Tourism on the Verge

Mattia Rainoldi
Mario Jooss *Editors*

Eye Tracking in Tourism

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Foreword

Tourism lies at the intersection of several academic disciplines and is a broadly studied field of research. One can adopt a wide variety of perspectives and likewise a broad repertoire of methodology when critically examining the field of tourism. The most conventional empirical social approaches within the spectrum of methodology are the classical quantitative and qualitative methods. However in recent years, "methods on the verge" have been gaining increasing popularity. Eye-tracking studies have also been part of this extended repertoire of methodology for several years, due to affordable hardware and software solutions. Within the framework of interactional reception research, the recipients of media are at the center of attention. We live in a world saturated with information, and it is primarily the visual sensory organ that enables us to filter, discern, and selectively process incoming information. At the rate of approximately 3–5 eye movements per second, we identify what is relevant from a pool of irrelevant information when navigating our way through daily media life. Needless to say, these tendencies and patterns of consumer behavior are of utmost importance for tourism which is an information-intensive industry. Although eye-tracking studies are becoming increasingly popular, the number of empirical studies in tourism remains relatively small. However, one always needs to err on the side of caution when applying new methodological approaches. The software and hardware solutions available on the market not only vary significantly in terms of quality, but above all, a flawed execution or one done improperly can lead to erroneous results. Adequate planning, thorough execution, meticulous analysis, and an evaluation of research projects have to coexist with the technical support of systems and tools.

This book presents a systematic approach to eye-tracking studies in tourism in order to provide a basis for its understanding and application. The chapters are curated so that tourist industry practitioners and stakeholders can consult this as a handbook, and for the academic community to derive information on the necessary methodological know-hows, to conduct eye-tracking studies in tourism.

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Introduction to Eye Tracking in Tourism

Mattia Rainoldi and Mario Jooss

As the global tourism industry continues to expand and become more complex and competitive, developing novel and real insights into tourists' behaviours and experiences has become paramount for many tourism businesses. While the subject of eye tracking has been increasingly discussed in the literature, the potential of eye tracking solutions in tourism is still only marginally explored. This book aims to closing this gap and brings together knowledge and ideas that will help to expand previous notions about the application and value of eye tracking in tourism. It will be a useful resource for tourism businesses, allowing them to adopt proactive approaches in the design of tourism products, services and experiences. It hopes to inspire both scholars and practitioners to engage with the theoretical, methodological, empirical and practical contribution of eye tracking research to the creation of a better understanding of contemporary tourists.

This is particularly important, in an era where human beings are exposed to an average of 34 Gigabytes of information per day (Kiernan 2020). A plethora of studies has reinforced the importance of visual attentions, ranging from the domain of engineering to tourism marketing (Scott et al. 2019; Sharafi et al. 2015). Derived from the psychological field, visual attention refers to a cognitive and multilevel process where one consciously or unconsciously selects a subset from all the available visual sources (Kastner and Pinsk 2004). Attention of the eyes implies one's interests towards a certain area (Li et al. 2016). This is of vital importance for marketers and retailers since consumers' eye movements signal their decision-making process (Li et al. 2016; Pan et al. 2011; Scott et al. 2019). When a variety of products are available, consumers direct their attention towards the stimulus that are relevant and of their interests (Clement 2007). Tourism is an industry that is highly linked to marketing and retailing. Different from the ordinary needs in

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selecting a product, choices related to travel packages include flights, accommodations, and destinations, among others (Thai and Yuksel 2017). This has further advanced the complexity of the destination choice where one searches against his or her desires, needs and preferences (Thai and Yuksel 2017). In recent years, this specific topic has drawn tremendous attention from both academics and practitioners in the tourism industry.

Given the subjectivity and intangibility of tourists' experiences (Neuhofer et al. 2012), visual components such as photographs and videos potentially shape tourists' perceptions towards the destination (Avraham 2015). Since the occurrence of information and communication technologies (ICTs) and the Internet in the 1980s and 1990s, technology has heavily changed the multiphasic tourist experience (Buhalis et al. 2019; Law et al. 2010; Neuhofer 2016). From the demand side, different studies identified various technological developments that enhance the overall experience such as social media (Varkaris and Neuhofer 2017), online booking platform (Wu and Law 2019), website design (Pan et al. 2011) and intelligent system (Ivanov et al. 2017). Research has demonstrated that these and many other developments (e.g. McFee et al. 2019) influence how the image of a tourism destination is formed. Destination image has proved to be highly influential to tourist satisfaction, loyalty, intentions to visit and electronic Word-of-Mouth (Chiu et al. 2016; Jalilvand et al. 2012; Moon and Han 2019). Consequently, this book calls an urgent need to understand tourists' cognition, namely visual attention, in this particular case.

For suppliers, it is back to the central question regarding how to effectively attract tourists' attention. Seeing that eye movements play a critical role in visual processing both online and offline, eye tracking technology has been adopted as a tool to analyze the behaviour of tourists or to create extraordinary user experiences. Since the 1950s, eye tracking is providing solutions for problems every decade (Senders 2000). Senders (2000) mentions that each new wave of cognitive psychologists and engineers takes on new challenges and further improve eye tracking systems. Eye tracking can be compared to a Phoenix, rising from the ashes time after time. Initially, eye tracking was linked to the field of human–computer interaction due to the growing interest in personal computers in the 1980s (Jacob and Karn 2003). More recently, Dalmaijer (2014) explains that by tracking the gaze pattern, eye tracking can be used for creating unusual experiences when playing games, supporting people with disabilities or hand-free interactions with user interfaces.

In the contemporary tourism industry, eye tracking technology has become a powerful instrument to examine advertising elements (Wang and Sparks 2016; Scott et al. 2019), as it allows the evaluation of data which can be linked to the attention and curiosity in relation to a certain advertisement or parts of an advertisement (Pieters 2008; Lee and Ahn 2012). Unlike the manual response paradigms, the measurement of pupil size, eye position, fixation duration, blink rates and various other indicators mirror numerous cognitive functions (Eckstein et al. 2017) such as memory, attention or learning. Eye tracking data can be presented in the form of heatmaps and gaze plots. Specifically, heatmaps reveal the distribution of aggregate eye movements while gaze plots display the time sequence of looking. Echoing the

eye–mind hypothesis (Just and Carpenter 1980), eye movements contribute to the knowledge about the relationship between brain and behaviour (Eckstein et al. 2017).

Today we have three main typologies at disposal, namely: screen-based eye tracker, mobile eye tracker and eye tracker within virtual reality or augmented reality environments. The first two has been commonly applied in tourism marketing and advertising, tourism website and interface design (Fraiss et al. 2017; Lee and Ahn 2012; Li et al. 2016; Scott et al. 2019). For example, Li et al. (2016) discover that tourists find the landscape pictures containing a single textual message as a more effective marketing material, in comparison to the pictures with multiple texts. Wang et al. (2019) suggest that natural scenes attract more visual attention than the built scenes. On a hotel website, Espigares-Jurado et al. (2020) coin that the position of information is more effective when placing it in an upper area; yet hoteliers should be aware that eye movements differ along with tourists' characteristics. Besides the human–computer interaction, eye tracking technology has also been applied in human–human interaction. For instance, Ngan and Yu (2019) evaluate the morphology of a smile in service failure and recovery, where smiles with teeth showing attract the longest fixation time in this particular context. Overall, eye tracking techniques offer valuable insights in usability evaluations as it can be carried out before, during or after the development or sales of products and services (Goldberg and Wichansky 2003).

Moreover, the mobile eye tracker serves as an effective tool in enhancing the on-site experience such as visiting museums (Mokatren et al. 2018; Rainoldi et al. 2018) or exploring a city panorama (Kiefer et al. 2014). Such information is especially valuable for the design of information services in tourism, as it allows real-time identification when tourists lose interest of a certain place (Kiefer et al. 2014). In addition, the application of eye tracking in virtual world has been identified as an emerging area in tourism research (Scott et al. 2019) which is useful in evaluating digital tourist guides or virtual cultural heritage (Netek 2011). Netek (2011) highlights its effectiveness in optimizing digital content and visitors' visual attention when appreciating the artwork, ancient architecture and historical relics. Raptis et al. (2018) investigate the interplay between mixed-reality and cultural heritage. Other research has advanced the discussion of virtual reality experiences through the lens of biophysics (Marchiori et al. 2017). That is, it is not uncommon to see that hospitality firms use visual elements to reach the tourists' feelings (Scott et al. 2016; Wang and Sparks 2016). After all, visual elements affect the behavioural motivations of tourists and visual attention is essential for interpretation, navigation, sightseeing and various other areas in tourism (Scott et al. 2019).

While acknowledging that visual attention is a fundamental aspect in tourism research (Wang and Sparks 2016), eye movements do not necessarily reflect the reasons behind the decision (Ngan and Yu 2019). Thus, the emergence of concurrent think-aloud and retrospective think-aloud protocol enables tourists to verbalize their thoughts. The former requires the participant to report their opinions during the experiment whereas the latter replays the eye movements and requires the participant comment on their cognitive action after completing the task. The study of Fraiss

et al. (2017) utilize the concurrent verbalization to examine the role of hotel mobile websites in customer satisfaction. Another research applies retrospective reporting to allow the visitors describe their visual attention in a museum experience (Eghbal-Azar and Widlok 2013).

However, given that eye tracking technology provides rich data on tourists' gaze patterns, this technique is not without limitations. First, due to laboratory conditions, the number of participants in eye tracking research is limited (Scott et al. 2019), ranging from 12 to 63 participants in previous tourism studies (Atalay et al. 2012; Kiefer et al. 2014). Moreover, eye movements neither reveal the comprehension difficulty nor the feelings and emotions towards a stimulus (Yoo 2008). That being said, the impossibility of recording the parafoveal field of vision, which is unconscious in nature, might have an immediate effect towards the subject's subsequent behaviours (Yoo 2008). As discussed in earlier research, potential solutions include the implementation of follow-up survey or interview (Li et al. 2016) as well as the synchronization of other neuroscientific or biometric tools such as electroencephalography and galvanic skin response to reveal one's true reactions (Ngan and Yu 2019). After all, given the growing popularity of eye tracking studies in the field of tourism, in the past decade a strong focus has been put on marketing and advertising, website usability and cultural heritage experiences. With the advancement and ubiquity of technology to date, tourism marketers rely heavily on visual elements (Wang and Sparks 2016) to appeal and trigger tourists' interests and influence their behaviours and perceptions towards a destination (Salim and Som 2018). Thus, to create an overview of technological development and its effects on tourism, and to further contribute to tourism technology research, additional practices and continuous improvements of literature on eye tracking in tourism are deemed to be necessary. With this in mind, in this book several authors contributed to giving an answer to this question: how can eye tracking research contribute to the creation of a better understanding of tourists' behaviours and experiences?

In the second chapter, Dung Le, Arghavan Hadinejad, Brent Moyle, Jiangyu Ma and Noel Scott provide a background discussion of the theoretical basis on which eye tracking research is built. The chapter continues by explaining the procedures available for eye tracking data collection and analysis and how this enables researchers and practitioners to understand consumers' visual attention. A range of eye tracking applications in tourism research is discussed alongside with future research directions.

Since eye tracking studies require thorough research designs and valid interpretations, in Chap. 3 Ye (Sandy) Shen, Michael Lever and Marion Joppe provide practical guidelines for both academics and practitioners who are interested in using eye tracking for future research. This is achieved by a comprehensive literature review on the applications of eye tracking in tourism and advertisement. The chapter adds value to this book by answering questions that are inevitable for novices in eye tracking research and providing a summary of Dos and Don'ts for the preparation and set-up of eye tracking studies, participant interaction, using the analysis software and researcher behaviour.

In Chap. 4, Erdoğan Koc, Hakan Boz and Aytuğ Arslan evaluate the benefits and limitations of eye tracking from a tourism perspective. The chapter discusses the rationale for the use of eye tracking and its combination with psychophysiological tools in tourism studies and suggests a range of practical applications. Examples include the potential of eye tracking in measuring visual and auditory processing, as well as the three most important research areas of eye tracking in hospitality and tourism; namely, (a) the effectiveness of print and online materials, (b) the understanding of consumer behaviour and (c) the usability of websites. The chapter is concluded by discussing limitations and advantages, supported by recommendations and guidelines for further research.

In Chap. 5, Rueth Genç bridges the notion of knowledge co-creation to eye tracking in tourism research. Based on the critical discussion of previous literature, a statistical model was developed to measure the impact of eye tracking in tourism knowledge co-creation. Hereby, the chapter explains how cross-cultural differences and the technological process have an impact on knowledge co-creation and how eye tracking provides a reliable source of quantitatively measurable data for the conduction the basis of cross-cultural investigations.

Tourist behaviour and experience might also vary depending on their generational characteristics. The following three chapters examine the diverse pattern of visual attention in different generations. Elena Marchiori and Lorenzo Cantoni focus in Chap. 6 on the application of the eye tracking technique to understand the practices of users accessing tourism-related online content on social media pages and the interpretation of main content and sentiments expressed in the resources they navigate. The chapter contributes in developing a better understanding of reading and interpretation practices of teenagers (Generation Z), when it comes to their access to social media pages related to a tourism destination.

Seeing that the tourism products and services are intangible in nature, Rebecca Wahler, Anita Zehrer and Aleksander Groth investigate in Chap. 7 the effectiveness of destination websites from the lens of Generation Y. The chapter provides important recommendations for destination marketing organizations. Taking the lack of studies contemplating Generation Y and its perception of touristic websites into consideration, the results of the study are noteworthy as it concludes explaining that visual attention is less attracted by pictures than was previously assumed.

In Chap. 8, Vanessa Knogler focuses on similarities and differences between Generation Y and Baby Boomers in viewing behaviour, perceived usability and task performance on Austrian destination websites. The findings indicate major differences in the viewing behaviour between the two generational cohorts. The results suggest that destination websites should address the specific needs of different cohorts in the design of their websites in order to improve user experience and, consequently, convert users into destination visitors.

In Chap. 9, Arghavan Hadinejad, Dung Le, Jiangsu Ma and Noel Scott provide methodological contributions to eye tracking studies in tourism by presenting a structured summary of four eye tracking experiments. The chapter focuses on the discussion of the effectiveness of advertisements and the capability of images in attracting consumers' attention towards the products in the tourism industry. The

findings highlight the usefulness of applying eye tracking to evaluate real-time attention and interest to marketing stimuli which is undeniably important to improve the performance of profit-oriented websites.

Performance and profit-oriented websites are vulnerable to drops in the conversion rate due to a lack of good user experience or usability. Therefore, Jürgen Bluhm and Ralph Berchtenbreiter examine in Chap. 10 the different user experience problems of the OTA onlinewe.de and the potential economic gains attainable through improvements in usability. The chapter describes how eye tracking supported real-life usability studies are a valuable and effective solution for understanding users' behaviour and perception and concludes by providing suggestions on how to improve usability and conversion rates.

The next two chapters focus on the effects of corporate social responsibility certificates and eco-labels on tourism websites. In Chap. 11, Dirk Reiser and Magdalena El Mahgoub link the notion of information overload to consumers' awareness and subsequent behavioural intentions towards Corporate Social Responsibility (CSR) certificates. Their study tests whether the strategic placement of CSR symbols can increase the attention and positively influence purchasing behaviours. The results show how visual stimuli, such as a CSR certificate, influence customers' behaviour in the booking process and suggest that the strategic placement of a certification symbol on a website can facilitate a booking decision.

The importance of the sustainability of products and travellers' ecological footprint has been acknowledged in the contemporary tourism industry. In Chap. 12, Dirk Schmücker, Friedericke Kuhn and Eric Horster investigate the gap between a positive attitude towards sustainability and the actual purchase intention by conducting an experiment that made use of eye tracking technology. The chapter demonstrates that eco-labels alone receive relatively little attention and suggests that customers' attention towards sustainability information can be improved by changing the informational environment by combining sustainability and experiential value.

In the concluding two chapters, the potential of mobile eye tracking technology in capturing tourists' behaviour and experiences in real-life environments is explored. In Chap. 13, Mattia Rainoldi, Yu Chung-En and Barbara Neuhofer focus on the relationship between the physical context of a museum and visitors' learning experience in Salzburg Museum through the lens of the contextual model of learning. The chapter highlights the existence of a relationship between exhibition elements and the way in which visitors from different age groups engage with them. The chapter offers insights into visitors' museum learning processes and offers practical implications for the design of museum learning experiences.

Ecotourism as an alternative form of tourism in response to the rapid growth in popularity of mass tourism offers an ideal area of application for mobile eye tracking studies. In Chap. 14, James Graham, Leslie A. North and Edward H. Huijbens provide insights into the vast research potential of mobile technology by evaluating visitors' experience and behaviour in two destinations in Iceland: Sólheimajökull and Þingvellir. With the use of a mixed-method approach that utilizes location-aware mobile eye tracking, post-assessments and observational analysis, a greater

understanding of the effectiveness of interpreting signs as well as the environment by tourists was developed. Such insights can be used for developing educational programmes and stimulating infrastructural changes to ensure the safety of tourists and the protection of vulnerable biota. The chapter concludes advocating that mobile eye tracking is a powerful tool for the effective management of nature tourism sites.

