam-Jensen and Heine 2009). Additionally, the analysis and interpretation of data can be extremely difficult for new users (Jacob and Karn 2003).

Additionally, eye tracking software requires extensive calibration procedures to ensure accurate data collection (Lapa 2007). A lack of proper calibration may result in collecting meaningless and unusable information. During the experiment process, technical problems (Jacob and Karn 2003) can make researchers feel helpless, especially the ones without sufficient knowledge.

There may also be other limitations or drawbacks relating to the participants. The experiment may be boring for the participants, and they may be negatively affected by the inactivity during the experiment (Dam-Jensen and Heine 2009). There is a possibility of participants focusing on areas outside the scope of the research if the researchers are not careful (Müller-Spitzer et al. 2014).

5 Conclusion

This chapter has explained how eye tracking is and can be used in tourism and hospitality. First, a rationale for using eye tracking and its relevance to tourism research are provided. A brief overview of the eye tracking research literature in tourism and hospitality presents the three vast areas of eye tracking research within the tourism, i.e. the effectiveness of print and online materials, website usability studies and understanding consumer behaviour. This review provides a framework for researchers and practitioners to understand how eye tracking is and can be used in tourism. This means that researchers can use eye tracking in tourism to explore the efficiency and effectiveness of traditional and non-traditional marketing communications materials, both visual and auditory.

Furthermore, based on real marketing stimuli and eye tracking data, the readers are shown in detail the elements of research and analysis in eye tracking. In doing this, practical recommendations and guidelines are presented, supported by research in the field. Based on the recommendations and guidelines provided, individual researchers can develop their own research to use eye tracking. The advantages, drawbacks and limitations of eye tracking shed further light on future research in the field in terms of what needs to be done and what needs to be avoided.

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