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Part I
Eye Tracking Methods, Concepts and Applications

A Review of Eye-Tracking Methods in Tourism Research

Dung Le, Arghavan Hadinejad, Brent Moyle, Jiangyu Ma, and Noel Scott

Abstract Technological advancement provides opportunities for improvements in the methods academics use in their research. Traditional studies of advertising and interpretive material effectiveness typically use self-report surveys that are subject to subjectivity and data validity bias. Eye-tracking technology provides researchers with an alternative, objective research method to study the processes involved in visual attention to and interest in such stimuli. Psychological research on eye movements began around one hundred years ago, but the recent development of cheap and reliable eye-tracking equipment makes it more accessible to tourism researchers, both for laboratory and in-situ data collection. Application of such eye-tracking methods may enlarge our understanding of our tourists' attention and perception as cognitive processes. This chapter provides a review of eye-tracking methods, its theoretical basis, advantages and disadvantages, data collection and analysis procedures. Gaps in knowledge and topics for future research are provided.

Keywords Eye-tracking · Attention · Marketing effectiveness · Tourism marketing

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1 Introduction

Early humans hunting dangerous animals or living in close social relationships who were able to direct their visual attention to relevant environmental stimuli rapidly were more likely to survive and reproduce. Thus to avoid information overload, human brains and sensory systems have evolved the capacity for selective attention and processing of goal-relevant visual stimuli (Davenport and Beck 2001). Consumers today use these same attentional processes to evaluate the saliency of the thousands of pieces of information in their environment, whether they are viewing television, social media or just walking down the street.

As a case in point, a person thinking about taking a holiday is unable to process in detail all the information they may observe and collect during their extended search process. Instead, their attentional processes allow them to focus on only a few of many possible stimuli in the environment (Scott et al. 2019). Therefore, only marketing messages that attract the audience's visual attention are processed and influence tourists' behavioural intentions. Understanding and managing the audience's visual attention is a key factor in designing effective and persuasive marketing messages (Wang and Sparks 2016). This applies to both traditional stimulus materials such as print advertisements, brochures or guidebooks, as well as websites, blogs, videos and augmented reality and virtual reality applications (Lee and Gretzel 2012; Schlosser 2003).

Eye-tracking research methods offer valuable opportunities to explore tourists' attentional process. Psychologists have conducted research on eye movements since the early twentieth century and due to the recent development of unobtrusive and wearable eye-tracking devices and sophisticated analysis software programmes, marketing, computer science, neuroscience and tourism researchers can apply the methods they developed (Duchowski 2002). A number of tourism studies used eye-tracking methods to explore how tourists perceive tourism advertisement (Berenbaum and Latimer-Cheung 2014; Li et al. 2016a; Potocka 2013; Scott et al. 2016; Wang and Sparks 2016). Further applications of eye-tracking equipment for research in tourism marketing and tourist behaviour research appear useful.

This chapter provides an introduction for researchers who want to use eye-tracking methods for studying tourist behaviour. The chapter is organised into three main sections. First, the authors summarise the theoretical basis of eye-tracking research, its advantages and disadvantages. Second, eye-tracking equipment, data collection methods and analysis are discussed. Third, the chapter reviews the applications of eye-tracking methods in tourism research and proposes topics for future studies.

2 Theoretical Basis for Eye-Tracking

Understanding how the eyes function to perceive the environment is necessary if we are to measure attention (Land 1999). Even though our vision appears to be continuous and stable, it is built from a thousand pieces of information collected through the eyes. Our eyes are in constant motion of two main types; one that directs the fovea to a stimulus (e.g. saccades and smooth pursuits), and another that maintains the eye fixed on a stationary stimulus (e.g. fixations). The eye senses light through rod and cone photoreceptors located in the retina. The density of these receptors varies across the retina with the greatest density in the fovea (fovea centralis). The greatest detail (highest resolution) about the visual field is when the lens of the eye focuses light on the fovea (Schütz et al. 2011). Peripheral vision is due to light falling on the lower density of photoreceptors surrounding the fovea. Eye muscle movement (EM) combined with re-orientation of the head and body serves to align the fovea (foveation) with potentially relevant locations in the visual scene. The human visual system combines a series of rapid foveations on different parts of the visual field and information from peripheral vision to build a detailed map of a scene (Rayner 1998). EM, therefore, is essential to the operation of the human visual system, but to be effective, it must allow those small areas of the visual field that are most salient to prioritised for inspection.

Attentional processes drive the EM that allows our fovea to collect the highest resolution image about the most salient part of the visual scene. Attention can be defined as "focused mental engagement on a particular item of information. Items come into our awareness, we attend to a particular item, and then we decide whether to act" (Davenport and Beck 2001, p. 20). Two different attentional mechanisms direct EM. These two mechanisms are termed bottom-up and top-down (Rosa 2015) or exogenous and endogenous attention (Posner 1980; Wedel and Pieters 2008). Bottom-up or exogenous attention is caused by elements of the visual field (e.g. contrast, luminance, movement), while top-down or endogenous attention is initiated from higher cortical centres and driven by affective states, goals, memory or context (Rayner and Castelhano 2008). "Bottom-up" or exogenous attention functions subconsciously and is rapid compared to top-down attention (Cheal and Lyon 1991) which is assumed to be under the overt control of consumer goals (Rosa 2015). An example of top-down is that a person who is thinking of a holiday in Greece is more likely to notice Greek holiday advertisements. Bottom-up attention may be biased towards viewing faces and body parts (Ro et al. 2007).

The combination of top-down and bottom-up mechanisms provides a basis for understanding eye movements. Top-down attention explains why task instructions during an eye-tracking study affect the object fixated (Duchowski 2002, pp. 458). Task relevance is a primary driver of attention in natural tasks (Orquin and Loose 2013). While most tourism research to date has only investigated the bottom-up attention and tested different marketing stimuli, future research could examine what naive viewers look at compared to those who have had an instruction (provided with a goal).

3 Data Collection and Analysis Procedures

Due to their close relation to attentional mechanisms, researchers study eye movements to learn about the perception of visual stimuli and how such stimuli relate to an individual's needs. This section discusses the procedures used for eye-tracking research data collection and analysis.

3.1 Eye-Tracking Technologies and Devices

There are two generic types of eye-tracking data collection equipment: fixed and mobile (Scott et al. 2019). The leading eye-tracking method for fixed eye-tracking equipment is called video-based infrared oculography (VIROG). This technique uses relatively low-cost cameras and image processing hardware to estimate the point-of-regard (POR) or point-of-gaze, that is, the (x, y) coordinates of the user's gaze on the displayed stimulus in real time (Holmqvist et al. 2012). The POR is determined from the images of a (usually infrared) light source reflected from the surface of the cornea or lens. The position of these light reflections, known as the Purkinje Reflections (Cornsweet and Crane 1973), can be measured relative to the centre of the pupil. Many commercial eye-trackers identify and measure only the first Purkinje reflection (glint) off the front of the cornea, which can provide appropriate accuracy and precision. Such eye-tracker systems use one camera and one or two infrared light sources and use a five- or nine-point calibration procedure. Recently, mobile eye-tracking equipment (similar to a normal pair of glasses) has been developed for non-laboratory research studies, e.g. driving research and outdoor visual perception research. These operate using similar methods as fixed data collection equipment. There are a number of data collection issues related to the use of mobile eye-tracking. Real-world conditions such as the sunshine reflected from the sand can overwhelm the infrared camera sensors. Moreover, the visual stimuli observed by the participant can be changing and the scene that each participant view may be different. This can make data analysis complicated, but new eye-tracking software can address this issue to produce heat maps (Scott et al. 2019).

3.2 Data Collection Procedure

An eye-tracking system should be unobtrusive to users. Advanced eye-tracking glasses are lightweight and have good ecological validity (Johansen and Hansen 2006) similar measurement errors to fixed eye-tracking equipment. It is important that the equipment is calibrated for each participant before the experiment starts (Blignaut and Beelders 2012; Holmqvist et al. 2012). Typically, calibration is done by displaying fixation targets on a screen, which the participant follows with their

eyes. An experiment should consist of discrete, short tasks followed by a break to avoid boredom or fatigue (Goldberg and Helfman 2010). In a laboratory setting, ambient lighting, noise, distractions and temperature can be controlled to provide a reproducible evaluation environment. In order to get accurate eye measurements, users should perform the experimental tasks without interruption. Asking users to think aloud, asking probing questions or even allowing participants to ask questions interferes with data accuracy. Researchers should obtain data instead from post-experiment questionnaires to interpret eye-tracking outcomes.

A fixed eye-tracking system uses a monitor connected to a computer, where the monitor frame contains an unobtrusively integrated sensor (e.g. high-resolution camera and near-infrared light-emitting diodes). Such equipment can determine the position of the participant's eyes at 50 Hertz (50 times per second) or higher. A typical eye-tracker's measurement error when viewing a screen 50 cm away has been estimated at less than half a centimetre (less than 1 degree) but maybe greater towards the edge of the monitor (Goldberg and Helfman 2010). Mobile eye-tracking equipment consists of a set of glasses connected to a small data processing and storage unit. This system measures eye movements in real time and then allows downloading of the data for analysis. Both mobile and fixed equipment can be used with skin conductance or other types of monitoring equipment.

Due to the huge amount of data collected through eye-tracking methods, the sample size of eye-tracking studies is small and similar to psychophysics or physiology studies (Goldberg and Wichansky 2002). Usability experiments using goal-directed searching tasks require a smaller sample than undirected browsing. Representative scan paths may be determined for search tasks using 27 participants (Eraslan et al. 2016). A meta-analysis of eye-tracking research on differences between experts and novices found an average cell size of 11. Table 1 summarises the sample size used in previous eye-tracking studies. Overall, designs have used between 12–63 participants.

3.3 Data Analysis Procedure

Data analysis begins by the use of software to identify fixations and saccades and extract this data. The software algorithms use various techniques, such as the number of gaze points within a defined radius, or eye movement velocity, to identify a fixation (Salvucci and Goldberg 2000). Typically, a fixation time of around 200 ms is used, and small changes in this value may change the number of fixations identified. Researchers should, therefore, report choices of this parameter in their papers. Analysis of data may be based on hypotheses and psychological theory or entirely on describing patterns of activity. Defining an area of interest (AOI) is often an important step in the eye-tracking data analysis procedure. Researchers define AOIs according to their research interests. For example, in brand awareness research, the AOI can be defined around the brand logo. This step can be done

Table 1 Eye-tracking study topics and sample size

Study	Topic	Sample size
Atalay et al. (2012)	Location of material on brochure racks	63/84
Bebko et al. (2014)	Advertisement effectiveness	63
Chua et al. (2005)	Effect of culture on image recognition	52
Eghbal-Azar and Widlok (2013)	Attention to displays in museums	16
Hernandez-Mendez and Munoz-Leiva (2015)	Online tourism advertising effectiveness	30
Marchiori and Cantoni (2015)	Online tourism website navigation	28
Green et al. (2011)	Olympic website advertising effectiveness	21
Hao et al. (2015)	Online advertising effectiveness	53
Kiefer et al. (2014)	How long to people look at a view	12
Li et al. (2016a, b)	Effect of text on attention	37
Pan et al. (2011)	Online travel agency user search strategy	41
Pan et al. (2013)	Online travel agency user choice strategy	16
Pan et al. (2004)	Website viewing	30
Scott et al. (2016)	Advertising	25
Wang and Sparks (2016)	Cultural effects on image evaluation	30
Yang (2012)	Restaurant menus	27

Source: Scott et al. (2019)

after data collection, and eye-tracking participants should not be aware of the boundaries of AOIs.

Eye movements within an AOI are measured by fixations and saccades. Fixations are defined as a "relatively stable eye-in-head position within some threshold of dispersion (typically ~2°) over some minimum duration (typically 200–300 ms), and with a velocity below some threshold (typically 15–100 degrees per second)" (Jacob and Karn 2003). Fixations are usually extremely short but can be mapped to specific *X* and *Y* coordinates on a grid are then matched with a picture of the visual stimuli (Scott et al. 2019). While a fixation is the estimated location of the eye gaze at a particular moment in time, saccades are the rapid eye movement between two consecutive fixations (Lai et al. 2013).

Fixations and saccades can be measured based on three scales of measurement (temporal, spatial, count). The most frequently used eye-tracking measures are fixation count, the proportion of time spent on each AOI, average fixation duration, fixation count on each AOI, gaze duration mean on each AOI and fixation rate (count) (Jacob and Karn 2003). Fixations are valid measures of visual attention (Wedel and Pieters 2008). For example, a fixation count (i.e. the number of times an AOI is fixated upon) reflects the importance of the objects within that AOI since salient parts of the stimuli are fixated more frequently (Fitts et al. 1950). Search efficiency is correlated with total fixations (Goldberg and Kotval 1998). Time to first

fixation can be used to evaluate the salience of an AOI. The shorter the time taken to first fixate on an AOI the more impressive or salient it is (Bebko et al. 2014). The first total gaze duration indicates interest in the stimulus, and repeatedly gazing at an AOI may indicate its influence on attention (Bebko et al. 2014).

Based on measuring fixation and saccades, eye-tracking software helps to create outcome visualisations such as scan path and heat map. A scan path shows the sequence of fixations and saccades. The longer scan paths length or duration, the less efficient the organisation of website elements are (Goldberg and Kotval 1999). A heat map that is colour coded to separate areas more or less intensively viewed is useful in visualising the elements that attract the audience's attention (Bojko 2009). Researchers can create a heat map for one participant or a number of participants depending on their research purpose. For example, heat maps created for two different groups of participants (Chinese vs Australian) help to easily compare the differences in their visual attention and perception (Wang and Sparks 2016). The data analysis procedure of mobile eye-tracking research requires one more step that is to import background images. This is because participants in mobile eye-tracking research may view different scenes and the software needs reference images for data analysis. The software maps each individual gaze data onto these reference images by applying image recognition technology to create scan paths and heat maps.

3.4 Advantages and Disadvantages of Eye-Tracking Methods

Eye-tracking methods offer objective measures of participants' attention and interest. In comparison to self-report questionnaires that rely on individual reflection and memory, eye-tracking methods help to measure both conscious and unconscious attention. Self-report instruments, used to infer cognitive and attentional processes, are highly susceptible to exogenous influences, sustaining the use of complementary measurements (Schwarz 1999). Eye-tracking can help to avoid bias and validity issues in data collection (Scott et al. 2019). In addition to screen-based eye-tracking that is designed for laboratory research, there is also the possibility of using mobile eye-tracking equipment in a real-world setting. Tourism researchers can use mobile eye-tracking to collect real-time tourist perception and attention data that would be more reliable and valuable for research findings.

However, there are several challenges that tourism researchers should be aware of in using eye-tracking methods. First, it takes a considerable amount of time and effort to design and conduct eye-tracking research. Also, there is often only one participant involved in the eye-tracking experiment at once time (due to the cost of eye-tracking equipment), and it generates a huge volume of data for each participant (the eye-tracking measures will be discussed in the next section). Therefore, the sample size of eye-tracking research is quite limited. Second, there are from 10% to 20% of the population that are illegible for eye-tracking research because of their eye issues. More time is needed to recruit and test the eligibility of participants. Third, analysing eye-tracking data requires the use of specific software, and the analysis

outcome must be carefully interpreted. For example, a lack of attention to a visual object does not necessarily mean that the respondent is unaware of it. This assumption is only true if the object is unfamiliar (Orquin and Loose 2013). Researchers using eye-tracking methods must have a good understanding of perception and attention as cognitive processes in data analysis (Kuhl and Chun 2014). Despite their reliability and low cost, recent eye-tracking systems, and especially eye-tracking 2.0 systems, can be more demanding and require more technical skills.

Eye-tracking does not record any measure related to peripheral vision, which makes up 98% of the human visual field (Land 1999). However, the rationale of using eye-tracking is that covert attention is followed by overt attention because peripheral vision allows choosing where to fixate our fovea next. In other words, we can see (process) some specific visual element in our visual field without directly fixating on it. For instance, banner ads can be seen on the right side of a page, using peripheral vision. Information from their position, visual appearance or previous web experience, is gathered and used to identify them as ads, and potential consumers frequently choose not to fixate on them.

4 Eye-Tracking Applications in Tourism Research

Eye-tracking methods are powerful means for the study of cognitive processes and are widely used in many research areas such as consumer behaviour (Rosa 2015), education (Lai et al. 2013), information technology (Duchowski 2002), landscape studies (Dupont et al. 2014), marketing (Hui et al. 2009; Wedel and Pieters 2008), psychology (Mele and Federici 2012), reading (Rayner 1998) and scientific studies of attention and eye movement control (Orquin and Loose 2013; Tatler 2009). However, the application of eye-tracking in tourism is still limited. A systematic literature review identified only 17 papers applying eye-tracking methods (Scott et al. 2019, Accepted). This section reviews how eye-tracking has been employed in current tourism research to suggest future research directions.

4.1 Tourism Research Using Eye-Tracking

Tourism research applies eye-tracking mostly to explore how tourists pay attention to and perceive marketing materials such as labels, advertisements and websites. By defining how the audience pays attention to different visual elements, eye-tracking research suggests better ways to design attractive marketing messages. Eye-tracking is effective in evaluating the audience's attention to specific elements of marketing materials such as calorie information on food labels (Nelson et al. 2014; Wolfson et al. 2017), sustainability-related labels (Samant and Seo 2016), nutrition labels (Antúnez et al. 2015) or sponsor information in sports telecasts (Breuer and Rumpf 2012). By applying objective measurements like eye-tracking, researchers can also

detect attentional bias including duration bias and direction bias when participants view neutral versus gambling-related pictures (Grant and Bowling 2015).

Eye-tracking has been employed in studying the effectiveness of marketing advertisements. Research reveals that photographic images are more effective than textual advertisements in attracting and retaining attention (Scott et al. 2016) but the addition of text in the advertisement increases attention, especially when it is written in the audience's native language (Li et al. 2016a, b). Eye-tracking is used to measure the influences of textual versus graphical presentation on judgements (Hellmann et al. 2017), image characteristics (Wang and Sparks 2016), gain-framed messages versus loss-framed messages (Berenbaum and Latimer-Cheung 2014) and alcohol consumption (Ellert et al. 2014) on perception. Furthermore, eye-tracking helps tourism researchers to investigate how tourism images can be perceived differently by participants from different cultural backgrounds (Wang and Sparks 2016).

Web utility is one of the central topics in tourism eye-tracking message. The interaction between tourism websites and users has been explored by applying eye-tracking methods (Benbunan-Fich 2001). In addition to eye-tracking web studies in marketing and computer sciences (Bergstrom and Schall 2014; Djamasbi et al. 2010; Drèze and Hussherr 2003; Ert and Fleischer 2016; Goldberg et al. 2002; Hao et al. 2015; Hernandez-Mendez and Munoz-Leiva 2015; Lorigo et al. 2008; Marchiori and Cantoni 2015; Pan et al. 2004), tourism researchers have examined how websites should be designed for better web visit experience. Different types of websites such as online travel agency web (Pan et al. 2011), online sports event web (Green et al. 2011), accommodation choice (Pan et al. 2013) and destination website (Mariussen et al. 2014) have been examined. The structural and visual complexity of the website (Pan et al. 2004), information supply channel characteristics (Mariussen et al. 2014), pictures such as brand image and symbols (Noone and Robson 2014), online hotel reviews (Aicher et al. 2016), price incentives (Tzuaan et al. 2014; Xie and Lee 2015) and consumer evaluations (Noone and Robson 2016; Xie and Lee 2015) are found to affect web users' attentional processes. Mobile eye-tracking has been used in sports management to improve player performance (Steciuk and Zwierko 2015). This is the pioneering study in using mobile eye-tracking for tourism research, but it provides evidence of the potential of mobile eye-tracking for future tourist behaviour studies.

4.2 Future Research Directions

Even though eye-tracking is a powerful tool in studying tourist behaviour, the applications of eye-tracking methods in tourism research to date are only limited to web utility and advertisement effectiveness. The dominant use of fixed eye-tracking methods also limits research possibilities in investigating real-world tourist behaviour or their experiences of augmented and virtual reality. In order to

explore the full potential of eye-tracking, areas for future research are proposed in this section.

Mobile eye-tracking can be further explored to study tourist experiences in non-laboratory settings such as natural scene viewing, museum visit, exhibition or event participation. Thanks to recent advancements in portable eye-tracking technologies, today it is easy to collect eye movements in more natural situations—usually requiring unconstrained eyes, head and hand movements—with full freedom of movement in indoor and outdoor settings (Duchowski 2002). By means of wearable eye-tracking technologies, researchers can obtain reliable and unobtrusive online measures of eye movements and parameters to study eye behaviour during complex visual cognitive tasks, analyse the way in which subjects acquire environmental information and investigate how information in visual environments is dynamically processed (Henderson and Hollingworth 1999).

The use of fixed eye-tracking equipment limits tourism researchers to investigate traditional marketing materials such as tourism websites, advertisements, labels on the computer screen in laboratory settings. However, tourists expose to a variety of digital devices every day such as augmented and virtual reality. Eye-tracking studies have been used to measure participants' experiences of augmented reality (Naspetti et al. 2016), virtual cultural heritage contexts (Gena et al. 2016), virtual museums (Bastanlar 2007), virtual tours (Potocka 2013) and hotel virtual tours (Pan et al. 2011) in the computer science and marketing research. Tourism researchers may employ eye-tracking in similar research settings to understand tourist behaviour in the virtual world.

Tourism marketing research to date has only focused on bottom-up attention process by testing different marketing stimuli; there is a gap in investigating how top-down attention influences tourist behaviour in visual search. In the investigation of human behaviour related to visual search tasks, subjects are traditionally asked to search for a given target and discriminate it among several non-targets that differ from the target. Previous research showed that task relevance is the primary driver of the viewer's attention (Orquin and Loose 2013). Individual purpose (e.g. natural or targeted, expect or non-expert) (Li et al. 2016a; b; Naspetti et al. 2016; Sang et al. 2016) affect their attention to and interaction with their environment. Therefore, future research using eye-tracking should consider top-down attention in investigating tourist gaze and viewing experiences (Rayner et al. 2001). Response times, eye-gaze parameters and accuracy of responses are relevant measures to be taken into account in visual search studies (Duchowski 2002).

Eye-tracking can also be applied in conjunction with other emotional measurement methods to provide a more comprehensive picture of tourist experiences. The combination of these objective research methods can provide new insight into tourist behaviour research and avoid bias due to the subjectivity of self-report questionnaires. A number of objective measurements of emotional responses such as skin conductance, heart rate or EEG have been suggested by tourism researchers (Li et al. 2015; Ma et al. 2016; Sivaji et al. 2014).

4.3 Eye-Tracking for Tourism Marketers

Eye-tracking methods offer tourism marketers an objective and advanced tool to understand tourist attentional reactions to marketing materials. This allows them to improve tourism advertisement effectiveness because tourism marketing is not very effective in promoting a destination (Govers et al. 2007) or evoking emotions (Li et al. 2016b). Tourism marketers can employ eye-tracking techniques to test different designs of tourism promotions such as print ads, videos, websites. One the one hand, eye-tracking devices allow them to identify eye-catching elements and suggest ways to enhance tourist attention to tourism promotions. On the other hand, tourism marketers can also verify whether tourists are aware of key messages and hence try to refocus viewers' attention to these important messages. For example, a research project was conducted by the research team at Griffith University in Australia in collaboration with the marketing department of Mantra hotel group. Eye-tracking experiments were used to compare tourist attentional reactions to different designs of Mantra's new website.

Moreover, tourism marketers can also apply mobile eye-tracking methods to enhance tourist experiences. The use of eye-tracking equipment in real-world situations will provide important information about how tourists pay attention to different elements exhibited at a place. This helps tourism marketers to redesign artificial attractions such as museums, exhibition centres in an attractive way to tourists. Based on eye-tracking research outcomes, marketers are able to modify marketing stimuli for the purpose of better staging tourist experiences and increasing their satisfaction. For example, architecture is of less interest to active travellers, while animated signs attracted attention (Afrooz et al. 2014).

This chapter provides a useful guide for tourism researchers who are looking for applying more objective measurements of tourist behaviour. The chapter has discussed theoretical basis, data collection and analysis procedures, advantages and disadvantages of eye-tracking methods. By reviewing how eye-tracking methods have been applied in tourism research, the authors suggest future research directions to exploit this powerful tool in tourism studies. The technological advancement is making objective measurements such as eye-tracking, skin conductance, heart rate and EEG more accessible to researchers and offers promising research opportunities to replace the traditional way of researching with self-report questionnaires.

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Best Practices for Eye-Tracking Studies: Dos and Don'ts

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Abstract Eye-tracking technology has been widely used for the diagnosis of marketing information in advertising studies, but its application in the tourism context is still limited. Much of the research to date has been limited to linear gaze tracking with one- or two-page documents. To better understand the application of this technology, specifically for nonlinear gaze point tracking over multiple pages that include text, advertisements, and pictures, this chapter reviewed the literature on eye-tracking in advertising and tourism studies. Research design and methods are summarized to give guidance for future studies. It also outlines some of the most important 'lessons learned' from research on the *Ottawa Visitor Guide 2017/18* using Tobii Pro wearable technology and its Studio software. The Dos and Don'ts provide guidelines for both academics and practitioners who are interested in using this technology. Additionally, the checklist offers an approach for analyzing reading behaviour and brochure attractiveness. As a final measure, useful applications and implications are described which may be helpful to tourism-based researchers looking to get involved in applying this tool to their own settings.

Keywords Eye-tracking technology · Research · Software · Tourism

1 Introduction

Eye-tracking has attracted much attention from both industry and academia in recent years. As a method of capturing real-time and objective data, it has largely been used for the diagnosis of various stimuli in marketing and advertising studies. Even though researchers found that these types of studies offered some insightful results, there has not been a plethora of research making use of the technology. One reason is that it presents some important challenges: Data extraction is time consuming and

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their interpretation can be subjective (Leuthold et al. 2011). Good research design and valid interpretation are critical for eye-tracking studies as a subject's focus on a certain gaze point can be the result of interest, but also of confusion. To provide some guidelines for best practices, we review the literature on eye-tracking in advertising and tourism studies and then summarize the research design and methods used to provide guidance for future studies.

Most previous eye-tracking studies analyzed linear stimuli where all participants see the same information (e.g. a photo and a page of advertisement) within the same amount of time in the same order. This type of research design enables researchers to use a timeline to code and analyze eye-tracking data, but they may not reflect participants' natural behaviour. Therefore, we offer the most important 'lessons learned' from research on the *Ottawa Visitor Guide 2017/18*. Travel brochures have been shown to increase the level of interest in a destination, and therefore play an important role in the promotional activities of Destination Marketing Organisations (DMOs). In this study, participants were free to choose how long they read the brochure and in which order they wished to read it. The Dos and Don'ts derived from this nonlinear gaze point tracking over multiple pages offer practical suggestions for similar studies. Researchers and practitioners could also use the checklist in this chapter to record participants' visual attention during observation, followed by interviewing participants to gain deeper insights.

2 Review of the Eye-Tracking Literature

2.1 Eye-Tracking in Advertising Studies

Attention is an important factor in advertising effectiveness, but since humans have limited mental capacity, they allocate visual attention to the aspects of greatest interest while ignoring those of little interest (Carrasco 2011). Increased visual attention requires people to make a greater cognitive effort to process the information, and in the case of advertising, this can lead to a higher likelihood of purchasing the item. Therefore, understanding what information attracts more visual attention is critical for enhancing marketing effectiveness. Since eye movement is an indicator of one's attention and cognitive processing (Fox et al. 1998; Just and Carpenter 1980; Krajbich et al. 2010), gaze point tracking is an accurate method for measuring visual attention (Berto et al. 2008). Participants cannot easily manipulate their eye movement data, and thus these data are more reliable than self-reports (Duchowski 2003; Smit et al. 2015). When people's eyes fixate on an element of information with a scene, they take time to read and process the information, and thus fixation time has a positive relationship with their attention and cognitive efforts (Hutton and Nolte 2011; Krajbich et al. 2010). Therefore, fixation counts (what elements attract people's attention), fixation duration (how long they pay attention to it), fixation point order (what object attracts attention first), and patterns of saccades (the amount of space they view) are commonly measured by eye-trackers (Smit et al. 2015; Wang and Sparks 2016).

Studies have investigated visual attention paid to different stimuli in the advertising context, such as fixations on advertisement, brand, pictures, and text within the first 5 s of viewing (Smit et al. 2015) or the use of colour, page placement, and the amount of text. These characteristics are helpful in the design and development of more effective advertisements. Eye movement is also tracked in recall tests, where participants may be asked to recall the content of the advertisement to which they were exposed. People were found to have better recall performance when they have more fixation counts and a longer fixation duration (Thomsen and Fulton 2007; Zhou 2012). Another increasingly popular application of the technique is in the retail sector where it is used to record people's shopping experience to improve product displays (e.g. Bansal-Travers et al. 2016; Huddleston et al. 2013).

2.2 *Eye-Tracking in Tourism Studies*

More recently, tourism researchers are expressing interest in gaze point tracking to investigate tourism marketing effectiveness and the visit experience. Thus, it has been shown that a block tourism magazine advertisement is more attractive and maintains attention longer compared to a text advertisement (Scott et al. 2016), and that there are cultural differences between Chinese and Australian participants in terms of fixation counts, fixation duration, saccades, and gaze plots when they view the same photo (Wang and Sparks 2016). Australians had a longer fixation duration and more fixation counts, probably because they were more familiar with the environment and the activities depicted in the images. Nightclubs, bungee jumping, whale watching, and surfing are considered higher arousal images, and attract more visual attention, as does text in a known language within a landscape photograph (Li et al. 2016). These and other findings are critical for improving the effectiveness of destination marketing. Similar to the retail sector, tourism researchers are also using mobile eye-tracking to improve the visit experience of museum exhibitions (Eghbal-Azar and Widlok 2013; Mayr et al. 2009) or lake shore areas (Potocka 2013) through gaze plots and heat maps that show what attracts tourists' attention.

2.3 *Stimuli and Research Methods*

Overall, eye-tracking studies in advertising and tourism are relatively new, and most of the research articles were published within the last 10 years. These studies commonly used gaze point tracking associated with surveys or interviews, and ANOVA to identify differences between two conditions (Table 1). Some researchers asked the participants to watch their own processed eye-tracking videos and to recall what drew their attention. This type of cued retrospective reporting provides a better interpretation of participants' eye movements.

Table 1 Examples of eye-tracking research

Sample size and stimuli	Research objectives	Methods
63 adolescents viewed 14 advertisements for alcoholic beverages (Thomsen and Fulton 2007).	To investigate whether adolescents pay attention to 'drink responsibly' related messages in magazine advertisements for alcoholic beverages.	Eye-tracking and recall tests: Scan paths, total viewing time, fixation counts per advertisement, and fixation duration were analyzed using ANOVA.
150 respondents participated in 68 tests and each test contained 2.7 advertisements on average (Smit et al. 2015).	To examine the role of direct context in attracting attention in magazine advertising.	Eye-tracking and content analysis: Fixation counts were analyzed associated with areas of interest. Visual attention models were built to analyze advertisement characteristics.
30 students viewed 16 tourism photos (Wang and Sparks 2016).	To investigate whether traveller groups (Australia and Chinese) pay different attention to the same tourism photo stimuli.	Eye-tracking and questionnaires: Fixation counts, fixation duration, saccades, and self-reported liking scores were analyzed using mixed-design ANOVA.
25 students viewed two A4 magazine ads (Scott et al. 2016).	To analyze the relative effectiveness of a block and a text tourism magazine advertisement.	Eye-tracking and questionnaires: Saccades, average fixation duration per advertisement, and self-reported liking scores for two advertisements were compared using ANOVA.
37 participants viewed 24 tourism photographs under 4 experimental conditions (Li et al. 2016).	To examine consumers' visual attention to tourism photographs and their perceived advertising effectiveness.	Eye-tracking and questionnaires: A heat map and eye movements data (total viewing time and number of fixations) were processed in the EyeLink Data Viewer programme. Multivariate Analysis of Variance (MANOVA) was used to analyze survey data.
8 participants visited the Linden-Museum Stuttgart 'Pacific Oasis' Exhibition, and another 8 participants visited the LiMo 'Nexus' Exhibition wearing an eye-tracker (Eghbal-Azar and Widlok 2013).	To explore visitors' scan patterns when they visit two museum exhibitions in Germany.	Eye-tracking and cued retrospective reporting: The participants were asked to watch their own processed eye-tracking videos and to retrospect their goals of attention.
36 people were invited to view three different landscapes (Potocka 2013).	To investigate the gaze points in the landscape.	Eye-tracking and questionnaires: A gaze plot and a heat map were created based on eye-tracking data. The open-ended questionnaires were

(continued)

Table 1 (continued)

Sample size and stimuli	Research objectives	Methods
		analyzed through content analysis.
Eye movements of 13 smokers and 12 non-daily smokers were recorded. They were asked to recall information about a tobacco wall display or a promotional offer (Bansal-Travers et al. 2016).	To examine consumers' attention paid to the tobacco wall in convenience stores and test consumer recall.	Eye-tracking and recall tests: Fixation counts and fixation duration were analyzed associated with consumer recall data.
32 participants read four kinds of catalogue pages of scientific popular magazine (Zhou 2012).	To examine what kinds of catalogue pages attract and retain readers' attention better.	Eye-tracking and recall tests: First fixation, dwell time, saccades counts, and consumer recall data under the four conditions were compared using ANOVA.
106 participants viewed 8 displays depicted in 16 slides and indicated their purchase intention (Huddleston et al. 2013).	To investigate the effect of visual attention to the product, information or price sign on purchase intention.	Eye-tracking and surveys: Fixation counts, fixation duration, and likelihood to buy were analyzed using ANOVA.

In terms of content, these studies investigated a viewer's attention to a magazine photo or a marketing text. The combination of text, advertisements, and pictures are seldom explored, yet this type of research could be insightful, particularly for destinations, and the necessary combination metrics are an important topic in eye-tracking research (Smit et al. 2015; Wang and Sparks 2016). In some of these studies, participants were asked to read magazines or view images without any tasks, but this makes it difficult to distinguish between the level of interest and the sheer amount of information. Other studies set some specific tasks for the respondents, such as remembering the content of what they read and the purchase of specific items.

Eye-trackers have some serious limitations that need to be taken into consideration in the research design. First, even though an eye-tracker can record eye fixations and saccade patterns, these data do not provide any information about the purpose of people's attention. Mayr et al. (2009, p.198) argue that 'interpretations of eye-tracking data . . . are often based on assumptions and heuristics about underlying cognitive processes', which is why studies complement gaze point tracking with cued retrospective reporting, questionnaires or interviews. Interviews—with or without cued retrospective reporting—have been shown to provide more insightful explanations as to why people fixate on a specific area and how the information influences their intentions. Second, eye-tracking data can be distorted because participants are aware that their eye movements are being analyzed and might attempt to disguise them. One tactic to overcome this is to provide other materials for subjects to read before giving them the material that researchers are interested in.

3 Dos and Don'ts for Eye-Tracking

Best practices for the various stages of preparing, implementing, and analyzing an eye-tracking study are not yet available in the literature. To document some good practices in complex tourism studies that involve nonlinear gaze point tracking over multiple pages with text, advertisements, and pictures, we investigated the appeal of the *Ottawa Visitor Guide 2017/18*. Although available online, a hard copy of the *Guide* was used, as it is easier to manipulate by study participants. Overall, the Dos and Don'ts provide guidelines for both academia and practitioners who may wish to use this technology. They are offered under the subcategories of preparation and set up, participant interaction, software, and researcher behaviour. Although this section offers suggestions for general users of eye-tracking and software, we also provide, where appropriate, specific actions for users of Tobii Pro Glasses 2 wearable eye-tracker and the Tobii Pro Studio software.

3.1 Preparation and Set-Up

Before the eye-tracker has even been taken out of its case, there are some good behaviours that should be adopted and will prove to be rewarding in the long run.

Prepare a 'Message to Researcher' prompt for participants. It is difficult to determine when the participant might need some kind of assistance since the software continues to track eye movement even when the head is moved in some way. Therefore, consider a sheet of paper on the wall with three options, that when stared at with the glasses will let the researcher know they need to intervene:

- I need to stop.
- I have a question.
- I am finished.

Take some time to set up the technology properly. The time to ensure that all of the equipment is functioning is not when the participant is sitting in the chair across from the researcher. As the process requires ample time to ensure that all batteries are charged, cords plugged in, SD (Secure Digital) card is inserted, tablet software engaged, participant ID prepped, nose-pieces on hand in case a different size is needed, and a myriad of other minute details*, it is an important step to prepare this well ahead of time. Then, while the participant is briefed and any pre-experiment questions are asked, the glasses can be placed and calibration done in a matter of minutes.

*These minute details are in regard to the specific technology that you use for your study. For Tobii, this includes developing a document to introduce your study, ensuring that the Tobii software is connected to your tablet's wi-fi network, selecting your correct project, and ensuring that your participants are set up in the 'Participants' tab.

Be patient with the calibration process. To ensure that the glasses fit and that the eye movements are tracked properly, calibration of the equipment is required. This can be challenging for researchers who want to allow the participant to get started, but nothing can be more frustrating than allowing the project to go ahead just to find out that the data is unusable after collection. It wastes both the researcher's and participant's time and can be avoided, or at least the likelihood of error reduced, by allowing an effective calibration. Participants need to look at the centre of a calibration card held by the researcher to allow the eye-tracker to record automatically. We highly recommend researchers to check the quality of the calibration. Nose-pieces for Asian and Western participants may be different, so the most suitable one needs to be selected for better calibration. We found two efficient ways to test whether the calibration is good. Researchers can let participants write some words to check whether the fixation is exactly where they are writing. Alternatively, researchers can ask participants to read a certain area (e.g. logo on the front page) and then check whether the fixation showing on the tablet is correct.

The *Adjustment* function in Tobii Pro is helpful for this process. The quality of the calibration is indicated by two circles with a green area (i.e. iris) and a white spot (i.e. pupil) in the adjustment mode. Researchers should make sure the white spot is within the green area: the larger the green area, the better the calibration.

Consider the stimuli with which the participant will engage. For instance, will they be in print or on a computer screen? If the former and the whole reading time exceeds 10 min, participants should hold the print material (e.g. a visitor guide) upright on the table. In the brochure study, we found that the eye-tracker stopped tracking eye movements very precisely after participants read for 10 min. This issue was caused by the slight displacement of the eye-tracker when participants tired, put

the visitor guide on the table, and lowered their head to read. If the stimuli are on a computer, the screen's brightness should be adjusted in advance and glare impact needs to be avoided.

3.2 Participant Interaction

Keep it light at the beginning. Allow the participant to have the researcher guess where they are looking, and show them what it looks like on the tablet. The initial 'discovery' phase of wearing the glasses can be an illuminating experience for participants who have never seen such a device used. This holds a utilitarian purpose as well since it relaxes the participant at the onset of the experiment. Comfort is crucial to ensure the experience feels as natural as possible for them.

Timing of tracker usage. Many participants will be partly relieved to remove the tracker glasses following the experiment, particularly if it is relatively lengthy in duration. Therefore, they do not want to wear it throughout the study when the glasses are not required (for instance, during the debriefing stage or—if applicable—the interview stage). Allow them to take the glasses off as soon as they are no longer needed. This will ensure they are focused on your questions and/or comments following the eye-tracking phase of the study, instead of fixated on the equipment resting on their nose.

Encourage general feedback from the participant regarding the use of the glasses themselves. If possible within the scope of the study (or at the very least, within the pilot testing phase), allow for feedback so that modifications can be made for future participants and a seamless experience may be had.

Prepare for and adapt to cultural differences. A high level of communication is required for a successful eye-tracking study to take place. Therefore, the researcher must be aware of and prepared for any potential occurrence of miscommunication (for instance, the material may be difficult for someone who does not speak the printed language fluently, and this could be interpreted by the computer as the participant lacking interest rather than comprehension). Avoidance strategies include restricting participation to those who are native speakers of the language of any text, accounting for suboptimal comprehension manually prior to any computer software analysis, or providing multiple versions of the stimulus to ensure functional readability, provided this does not interfere with the study's design.

Create as natural a setting as possible for the participant. For instance, if the participant needs to read a magazine as part of the study, consider setting it on a table with other print material and multiple seating options close to it, thus recreating a waiting room-type environment in which many magazines are read. An unrelated magazine may in fact be a positive way to begin a study of this type, which would allow the participant to overcome any occurrence of discomfort and awkwardness with the eyeglasses themselves without affecting the subsequent read-through of the material that is intended for the study.

Encourage participants to behave as naturally as possible. Researchers should ensure that their participants are not aware of any specific areas of interest prior to the study's commencement. For example, if participants are aware which parts of a magazine or brochure is of interest to the researcher—advertisements, titles, photos, text—they may focus more on these areas, thus displaying a misleading level of interest. However, it is important to remember that concealing important information, such as the study objectives from the informed consent form all subjects should sign prior to participating in the study, is considered to be deceptive and must receive ethics approval in many countries. Also, the researcher must debrief each participant at the conclusion of the study about its true purpose and interview them about their experiences. This allows for the assessment of any concerns that participants might have had about the research.

Consider limiting the number of pages that the subject needs to view. It can become tedious for participants after a certain period of time of just scanning through a large number of pages. A secondary suggestion in the same line of reasoning is to not give them a specific time allowance, which may throw off their natural behaviour. By telling them that they have as long as they need, they will not feel rushed. However, participants generally err on the side of brevity rather than spending too much time interacting with the study's stimulus.

Do not watch subjects directly or make it obvious that they are being observed. Nothing can be more off-putting for a participant than a researcher staring at them as they attempt to keep focus somewhere else. It is human nature to be aware of one's social surroundings, and that is no exception here. It is suggested that, if at all possible, the researcher remove themselves entirely from the room, opting to sit outside or on the other side of a one-way mirror (if seeking nuances in facial expressions or body language is part of the study), to help facilitate this.

3.3 Software

Do not rely solely on insights from the eye-tracker software. It is not only prudent but simply good practice to attempt to gather as much insight as possible during a live eye-tracking session. This way, emergent patterns can be corroborated later using the software analysis, rather than going in blind. The main reason for 'paralysis by analysis' is an overabundance of potentially relevant information (with measurement of percentage fixated, time to first fixation, fixation duration, fixation count, and visit count, this will undoubtedly occur)—certainly, one could become lost in the data. Rather, it is better to have questions and insights collated and for these to be answered, confirmed, or repudiated through the data. This has two benefits: (1) it allows the researcher to glean stronger insights using a smaller amount of more relevant data, and (2) it supports the important need for triangulation, as the eye-tracker may not always capture the eye's movement 100% of the time. The researcher is also not immune to errors in this regard.

3.4 Researcher Behaviour

Two researchers are better than one. Work together to identify moments of discussion later. Based on our study of the *Ottawa Visitor Guide 2017/18*, we developed a checklist from observing participants' eye movements. This checklist is especially helpful for researchers who are interested in brochure reading and want to conduct interviews directly after the eye-tracking experiment. Researchers should have kept track of what information attracted participants' attention in general and ask questions accordingly. Two researchers need to do the checklist independently during observation. It allows for comparison and further discussions (Table 2).

Table 2 Eye-tracking checklist for a brochure study

Checklist for order and speed	Checklist for areas of interest
Book order • Front to back, in order • Planned disorder (e.g. read index and found page etc.) • Unplanned disorder, no order • Scan, then read front to back	Headings • Started with headings • Read headings after seeing other content (e.g. pictures or text body) • Read headings last • Did not look at headings
Page order • Top to bottom • Bottom to top • Scattered • Scanned all, then read top to bottom	Picture frequency • Looked at all pictures • Looked at most of the pictures • Did not look at pictures • Looked infrequently
Picture order • Looked at first on the page • Looked at last on the page • Switched between words and images	Advertisements • Looked at advertisement first • Looked at advertisement last • Did not look at ads at all • Looked at ads occasionally but infrequently • Switched equally between ads and other content (e.g. pictures or text)
Rate of speed • Fast speed, less thorough through each page • Slow speed, more thorough through each page • Slow speed, non-native English speaker or low comprehension for other reasons	Map • Looked at specific places and cross-checked after • Looked at specific places only • Skimmed maps • Did not look at maps
Content • Read each word • Skimmed over words quickly • Read some content thoroughly, skipped entirely over others – Paid more attention to font in bold – Paid more attention to the coloured font	Total brochure • Read everything • Focused on specific areas (specify:_____) • Skipped some things (specify: _____) • Skipped most things • Only looked at front and back cover

Keep track of some interesting points. Depending on the number of researchers in the study, there is an opportunity to divide roles (for example: two mainly observe order based behaviour, the other two mainly content based, etc.).

When an interesting point appears (e.g. most participants did not read the advertisements, but one did read most of them), the researcher could use the *Log* function to capture the advertisements and ask interview questions about why these advertisements attracted the participant's attention.

Arrange for the study's process prior to engagement with the participant. It is not enough to simply say you plan to have 'eye-tracking, followed by interviews', for instance. The process is actually composed of several phases:

1. Pre-tracking phase—set up, testing equipment, ensuring all pieces are present and functioning, testing calibration, etc.
2. Tracker-explanation phase—teaching the participant how to wear the glasses, keep them aligned properly on the face, ensure correct nose-piece is installed, correcting for any bright or dark pupil effects, etc.
3. Participant tracking phase—monitoring the subject's eye movements, noting if calibration does not seem to be accurate (e.g., 'reading' text that is not within the gaze point); doing checklist to have a general idea of what information attracts attention
4. Post-tracking phase—saving tracker recording, follow up questions with the subject, properly removing and storing eye-tracker equipment
5. Interview phase

Allow time to discuss and deliberate on the subject's real-time tracking episode. By taking the time to have the researchers compare their notes, it ensures that they are in agreement prior to the survey or interview phase of the study (if applicable). Disagreement will make it problematic to gain insights from the participant during the interview. If both researchers try to capture the same patterns during the tracking, they can then apply a simple but effective rule of thumb for comparing their notes afterwards: If findings are the same, approve. If observations are different, discuss. If they are contradictory, discard.

4 Tobii Pro Experience Report

During our use of the Tobii Pro Glasses 2 wearable eye-tracker, we came to love some things and wish for the improvement of others. The following brief sections outline our experiences in terms of the advantages and disadvantages of using this specific tool in an academic setting.

4.1 Advantages

The main advantage of using Tobii Pro was its accessibility to us. First of all, they are sure to remind users that they are the world's full-scale tracking platform and the global leader in tracking technology (Tobii 2015). Beyond this, within an academic department at most universities, there will be a limited use of special technologies in which only so many devices are provided. Our case was no exception, as we were fortunate to have mentors in this experience in those who had used the eye-tracker technology before and were able to provide guidance in the initial process of familiarization.

In addition to the guidance of the mentors, Tobii Pro also provides users with technical support. An intensive 4-week training programme is free to all users. It enabled us to get used to the eye-tracking system, understand how to collect good data, and learn how to analyze and export the data. The hands-on tasks, webinars, and articles let us have good knowledge and practical experiences before we conducted a study.

Another advantage of using Tobii Pro Glasses 2 wearable eye-tracker is the ease with which the technology works in a range of environmental settings. We ended up moving our study three times, to three separate locations, and each time felt confident that the study would not be affected by this change in testing environments.

Finally, the Tobii eye-tracker's ability to project, in real time, the eye-tracking on the accompanying tablet makes for a great opportunity for researchers to aid in the recruitment process. While seeking participants for our brochure study, for instance, we set up the eye-tracker, put it on my face, and allowed passers-by to see the room from *my* perspective—a natural ice-breaker!

4.2 Disadvantages

No technological platform is without its imperfections, and although Tobii's device was, for the most part, reliable for our study's purposes, there were still some disadvantages that we observed through a daily application of its various functions and capabilities. Since the device requires specific calibration depending on each

participant's facial structure, this constant calibration procedure was a major hindrance to this study's procedure—often adding 10 min or more just to ensure that the tracker was working properly. More than once, we had to re-calibrate a single participant multiple times, likely losing their confidence in the study through each attempt.

Another major disadvantage of the eye-tracker is the weight of the glasses. Although they are supposedly lightweight, they are still heavier than a traditional pair of glasses due to the technology they contain. As a result, we had participants requesting a break or to remove the glasses as soon as the tracking phase was completed, in order to relieve some of this pressure.

5 Conclusions and Implications

Through the above best practices, this research contributes to practical tourism research in three meaningful and disparate ways. First, the broad benefits and limitations of eye-tracking technology are described. Using this technology can overcome participant error or bias in using an objective measurement of physical eye-movement patterns rather than subjective self-reporting. In terms of limitations, researchers need to be cautious when interpreting the eye-tracking data since more fixation counts could be due to participants' interests or confusion. Conducting interviews helps researchers to better interpret data since participants contribute to explaining their own behaviours. Second, we have outlined the specific benefits and limitations of using the most developed eye-tracking technology available to date to both researchers and practitioners, the Tobii Pro eye-tracker and Pro software. By focusing on specific capabilities of this equipment, users will be able to better prepare themselves for their studies in an academic setting, as well as provide meaningful and personalized insights in a professional one. Third, by offering a multi-paged (68 in total) eye-tracking scenario, where typical scenarios involve reading just a single- or two-page document at most, this research proves that entire tourism brochures, along with other lengthy tourism-related texts, can be coded and analyzed. This opens great opportunities for future research that involves hermeneutical interpretations or content analyses of brochures, guide books, DMO-websites, review sites, etc. Given that eye-tracking technology is a new method for data collection, not only within the rich domain of leisure and travel but in most disciplines, the dos and don'ts in this chapter provide stakeholders with some potentially valuable guidelines for its use.

Despite this universal appeal, given the authors' understanding and experience in tourism marketing and behavioural studies and research, we can speak to the implications for future research using eye-tracking technology within these specific domains. An eye-tracker can be effectively used to test DMO-designed advertisements in on- and offline environments, including photos, brochures, and websites, among others. For example, a DMO may find that it is able to narrow down its designs to two uniquely different options, and want to test how both of those

advertisements would appeal within their location and internationally. Or they have a text-based advertisement and a picture-based one, and they want to know which one tourists prefer depending on the context in which they view them. As a final example, there may be interest in determining how many pages a DMO website should be, and an eye-tracker could be used to test participants' fatigue in navigating various options. In each of these scenarios, the opportunities for destination marketers to improve their design and increase traveller satisfaction are in reach, whereas through traditional self-reporting studies, these findings may have otherwise gone undetected. In this way, not only will they know that their consumers are visiting their website and for how long, but what they are looking at while there, how long they fixate on certain items, and equally as important what they are *not* noticing. Additionally, eye-tracking technology can be used to gather data regarding what draws the attention of tourists in exhibitions, hotels, or tourist information centres. It can help researchers and practitioners to better understand tourists' visit experiences and satisfy their needs and interests. Overall, eye-tracking allows these capabilities which help to understand the effects of different stimuli and enhance one's marketing effectiveness and ability to provide better services.

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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.

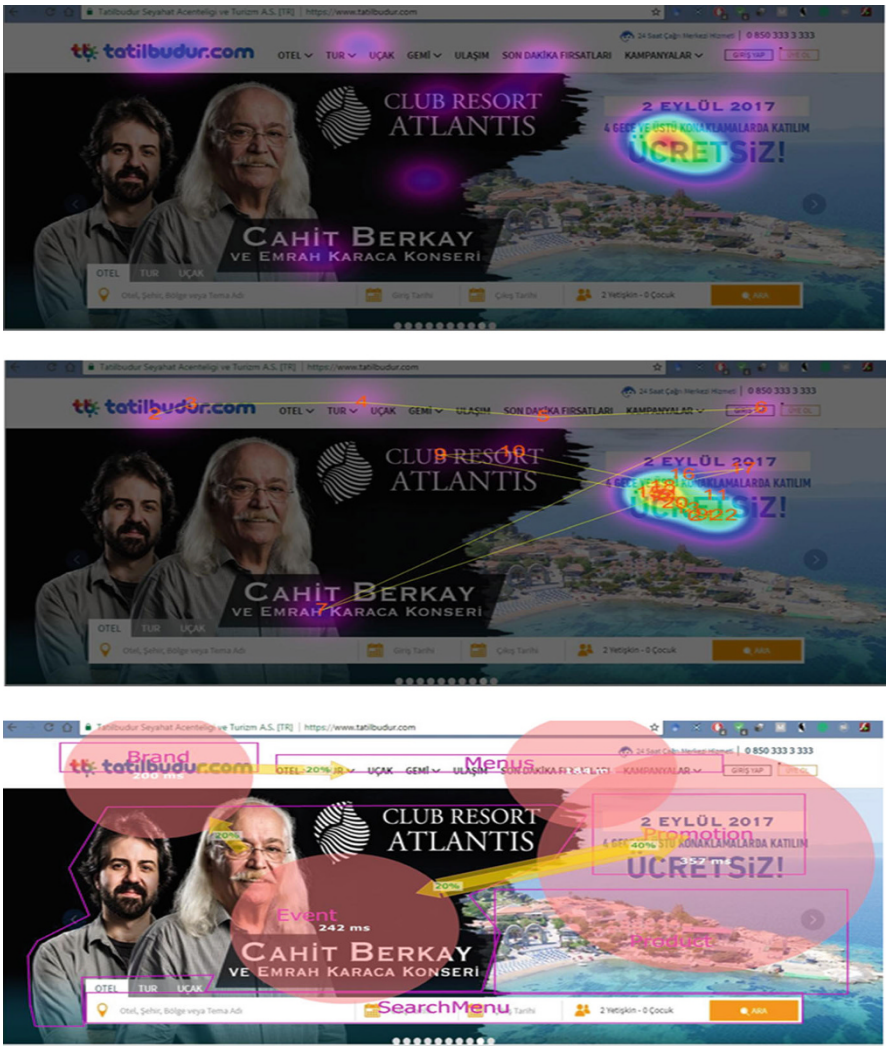

Fig. 1 Heat map, saccades and scan path analyses

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

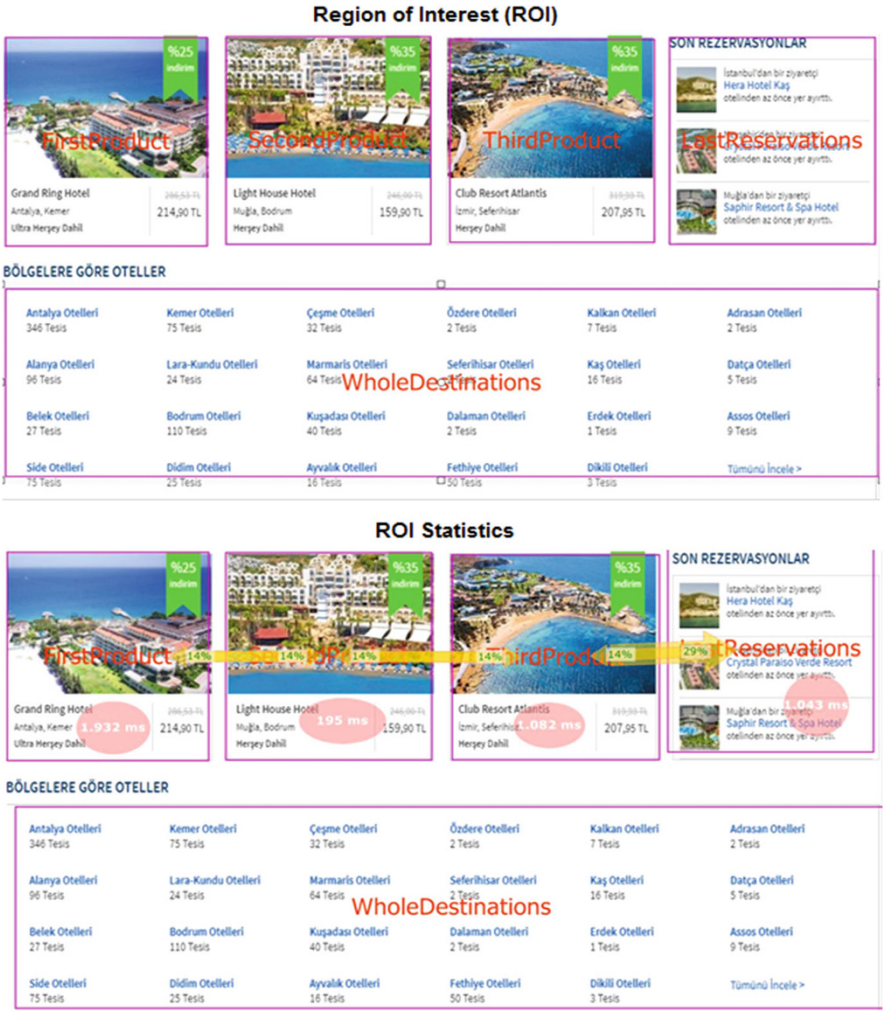

Fig. 2 Region of interest analysis

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.

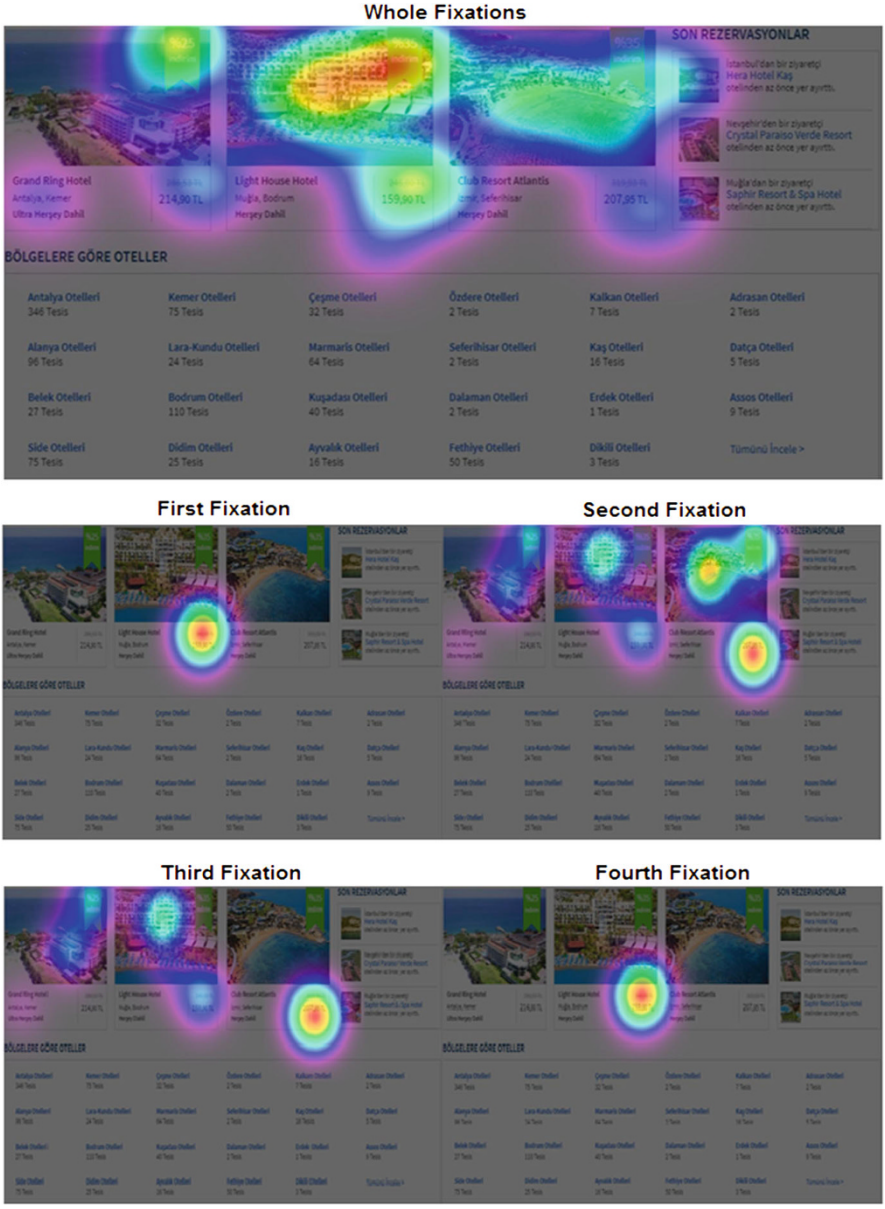

Fig. 3 Heat map analysis

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

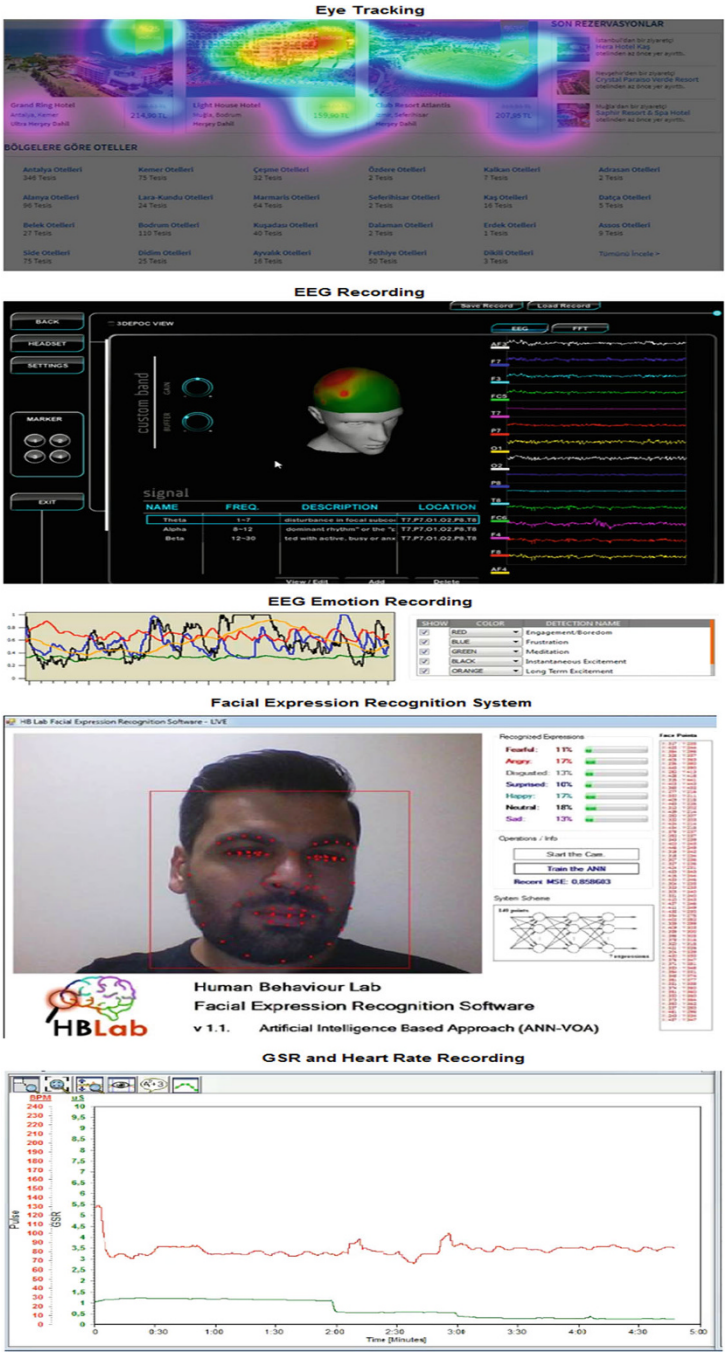

Fig. 5 Combining eye tracking with other neuromarketing tools

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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Knowledge Co-creation Through Eye-Tracking in Tourism

Ruhet Genç

Abstract The intention of this manuscript will be to discuss the role of eye-tracking studies in knowledge co-creation for tourism experiences. The designation of touristic information services is dependent on the feedback coming from tourists, and currently, the most objective method for deriving tourist information can be argued as eye-tracking. By comparing past literature with a critical analysis, this chapter will underline the importance of eye-tracking method as an integral part of tourism studies, on the basis of knowledge co-creation out of the experiences of tourists. The main focus of this study will be on how to analyze the phenomenon of knowledge co-creation in tourism in the face of visual stimuli around tourists in touristic destinations. In conclusion, the chapter will contribute to the literature by discussing the role of eye-tracking method in knowledge co-creation of tourists through objectively reflecting their experiences with visual stimuli around them. In doing so, knowledge co-creation studies in tourism can be carried out in a quantitatively measurable manner by adopting eye-tracking method.

Keywords Eye-tracking · Tourism · Co-creation

1 Introduction

Consumer evaluations are usually drawn from self-reports including questionnaires and interviews in the field of tourism, although they are limited as well as susceptible to potential biases such as difficulties in recalling (Wang and Sparks 2016). In order to measure the consumer evaluations objectively, a number of techniques have been used where the benefit, interest, or satisfaction of tourists are transformed into quantitatively measurable form.

Among these techniques, eye-tracking appears as an important technique for measurement in tourism studies, since, for instance, it has been known to provide

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a rich data source for attentive user interfaces (Vertegaal 2003), it has been used to predict the moment when tourists lose their interests and begin to get bored (Kiefer et al. 2014), or even it has been used to determine the differences between ethnic groups with respect to tourism photography (Wang and Sparks 2016).

Eye-tracking appears to be the only method for measuring gaze points or eye movements in a quantitative manner. It allows researchers to understand the subconscious processes and decisions of their participants as well as which type of visual stimulus triggers the fundamental brain circuits responsible for attention, cognition, and emotion. Then, these insights may be used for understanding individual preferences and decision strategies properly in order to develop marketing strategies in the related fields accordingly. By enabling the contribution of users as objective feedbacks instead of biased self-reports, knowledge co-creation, which denotes the creation of information in a collective manner, will be obtained. In the next section, the past literature regarding to eye-tracking research will be briefly introduced, then the use of eye-tracking methods in tourism research will be discussed in detail.

2 Eye-Tracking Research

Historically, the research on human eye moves has begun in the early 1900s. Over time, these techniques started to be used in marketing research, such as determining the consumer responses. Research has been conducted in order to investigate the visual processing behavior of consumers, including visual attention toward advertisements or packages with pictures (Li et al. 2016). In a visual marketing stimulus, consumers move their eyes to process a certain object or location (Manthiou et al. 2017). Although the human senses are capable of collecting the bulk of information, the brain can only process a small percentage of the stimuli received by the environment, using selective attention technique to deal with the information overload (Xu et al. 2017).

In the last decade, eye-tracking equipment has been developed in order to record the eye movements of consumers while they are viewing large amounts of stimuli under quasi-natural conditions (Wedel and Pieters 2008). The main characteristics of the eye-tracking method are fixations and gaze points, representing the movements of eyes and later they are visualized on heat maps to show the general distribution (Manhartsberger and Zellhofer 2005). Eye fixation is defined as a point where the eye fixates on an object in order to acquire information (Duchowski 2007). Additionally, area of interest (AOI) is a useful tool for selecting subregions of a displayed stimulus and extracting metrics, particularly for these regions. The AOI analysis deals with defining the areas within a page and comparison of the eye-tracking data on the basis of some aspects such as number of fixations, duration of fixations, and so forth (Manhartsberger and Zellhofer 2005).

Pursuing these further, previous studies showed the effectiveness of the eye-tracking method for data collection. For example, studying eye movements

through eye-tracking systems is capable of providing insight into visual information acquisition behavior (Hyökki 2012; Hernández-Méndez and Muñoz-Leiva 2015; Wang and Sparks 2016). According to Duchowski (2002), the effectiveness of advertisements can be studied in copy testing, images, video, and graphics by using eye-tracking methodology along with providing useful data in other domains including neuroscience, psychology, industrial engineering, and computer science. Furthermore, there is a growing trend for using eye-tracking technology in commercial applications specifically in the United States and Europe, parallel to the developments in marketing, cognitive sciences, and human–computer interaction (Pieters et al. 1999; Xu et al. 2017). Eye-tracking is also capable of capturing objective and real-time data about the elements of a specified stimulus which individuals are attending to (Wang and Sparks 2016). In general, eye-tracking provides objective information (Sundstedt 2012), as well as an extended understanding of people's reading behavior and reactions to words and pictures by tracking the eye movements and replaying them in real time or in slow motion (Rayner et al. 2001). Most importantly, by measuring the visual attention of tourists, real-time gaze patterns can be obtained (Isaacowitz et al. 2006) which later can be used in the design of touristic information services (Kiefer et al. 2014) since tourism offers a platform to understand visual attention (Rakić and Chambers 2010) as well as putting emphasize on visual components including pictorials reflecting the image of destination in the market (Feighey 2003). In short, eye-tracking appears as a reliable method both for academic and commercial purposes in the existing literature.

Nevertheless, there are some drawbacks on using eye-tracking method. For instance, the eye movements and metrics of participants may not reflect the underlying cognitive processes in eye-tracking evaluations. Besides that, further research on the field of AOI suggested that AOI production methods and subjective choice of AOIs by researchers in shape, size, and location have a significant impact on attention-attracting and attention-maintaining capacities of AOIs, and this reflects on the statistical analysis (Hessels et al. 2016). Therefore eye-tracking research is claimed to be answering "what" and "how" questions about the ocular behavior of participants, but does not reveal the reason behind it. For that reason, scholars claim that the results of eye-tracking studies are insufficient for a proper analysis, and they are required to be combined with other evaluation methods such as self-report questionnaires or interviews to get full information about the participants (Samiee and Jeong 1994; Walters et al. 2007; Xu et al. 2017).

3 Eye-Tracking and Tourism

Recently, tourist experience of cultural difference has gained growing interests as tourists from different linguistic, ethnic, religious, and cultural backgrounds come together in a certain tourism destination, requiring to be served differently while improving intercultural communication on the basis of shared universal values (Luka et al. 2010). Visual cues are also important sources to measure these cultural

differences among tourists in an objective manner. As a crucial part of human's information processing, visual appeal is capable of adding meaning to something which is natural in itself (Xu et al. 2017).

Tourism marketers and advertisements also rely heavily on visual stimuli like imagery, visual associations, drawings, painting, visual memory devices, symbols, etc. (Li et al. 2016; Scott et al. 2016; Wang and Sparks 2016). For instance, in their study, Scott et al. (2016) showed the usefulness of the eye-tracking method for evaluation of tourism advertising compared to self-report measures which can be distorted by biased data. Considering the fact that the eye-tracking method has already being used in the tourism sector, researchers may work on using the method in other possible fields in the tourism market, such as the development of new products and services. The literature on the tourism sector is mostly based on subjective measures rather than objectively.

Although self-reports are frequently used for the evaluation of tourist experiences since it is easily interpretable, practical, provides rich information, causal force, and motivation to report (Paulhus and Vazire 2009), this method lacks some fundamental properties. Standard written copy tests are proven to be unsuccessful for grasping emotional aspects in tourism marketing (Hazlett and Hazlett 1999). Verbal or written response measures are claimed to be limited, as they require respondents to think back to remember what they felt and fail to capture a person's emotional experiences instantly. Besides, these measures are also susceptible to social demand influences since respondents may give responses that are suitable to social norms rather than what they actually feel or think of (Xu et al. 2017).

On the other hand, the findings derived from eye-tracking study are useful sources for knowledge co-creation for the tourism sector. As Karpouzoglou et al. (2016) discuss, the technology allows the realization of knowledge co-creation and resilience. Therefore, evaluations of newly developed products and services in the tourism sector can be carried out by the eye-tracking method and tourists may express whether they like new applications or not with their eye movements. As a result, tourists contribute to the development of new products and services in the tourism market. Parallel to the discussion above, this contribution is less biased and more reliable compared to other techniques such as self-report.

Considering the different backgrounds of tourists from different parts of the world, studies suggest that a more nuanced approach recognizing the multidimensional aspects of geographical distances would be more appropriate instead of the long adopted "one-fit-all" tactic (Ambos and Håkanson 2014). Hence, evaluations should be carried out separately when taking tourists of two physically and culturally distant countries into consideration. Unless the geographical distance among the countries of different tourist groups is small, the results of the eye-tracking study will be culturally biased given the fact that perceptual development is shaped by culture (Pezdek et al. 2003).

In the next section, a model will be suggested in order to measure the impact of the eye-tracking method in the co-creation of tourism experiences.

4 The Model

Two important aspects take place while measuring the impact of eye-tracking on knowledge co-creation in the tourism sector. Starting with the cross-cultural differences, tourists from different cultural backgrounds have different visual attention patterns. For instance, the study conducted by Marcon et al. (2008) on cross-cultural differences reveals that Western people cannot easily differentiate Asian people (Chinese, Japanese, Korean, etc.) since they are inclined to perceive slant-eyed people as similar. In general, Western people identify faces with eyes (shape, color, and so on) but when there are fewer cues for identifying eyes, they fail to recognize faces altogether. On the other hand, Asian people do not have a problem while identifying Asian faces, because they are looking for different cues from different points of the face while recognizing a face. The phenomenon is known as cross-race effect (Marcon et al. 2008). Similar to this cultural variety in face identification, other studies claim that some cultural impacts may lead to differences in eye movements, gaze points, and fixations (Chua et al. 2005), which are fundamental for the eye-tracking study. The main element creating cultural difference can be considered as geographical distance since as the geographical distance between two destinations increases, cultural difference is expected to increase due to the presence of different ethnicities, languages, religions, and social norms (Takayama 2013). In other words, neighbor destinations can show more cultural similarities and share more common cultural practices. Hence, the model will include geographical distance as an indicator of cultural difference, transforming cultural differences in a quantitatively measurable form.

In addition to cultural differences between tourists based on geographical distance, technological advancement is also a determinant factor for the eye-tracking study. Technological progress leads to advancements in the eye-tracking technology, such as more sensitive heat maps or new equipment for measuring durations of gazes and fixations. Since eye-tracking is a method that transforms visual attention or eye movements in a quantitatively measurable form. As it has been discussed, current eye-tracking technology is capable of explaining what and how questions about the ocular behavior but not the reason behind the gaze or fixation. By time technology may allow researchers to understand why people have specific ocular patterns through brain-imaging tools by which they can visualize the neural activity in the function-specific locations of the brain.

Furthermore, technology can be considered as a time-dependent variable. In other terms, technology develops exponentially over time such that it has acceleration for doubling itself, as Gordon Moore (1965) has argued this phenomenon in one of his works on integrated circuits, and the phenomenon is named after him as Moore's Law. Therefore, the model will include a time variable in order to reflect the impact of technological progress over time.

Hence our model can be considered as:

$$ET = \beta 0 - \beta 1GD + \beta 2TAt + \varepsilon$$

where,

ET implies the impact of eye-tracking
GD implies geographical distance
TA implies the technological advancement
t implies time (or periods/seasons in which tourism markets work)
β0, β1, and β2 imply coefficients
ε implies residual

According to the model, geographical distance and technological progress subject to time are two main variables by which the impact of eye-tracking method can be explained. The geographical distance variable is suggested as negatively related with the impact of eye-tracking, given the fact that physical proximity ensures the minimization of differences in gaze points, fixation times, and eye movements due to the differences in cultural background. Additionally, there may be other variables that are capable of explaining the variance in the level of the impact of eye-tracking that the suggested model has not captured. Therefore, a residual is presented in the model, denoting the variance that cannot be explained by the two variables.

The suggested model can be used for any type of numerical data since the main target of the model is to provide a tool for the measurement of the impact of the eye-tracking method on tourism in a quantitative form. Furthermore, the research enables the measurement of the effect through statistical analysis based on two main variables in a mathematical framework rather than relying on subjective methods which would decrease the reliability and objectivity of the findings.

5 Concluding Remarks

In general, the eye-tracking study is an objective measurement for quantitative analysis of tourist perceptions and their evaluations regarding newly developed touristic products and services. The model presented in this manuscript is a useful tool since it captures cross-cultural differences in perceptual inclinations as well as technological improvements for detailed investigations. Although differences in gaze points and fixation time may be influenced by other variables such as heuristics and resource depletion (Wästlund et al. 2015), long-term and macro-level analysis will provide more consistent results across contexts and situations.

Nevertheless, there are still weak points with respect to the model. For example, the impact of the model has not been supported by practical results. Hence, the model suggested in this manuscript has some drawbacks regarding real-world phenomena. Moreover, the cultural difference may not be directly influenced by geographical distance and the assumption for transforming cultural difference into

physical proximity should be investigated by further research in the future of tourism-related eye-tracking studies. The limitations of this study generally stem from insufficient scientific investigation in the field of tourism on the basis of cross-cultural differences in eye-tracking measurement. However, the model is still useful considering the fact that there has been no previous attempt for modeling the impact of the eye-tracking model in the field of tourism which will enable the measurement of the effect in a quantitatively measurable form.

In short, as it has been discussed, eye-tracking is less influenced by response bias than self-reporting, and its method is more standardized for investigating cognitive processes compared to the memory-based measures (Krajewski et al. 2011). For this reason, eye-tracking appears to be a useful method for carrying out knowledge co-creation studies in tourism in a quantitatively measurable form meanwhile it provides a reliable source for creating the knowledge about touristic preferences. All in all, science requires numbers, and transforming qualitative findings into numeric data lies at the heart of scientific inquiry.

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Part II
Eye Tracking Research and Case Studies

The Relevance of Eye-Tracking to Understand Users' Practices and Content Interpretation in Tourism-Related Online Navigation

Elena Marchiori and Lorenzo Cantoni

Abstract This chapter presents and discusses the implications of current approaches to understand practices of users accessing tourism-related online content, especially when it comes to their understanding and interpretation of main contents and sentiments being expressed in the resources they navigate. The Eye-Tracking technique has been implemented to reach such goal, integrating results from previous research conducted by the authors (Marchiori and Cantoni, Information and communication technologies in tourism 2015, Springer, Cham; Cantoni et al., Design, user experience, and usability: understanding users and contexts, Springer, Cham, 2017). The eye-tracking technique is used to explore the match between users' actual navigation on webpages and their interpretation of the topics covered by such online resources. Results suggest that a multisource approach/data triangulation helps to reduce possible biases that may occur if only one approach is adopted both in online content analysis as well as in online consumer behavior investigation.

Keywords Eye-tracking · Web navigation · Online content analysis · User experience

1 Introduction

The ability to evaluate what prospective customers are looking at in an online publication outlet represents a new way to enhance the promotion of a destination and can provide actionable implications to designers and managers who want to better design online messages. In fact, as it has been extensively argued by studies on listening/reading and interpretation (Gadamer 1960; Cantoni and Tardini 2014),

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expression and interpretation of meaning might be misaligned: the sender intends to express a meaning, while the addresses might interpret the message in a different way(s). When it comes to social media platforms, the interpretation task is made even more complex: on the one side many different users publish very different (even contradicting) messages, with different communication goals and strategies; on the other side, all such messages are published together and have to comply with specific templates defined by platforms' creators.

The eye-tracking technique is nowadays used for studying eye movements applied to several fields. In the context of online navigation practices and content interpretation, scholars already confirmed that "seeing is not necessarily liking" (Cantoni et al. 2017; Husić-Mehmedović et al. 2017; Fraiss et al. 2017). Indeed, the eye-tracking measures should be complemented with other methods such as surveys, direct observations, log-file analyses in order to avoid biases in data interpretation (Qu et al. 2017).

This chapter proposes an approach to online content analysis that includes the Eye-Tracking technique (ET) using the tourism domain as an application field. The procedure for performing an analysis of users' practices and content interpretation using the eye-tracking technique is described using a specific case study: an experiment with 48 users (21 males, 27 females) who have been exposed to several tourism-related online contents. The eye-tracking tools Tobii Studio 3.4 and the Tobii tracker X2–60 have been used to capture users' gazes and fixations, together with a pre-post questionnaire for collecting their self-reported perceptions on specific tourism-related online contents. Results provide insights on how to apply an eye-tracking technique in order to understand what kind of relation exists between content recognition and eye movements on tourism-related social media contents.

Overall, the capacity of ET has been recognized as a useful tool to understand what grabs users' attention the most, while navigating social media pages (e.g., elements of a web page, such as topic and sentiment expressed). In particular, ET might be useful for: (1) investigating online navigation patterns; (2) understanding how to better communicate/design online messages; and (3) understanding users' online decision-making process.

Destination managers might benefit from this study as the proposed framework, which comprises self-reported and eye-tracking techniques, could be used for testing the effectiveness of an online marketing campaign, or a website interface, or a new mobile application.

2 Related Works

2.1 Eye-Tracking Technique and Tourism

With the term "eye-tracking" it is intended a technique that measures the movements of the eyes with respect to the head (Nielsen and Pernice 2010). Nowadays, thanks to

technological advances, the ET technique uses eye-tracker hardware and software that can be applied in various fields.

In particular, psychology and marketing benefit from the use of ET as it allows a deeper understanding of users' behavior (Gidlöf et al. 2013). ET is also used to evaluate user experience for (digital) products and services (Qu et al. 2017). Eye-tracking is also applied to investigate the online consumer behavior in the tourism and hospitality domain, in particular, to explore: the online decision-making process of potential clients (Noone and Robson 2014); users' behaviors using different smart devices (Fraiss et al. 2017); people's perception of tourism-related images according to ethnicity (Wang and Sparks 2014); until using mobile ET for investigating visitors' interactive learning experience in a real-life museum context (Rainoldi et al. 2018).

Eye-tracking research has been carried out also in the field of social media and tourism. Taking as a reference point the previous studies applying an eye-tracking approach to social media (Wan Adilah et al. 2013), this branch of research has attempted to analyze what are the digital aspects that attract users the most while navigating on tourism-related social media pages (Marchiori and Cantoni 2015). Moreover, other studies used the eye-tracking technique to analyze advertising effectiveness on tourism-related blogs, social networks, and review portals (Méndez 2015).

2.2 Eye-Tracking Technique and Users' Practices

A previous study done by Cantoni et al. (2017) compared the results from three different research approaches, namely: eye-tracking, web analytics, and self-declared investigation in order to gain an understanding of users' preferences in terms of tourist attractions for a specific destination. In fact, the study revealed certain correspondences in terms of preferred themes, but some results may seem contradictory. For example, even if participants mostly looked at sections related to a theme (i.e., nature), the majority of self-declared attractions belong to another one (i.e., sports/outdoor), indicating that what users look at does not always reflect their preferences. This shows the importance of adopting a multisource approach: if only one approach is used, possible biases may occur in identifying online preferences.

Current approaches in (web) content analysis generally consider the viewpoint of the coder in his/her identification of the main topic expressed and/or using in-depth sophisticated analysis such as restructuring sentences and analyzing their specific linguistic composition. So far inter-coder reliability generally helped to identify if there was or not an agreement in the way coders interpreted the same content (e.g., text, video, or a mix of them as on social media). However, evidences from content analysis involving actual users are needed in order to better assess web page navigation and better identify the content categories.

3 Research Design

Having the abovementioned theoretical background, an approach is proposed that includes the eye-tracking technique, using the tourism domain as an application field. An experiment, which comprises the exposure of users to a selection of manipulated contents from social media about a tourism destination, was performed.

The eye-tracking tools Tobii Studio 3.4 and the Tobii Tracker X2–60 were used to capture users' gazes and fixations while users navigated the manipulated contents.

Pre-post questionnaires were performed for collecting users' self-reported agreement on the identification of the main topic/sentiment among the four most popular social media platforms: Facebook, Tripadvisor, Twitter, and Instagram.

Thus, it is assumed that eye-tracking technique can be a valid aid to answer the two following research questions:

1. *Which elements of the pages do attract users' attention the most, which in turn might lead to the identification/interpretation of the main topic/sentiment expressed within social media pages?* In order to answer this question eye-tracking data were checked against users' assessment of the main topic/sentiment among social media pages.
2. *How do users interpret the main topic/sentiment of mixed pages, that is, pages that contain positive and negative content?* In order to solve this second research question, users were randomly divided into two groups; one group was exposed to positive and mixed contents, while the other group was exposed to negative and mixed contents. This procedure allowed to identify if there is any sentiment prominence in the interpretation of such pages. Also, a question devoted to investigate the willingness to visit the destination in both cases (exposure to main positive or negative contents) was asked.

Case Study
The case study selected for the experiment was a tourism destination located in the South of Switzerland: Ticino. A group of teenagers participated in the experiment; they were from a border city located in the North of Italy. A total of 48 participants (21 males, 27 females) aged between 17 and 19 years recruited on a voluntary basis took part in the test, which was performed in April 2016. Participants were recruited from a high school of an Italian city located in a region neighboring the Swiss destination under study. A consent form signed by them (or their parents) was required in order to involve them in the test.

3.1 Selection of Stimuli

The test was based on a user navigation of a selection of manipulated social media pages regarding the destination Canton Ticino, the Italian-speaking region in Southern Switzerland on the border with Italy.

Design of the visual social media stimuli:

11 stimuli were used for the experiment. The stimuli were from original social media pages from different social media platforms divided as follows:

Social media platforms: Facebook (3 stimuli), Tripadvisor (3 stimuli), Twitter (3 stimuli), and Instagram (2 stimuli).

Topic: each stimulus (a screenshot of a social media feed page) was representing one main topic. The 11 topic categories from the DORM model have been used, namely: accommodation, attractions, events, gastronomy, culture and traditions, safety, destination image, entertainment, locals, weather, and transportation.

Most stimuli included also a subtopic, with the goal to clarify the object of the main topic. When present, the subtopics covered "price" or "tourist experience."

Sentiment: each stimulus was representing one main sentiment polarity (mainly positive or mainly negative) or a mixed scenario, that is the page contains positive as well as negative contents). Thus, stimuli were divided in three groups: four stimuli had mostly positive sentiment, four had mostly negative sentiment, while three stimuli were mixed, having a balanced presence of positive as well as negative sentiment.

Table 1 presents a summary of the composition of the visual stimuli. In the rows, the social media platforms are indicated, while in the columns, the related sentiment is indicated. Each cell contains the related main topic.

3.2 Setting of the Experiment

The setting of the test was structured as follows: each participant was invited to sit in front of a PC, equipped with the Tobii X2–60 hardware mounted below the PC screen. Once the eye calibration process was completed, the test started.

A pre-questionnaire was administered asking demographic information (age and sex), if they had already visited the destination under study (Ticino) or not, and their willingness to visit it.

Users were randomly dived in two groups:

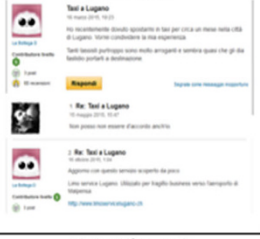
- Group A (22 students) was exposed to 4 mainly positive stimuli +3 mixed stimuli.
- Group B (26 students) was exposed to 4 mainly negative stimuli +3 mixed stimuli.

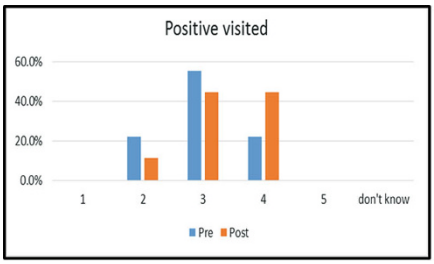
Each user was exposed to seven stimuli. Each stimulus contained 1 of the 11 defined topics.

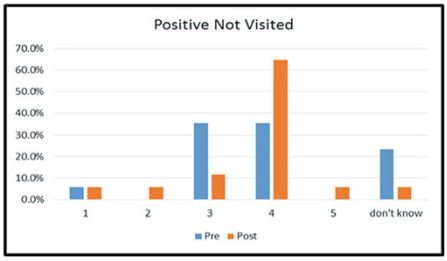
After the exposure to each stimulus, participants were asked to identify:

- Main topic: accommodation, attractions, events, gastronomy, culture and traditions, safety, destination image, entertainment, locals, weather, transports (destination dimensions derived from Marchiori and Cantoni 2016)
- Secondary topic: prices, tourist experience, or none

Table 1 Summary table of the 11 stimuli used in the experiment

	+	-	+ -
FACEBOOK	Safety 	Events 	Weather 
TRIPADVISOR	Site attractions 	Residents 	Transportation 
TWITTER	Culture and traditions 	Entertainment 	Gastronomy 
INSTAGRAM	Overall Image 	Accommodation 	- None -





Figs. 1 and 2 Exposure to mainly positive stimuli. Pre and Post willingness to visit Ticino among who had already visited the destination, and who had not visited it yet

- Sentiment expressed: a 5-point Likert scale was used, from completely negative to completely positive

A post-questionnaire was finally administered, asking users what did grab their attention the most, and their willingness to visit the destination.

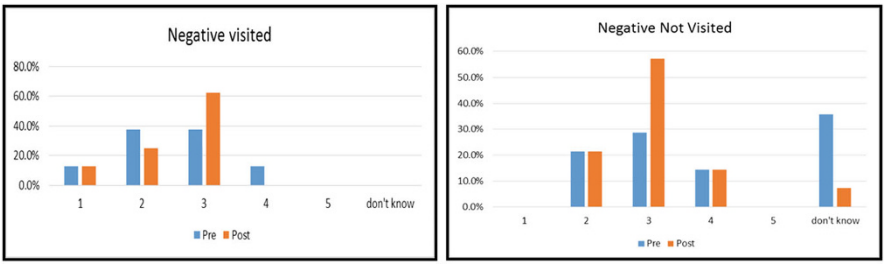
4 Results

Results of the pre-test questionnaire revealed that 95% (46 out of 48) of the respondents had heard about the destination under study. However, 65% (31) of the respondents had not visited Ticino yet. Among the 35% (17) who had already visited Ticino, the large majority indicated a medium-high level of appreciation of the destination. Among them, almost all (14) stayed there overnight at least once. Overall, the main reason to visit Ticino had been "Events" (35%).

4.1 Self-Declared Willingness to Visit Ticino

Figures 1 and 2 present the results of group A, which is the group exposed to mainly positive stimuli about the destination. Within them, two additional groups were checked against each other: the ones who had already visited the destination, and the ones who had not visited it yet. Pre and post answers were checked using a 5-point Likert scale where 1 = not willing to visit, and 5 = very much willing to visit. Results revealed that those who visited already the destination after the exposure to positive stimuli tend to reinforce and increase their willingness to visit. The ones who had not visited the destination yet, after the exposure to positive stimuli tend to increase their willingness to visit and reduce their uncertainty ("don't know").

Figures 3 and 4 present the results of group B, which is the group exposed to mainly negative stimuli about the destination. Results revealed that those who visited already the destination after the exposure to negative stimuli tend to reinforce



Figs. 3 and 4 Exposure to mainly negative stimuli Pre and Post willingness to visit Ticino among who had already visited the destination, and who had not visited it yet

an average position (Likert value 3) to visit Ticino. The ones who had not visited the destination yet, after the exposure to mainly negative stimuli tend to reduce their uncertainty and reinforced the average position.

4.2 Correlation Between Eye-Tracking (ET) Outcome and Self-Declaration of Main Topic, Subtopic, and Main Sentiment Expressed for Each Stimulus

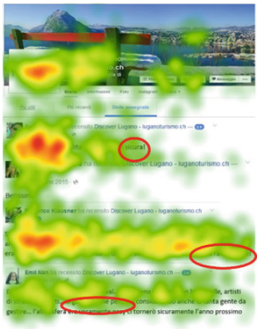
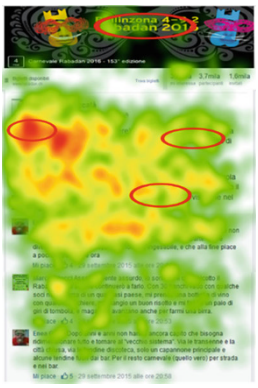
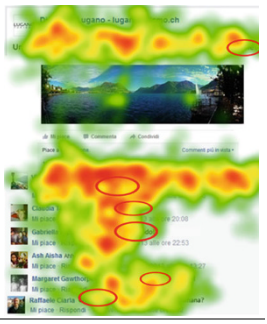
Tables 2, 3, 4, and 5 present an in-depth focus on the correlation between ET outcome and interpretation of the main topic, subtopic, and the main sentiment expressed divided by social media platforms.

Table 2 presents the results for the platform Facebook. Checking the ET heat areas that grabbed the users' attention the most against the users' interpretation of the main topic, subtopic, and the main sentiment expressed, it can be assumed that the only non-recognized main topic of the stimuli was for the topic "safety." Indeed, as underlined with circles in the picture (Stimulus 1 of Table 2), the indication of the topic safety was only in textual form and displayed in the middle and bottom of the page. This might suggest that users tend not to look at the bottom of the page for identifying the main topic expressed.

Table 3 presents the results for the platform Tripadvisor. Results revealed an overall agreement in the identification of the main topic, subtopic, and the sentiment expressed. As underlined by the circles in the heat maps, users tend to pay attention to the title and first comment. It has to be said that the pages presented from Tripadvisor were mainly textual-based and therefore forced the respondents to read the contents in order to evaluate the page. Thus, that might be the reason why the first comment on each page was viewed entirely by the users.

Table 4 presents the results for the platform Twitter. Results revealed an overall agreement in the identification of the main topic, subtopic, and the sentiment expressed. As underlined by the circles in the heat maps, users tend to pay particular attention to the hashtags presented in the text. Indeed hashtags appeared to act as a

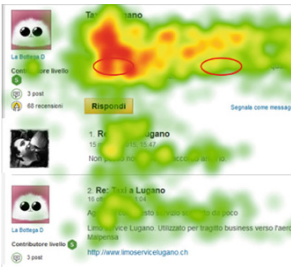
Table 2 Facebook pages

	Level of coding	Intended manipulation	Coded by users	Eye-tracking heat map
Facebook stimulus 1	*Main topic*	Safety	Recognized by 3 out of 22	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	>Positive	Recognized by the majority	
Facebook stimulus 2	*Main topic*	Events	Recognized by the majority	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	>Negative	Recognized by the majority	
Facebook stimulus 3	*Main topic*	Weather	Recognized by the majority	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	Mixed	Recognized by the majority	

particular formatting in the text (e.g., as bold formatting) and/or as a summary of its meaning, which captures the attention the most. Pictures also were paid attention; however, there is not a specific area in the pictures that appeared to grab most of the attention.

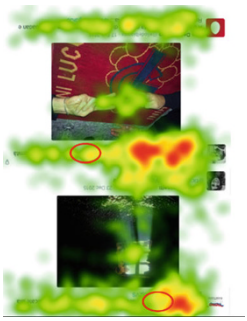
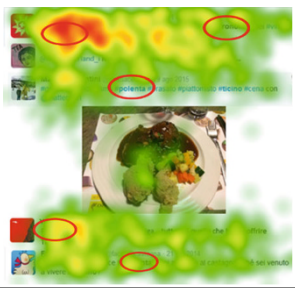
Table 5 presents the results for the platform Instagram. Results revealed an overall agreement in the identification of the main topic, subtopic, and the sentiment

Table 3 Tripadvisor pages

	Level of coding	Intended manipulation	Coded by users	Eye-tracking heat map
Tripadvisor stimulus 1	*Main topic*	Site attractions	Recognized by the majority	
	Subtopic	Price	Recognized by the majority	
	Sentiment	>Positive	Recognized by the majority	
Tripadvisor stimulus 2	*Main topic*	Residents	Recognized by the majority	
	Subtopic	None	Mixed	
	Sentiment	>Negative	Recognized by the majority	
Tripadvisor stimulus 3	*Main topic*	Transportation	Recognized by the majority	
	Subtopic	Price	Recognized by the majority	
	Sentiment	Mixed	Recognized by the majority	

expressed. However, for the first stimulus "Image," respondents indicated instead "Entertainment." This suggests how the keyword proposed "Image" was too generic and maybe not clearly understandable for the content analysis task they received. As underlined by the circles in the heat maps, users tend to pay particular attention to the comments present in the text. Indeed, in the stimuli proposed the expressions of sentiment were displayed mainly in the comments. Pictures also received attention; however, there is not a specific area in the pictures that grabbed most of the attention.

Table 4 Twitter pages

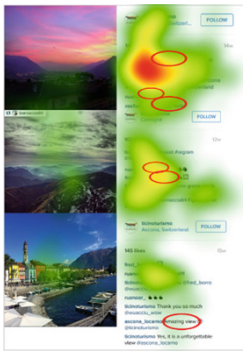
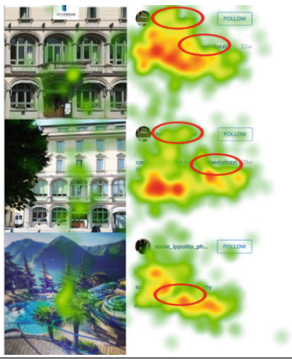
	Level of coding	Intended manipulation	Coded by users	Eye-tracking heat map
Twitter stimulus 1	*Main topic*	Culture and traditions	Recognized by the majority	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	>Positive	Recognized by the majority	
Twitter stimulus 2	*Main topic*	Entertainment	Recognized by the majority	
	Subtopic	Price	Mixed	
	Sentiment	> Negative	Recognized by the majority	
Twitter stimulus 3	*Main topic*	Gastronomy	Recognized by the majority	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	Mixed	Recognized by the majority	

5 Conclusions

This study wants to contribute to the current reflection of the methods used for online content analysis, particularly of social media pages, by including the eye-tracking technique. ET technique in this study is assumed to help to understand where a user/interpreter looked at while interpreting the main topic and sentiment of a page.

This study provides insights about the actual interpretation of social media pages as actual users (segment teenagers) were involved. In this study respondents were

Table 5 Instagram pages

	Level of coding	Intended manipulation	Coded by users	Eye-tracking heat map
Instagram stimulus 1	*Main topic*	Image	Majority indicated entertainment	
	Subtopic	Tourism experience	Recognized by the majority	
	Sentiment	>Positive	Recognized by the majority	
Instagram stimulus 2	*Main topic*	Accommodation	Recognized by the majority	
	Subtopic	Price	Mixed	
	Sentiment	>Negative	Recognized by the majority	

asked to navigate several social media pages, allowing to know, thanks to the use of the ET technique, their perceptions associated with a specific content.

Results show an overall common agreement on the main topic, independently from the main expressed sentiment. Respondents' eyes were passing over significant elements related to the contents of the webpages. Apparently, in order to establish the main topic of a page, users looked more to text rather than to images.

However, in a content analysis which uses heat maps from eye-tracking data several insights can be mentioned:

- Images seemed to play a less significant role in the identification of the main topic, subtopic, and the sentiment expressed. However, results might change if the total number of fixations over the pictures is considered. Indeed, the creation of the areas of interest for each picture could be implemented in the content analysis.
- Some platforms are mainly picture-visual based such as Instagram and in part Twitter and Facebook. Thus, a combination of an in-depth analysis of the parts of the text viewed and the fixations on the pictures could be considered in the content analysis. This might provide a better understanding of the keywords/

sentences which were mainly viewed and in turn, might be associated with the content of the picture/s displayed on the same page.

- In this study, 65% of respondents answered "pictures" as the format that grabbed their attention the most, while 35% answered "text". This insight indeed revealed how a user tends to remember mainly picture/visual based aspects even if the actual navigation data revealed that a user spent the majority of his/her navigation time in looking at texts. The relative predominance of text over images when it comes to fixation time might be explained due to the different access we have to the two different communication codes: the visual one is perceived and interpreted in a holistic way, while the textual one requires a spatially ordered and more time-demanding attention.

As emerged from the study, a social media page can also be deconstructed in several aspects that might grab the attention the most, such as:

1. Format (textual or visual)
2. Characteristic of the textual part (the sentiment expressed, presence of formatting like bold, italic; size like title or paragraph)
3. Position of the element that grabs the attention the most (e.g., on top of the page)
4. Presence of symbols in the text (e.g., hashtag, emoji)
5. Stereotypical images, which easily communicate a positive or negative value (e.g., an image portraying garbage in a street might communicate a lack of care and thus create a negative judgment)
6. Presence of specific rating symbols (e.g., like button, star rating)

An in-depth investigation of the role of each of the abovementioned aspects could be further conducted in a future research.

Several limitations associated with this study are discussed below. Future research is suggested to carefully consider them. (1) In this study, users were required to identify the main and secondary topic of each page together with the sentiment expressed. These tasks can be considered as biased as they create an unnatural web navigation within the page. That is, users were focused much on reading rather than freely navigating the page. Future research can, therefore, check results against a free navigation, allowing users to freely search for content they are interested in and then follow their actual web navigation habits. (2) Lack of investigation on the areas of interest, specifically for the pictures. Future research can, therefore, consider using the functionality offered in the ET software, which allows to determine in advance the areas of interest to track and thus better count the number of fixation and gaze movements within them. (3) A specific age segment was considered in this study using tailor-made stimuli for a specific destination. Future research can, therefore, enlarge the sample and ensure a more variability in the stimuli proposed.

While this research has contributed to a better understanding of reading and interpretation practices of teenagers, when it comes to their access to social media pages related to a tourism destination, it has also practical implications. In particular, it can help destination managers and others involved in a destination's online

marketing, to better design their messages, based on a deeper understanding of actual users' practices.

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Areas of Interest on Destination Websites: A Generation Y's Perspective

Rebecca Wahler, Anita Zehrer, and Aleksander Groth

Abstract Technological developments change the way tourists gather information. An appealing website is one approach of tourism organizations to attract potential customers' attention and turn them into repeat visitors by providing a unique website experience. Thus, choosing proper website elements addressing expectations and emotions alike is the key challenge to gain behavioural intentions. On the basis of a broad technological know-how, Generation Y is known for being highly demanding regarding website design and features. Little research exists on user experience and preferences of this specific user group. This study analyses the website 'Visit London' by means of two qualitative methodologies, eye-tracking and retrospective think-aloud (RTA). Due to the evaluation of the eye movements of 16 Generation Y members, results reveal which elements are expected from a destination website. Finally, recommendations for website design are proposed.

Keywords Generation Y · Eye-tracking · Web design · Retrospective think-aloud

1 Introduction

Tourism enterprises try to compensate for the intangible nature of tourism products and services (Loda et al. 2009) by offering a highly emotional web experience and simultaneously gaining higher customer loyalty (Djamasbi et al. 2010). Business-related websites use appealing and trustworthy stimuli, since they present an opportunity for customers to interact with the company; hence, an essential role in the decision-making process for potential customers can be attributed (Bonnardel et al. 2011; Lindgaard et al. 2006; Luna-Nevarez and Hyman 2012). When designing a

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website, one of the most difficult aspects is the selection of website elements, which must appeal to the customers, but also comply with the desired target group (Lindgaard et al. 2006; Xiang et al. 2015). Due to Generation Y's strong purchasing power, especially when considering their online market power, many enterprises focus on this target group. However, this generation's attributed profound technological know-how sets high standards regarding a website being perceived as appealing. Based on a lack of literature on Generation Y's preferences regarding website design, businesses are struggling to find the best, and most successful, approach. Thus, a user behavioural study was conducted to examine Generation Y's perception of destination websites with the objective to develop recommendations for destination marketing organizations.

2 Theoretical Background

For examining how Generation Y perceives touristic websites, a deeper understanding on the topics of consumer behaviour, sensory marketing, perception of quality, and Generation Y itself will be discussed.

2.1 Consumer Behaviour

Consumer research is an applied social science with the prime goal to explain, predict, and influence customers' behaviour. Following Kroeber-Riel and Weinberg (2003), consumer behaviour can be defined in a wider sense as a consumption of tangible and intangible goods. Consumer behaviour is dynamic in nature, based on the interaction between effect and cognitions, and involves exchanges (Solomon 2004). Psychological and cognitive factors are crucial concerning the impact on the decision-making process of web users (Jeong and Choi 2004; Kroeber-Riel and Weinberg 2003; O'Connor 2004). Tourists prefer to obtain their information (e.g. about destinations) online, nevertheless, book their holiday offline via their travel agency (VIR 2014). Literature explains this behaviour with a lack of trustworthiness and reliability of web presentations (Loda et al. 2009).

Numerous studies analysed how specific website dimensions influence the perception and behaviour of the so-called 'eConsumer' (Jeong and Choi 2004; Xiang et al. 2015). According to Thielsch (2008), the most important aspects within a general evaluation of websites are the following dimensions: *content*, *usability*, and *aesthetics*. However, within the first seconds of interaction between a human and a computer, aesthetics are considered to be the most important dimension. Kim et al. (2007) stress the importance of analysing the user through different sensory stimuli regarding the communication of women and men. Women tend to prefer visual and non-verbal stimuli, while men seem to appreciate more analytical information on websites (Kim et al. 2007).

2.2 Sensory Marketing

Krishna (2012) defines sensory marketing as '*marketing that engages the consumers' senses and affects their perception, judgment, and behaviour*' (p. 332). The goal of sensory marketing is to charge brands as well as products with emotions (Sliburytea and Skeryte 2014). Depending on the type of product or service, the focal point of marketing can, therefore, be shifted to a consumer's different sensory organs (Krishna 2012).

When aiming for an attractive website, the focus lies on the visual web marketing (as a subpart of sensory marketing) in order to stimulate the visual sense of a visitor. The design, as well as the visual communication, are considered key components of visual marketing (Wedel and Pieters 2008). Lindgaard et al. (2006) emphasize that web marketers only have 50 ms to generate a positive first impression for their website. Hence, marketers are left and challenged to choose the best website elements to present their 'quality' within this short time span.

Djamasbi et al. (2010) established a 'virtual hierarchy' for virtual representations (i.e. graphic and textual elements) to influence (to a certain degree) a visitor's perception and exploration behaviour. The elements of his virtual hierarchy are as follows (Djamasbi et al. 2010 p. 308):

1. Motion (animated elements draw user attention before any other elements)
2. Size (larger objects attract more attention)
3. Images (images attract more attention than text)
4. Colour (elements with brighter colours attract more attention than those with darker colours)
5. Text style (typographical variations serve as effective non-verbal cueing systems for attracting attention)
6. Position (top elements attract more attention than those located on the bottom)

One challenge of closely adhering to elements within this visual hierarchy results in a potential sensory overload (e.g. too many moving or colourful objects), which may result in a negative perception of a website. Users in general have difficulties coping with the daily amount of information; hence subjective and relevant information is purposefully and carefully selected (Wright 2006). Another challenge may be constituted by the (unknown) expectations of web users (Djamasbi et al. 2010). Any practical application of visual marketing is redundant when varying intentions and motivations of consumers are not taken into consideration (Mazaheri et al. 2011). Applied to destination websites, it is essential for destination marketing organizations (DMO) to have a good understanding of the set of values that should be communicated through different stimuli on a website. If a DMO fails to clearly define and position its destination online, these sensory stimuli will result in a negative first impression, especially when the stimuli do not comply with the selected target group (Luna-Nevarez and Hyman 2012).

2.3 Perception of Quality

From a consumer point of view, quality displays a characteristic of products or services that reflects the degree of needs and expectations consumers wish to be fulfilled. Since these expectations and needs of consumers can fundamentally vary, any judgement is very subjective. Consequently, every customer perceives quality in an individual and different way (Gill 2009; Kim and Niehm 2009).

In terms of websites, quality can be defined as a 'users' evaluation of whether a website's features meet users' needs and reflect the overall excellence of the website' (Chang and Chen 2008, p. 821). Particularly on touristic websites, Hernández-Méndez and Munoz-Leiva (2015) highlight the importance of a healthy exchange of information and interaction (i.e. B2C and C2C) as a key factor. Xiang and Fesenmaier (2004) further stress the significance of usability for touristic websites. Regarding quality indicators for websites, literature offers numerous opinions. While Vasto-Terrientes et al. (2015) name the relevance of online shops, slogans, and different language options as a quality criterion, Lee and Gretzel (2012) emphasize the application of images and graphics as well as customer ratings and sound.

The so-called 'expectation–confirmation' model by Bhattacherjee (2001) illustrates the context between a customer's expectations, the perceived utility, a customer's satisfaction, as well as the intention to continue with an 'information system' (IS) process, e.g. the exploration of a website (Chung et al. 2015). When these expectations are met, consumers consider a website as useful and stay longer on the website (Bhattacherjee 2001) (Fig. 1).

For the purpose of ensuring high-quality standards, constant evaluation regarding the efficiency of a website is essential (Ekinci and Riley 2001). However, an acknowledged definition for the evaluation of a website remains impossible, as literature provides multiple and varying approaches of such evaluation techniques (Law et al. 2010). The following four methods are proposed to evaluate a website's efficiency: calculation of the Net Promoter Score (Chaffey et al. 2009), eye-tracking (Hernández-Méndez and Munoz-Leiva 2015), modified balanced scorecard (Morrison et al. 2004), and content analysis (Luna-Nevarez and Hyman 2012).

Kasavana (2002) explains that it is impossible to develop a standardized catalogue of criteria to evaluate the efficiency of a website in terms of *one size fits all*.

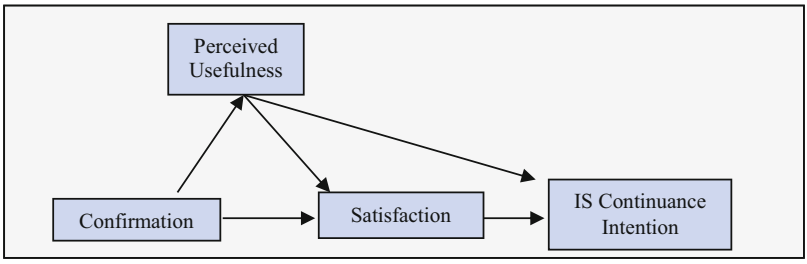

Fig. 1 Expectation–confirmation model (Bhattacherjee 2001, p. 363)

Naturally, websites (e.g. of destinations) differ among each other (e.g. city, region, country), but also attract different and certain kinds of customers (e.g. city tourists, beach vacationers) with different sets of expectations. Furthermore, quality indicators are rated differently depending on the sector or industry (e.g. retail sector compared to the tourism industry). Hence, in terms of website presentations, a user's preferred website elements or dimensions vary between industry, target groups, and destinations (Djamasbi et al. 2010, 2011; Luna-Nevarez and Hyman 2012).

2.4 Generation Y

The term 'Generation Y' represents all persons born between the late 1970s and early 1990s (Cui et al. 2003; Urban 2014). This generation possesses a strong purchase power. Therefore, many businesses identify and try to win this target group with selected marketing strategies (Djamasbi et al. 2010). In addition, this generation spends more than the average consumer online and incorporates a strong 'wanderlust' (Fox 2008; Benckendorff et al. 2010). It is predicted that Generation Y will represent 50% of all travelling expenses by the year 2020 (Travelport 2012). Hence, businesses heavily invest in convincing and captivating website presentations in order to convincingly attract this generation's attention (Djamasbi et al. 2010).

Djamasbi et al. (2010) further identify a deficit in studies concerning Generation Y's preferences for websites and conducted a study to analyse websites within the retail industry with special attention towards these preferences. As a result, the following website elements have been identified as being preferable for Generation Y: big images, images of celebrities, integrated search feature, and little or only short text passage. However, there is no further application of these results when looking at businesses from different industries or sectors, e.g. tourism.

3 Methodology

The official website of the tourism destination London (www.visitlondon.com/de) was chosen to investigate this generation's preferences (in German language). This research is based on a study by Luna-Nevarez and Hyman (2012), in which this website received the highest overall score. Within their study, the focus has been set on a content analysis of various destination websites, neglecting the perceptions of 'real' website visitors.

3.1 Experimental Research Design

For this empirical study, eight male and eight female participants (convenience sampling) were selected and tested in 2 days. A very narrow time frame was chosen in order to prevent any content updates from happening, which would make a comparison between participants void. Qualitative, as well as quantitative research methods, were applied to analyse visitors' perception of the destination website 'Visit London'. The experimental setting was structured as followed: (1) pre-questionnaire, (2) eye-tracking experiment, (3) post-questionnaire, and (4) retrospective think-aloud (RTA) method (Bogdan and Biklen 2006). The combination of eye-tracking and traditional research methods allows to better understand users' cognitive processes, their online search behaviour, as well as preferences regarding certain website elements (Wang et al. 2014). Tables 1, 2, 3, and 4 summarize the applied methodological approach and the corresponding measures.

3.2 Key Findings

At this point, it has to be noted that besides the outcomes of the questionnaires and the RTA recordings, solely the fixations within the 17 determined AOIs (see Table 5) during the first 20 s (time of first impression) of website observation were the basis for our evaluation.

Table 1 Pre-questionnaire

Description	The questionnaire is composed of closed questions targeting the user's touristic domain. Confirmatory statements applied a 7-point Likert scale. A 10-stage ranking system for different website elements was provided. At the end of the questionnaire, a short scenario description of an upcoming holiday in London was presented, whereupon participants could take notes regarding their expectations towards the destination website in the context of their holiday. After scanning the website, fulfilled expectations should be confirmed with a check.
Objectives	Get to know the subjects and their interests better (Nielsen and Pernice 2010); collect demographic information as well as data regarding past behaviour (e.g. at touristic websites) (Breakwell et al. 2012; Veal 2008). Additionally, find out which website elements are expected and confirmed or rather consciously perceived during the time of the first impression.
Measures	7-point Likert scale[a]
Evaluation	Mean value, standard deviation, frequency rate

[a]7-point Likert scale: 1 = not at all applicable, 4 = neutral, 7 = highly applicable

Table 2 Eye-tracking

Description	A non-portable eye-tracking device (Tobii T60) has been used to track an individual's eye movement by means of the reflected infrared lights of the participant's pupils (Tobii Technology 2015). After an individual calibration, the website was observed for a period of 60 s, the eye-tracking software stopped the experiment automatically. In order to collect valuable data, 17 Areas of Interest (AOIs) across the website were defined. Tobii studio enables a visualization of the collected information by creating heat maps of the individual participant eye movement (Tobii Technology 2009, 2015).
Objectives	Monitoring the eye movements in order to make conclusions about the cognitive processes of the test subjects (Djamasbi et al. 2010); visualizing the eye movements by means of the so-called heat maps[a] and gaze plots[b] (Nielsen and Pernice 2010) and detect which elements of a website are perceived most frequently during first-time impressions (Wang et al. 2014).
Measures	Tobii T-60 eye tracker in combination with Tobii studio 2.0.x software
Evaluation	'Fixation[c] count' (incl. zero), 'time to first fixation', 'total fixation duration' (including zero) within the defined AOIs

[a]Heat Map = the visualization of the accumulated fixations of all participants by means of a screenshot (of the examined object) and colour coding according to the length and sum of the fixations (Nielsen and Pernice 2010)
[b]Gaze Plot = the visualization of all eye movements of a single participant by means of a screenshot (of the examined object) and coloured dots representing the individual fixations (Nielsen and Pernice 2010)
[c]Fixation = the visual gaze of a certain location which on average lasts about 250–350 ms (Runia et al. 2011; Rayner and Castelhano 2008)

Table 3 Post-questionnaire

Description	This questionnaire included open questions, confirmatory statements (7-point Likert scale), and the Net Promoter Score (NPS). A combination of different types of questions provides insights towards a participant's attitude from different perspectives (Veal 2008).
Objectives	Find out more about the subjective satisfaction, the perceived quality, and the response to certain elements of the analysed website (Nielsen and Pernice 2010) and how likely the participants would recommend the website to friends and colleagues (Reichenheld 1996; Net Promoter 2015).
Measures	Likert scale, Net Promoter Score (NPS)
Evaluation	Mean value, standard deviation, frequency rate

3.2.1 Pictures Scoring the Highest Fixation Count

Asking the participants to rank different website elements according to their perceived importance from 10 being of the highest value to 1 being the lowest value, the website element 'pictures' was rated as the fourth last compared to other elements ($m = 4.75$). Furthermore, from a total of 95 collected written expectations towards the website, this investigated website element was noted five times. However, regarding the question if 'pictures are perceived as more informative than texts on a website', the overall mean score resulted in 5.56 (7 = highly applicable). This result was also observed within the eye-tracking analysis of five specific AOIs: *small*

Table 4 Retrospective think-aloud

Description	The recorded eye movement video (RTA gaze video[a]) was shown to the individual subject at the end of the experiment. The main task was to think aloud and comment on the individual eye movements. All comments were recorded with Tobii Studio 2.0.x (Tobii Technology 2009).
Objectives	Gather more valuable subjective interpretations of the recorded eye movements from the participants; complementing eye-tracking results with further data and giving it consequently more significance (Guan et al. 2006).
Measures	Tobii Studio 2.0.x software
Evaluation	Transcription of the participants' comments. Significant statements were marked and adduced for the interpretation of the heat map.

[a]RTA gaze video = Showing the incremental visual frisking of the examined object (Tobii Technology 2009)

Table 5 AOIs (Luna-Nevarez and Hyman 2012)

Destination logo	Short texts	Social media
Search menu	Language options	Advertisements
Navigation menu	Weather	Large pictures
Large headings	Pictures of celebrities	Medium-sized pictures
Medium-scale headings	Pictures of random people	Small pictures
Long text	Contents	

pictures, *medium-sized pictures*, *large pictures*, *pictures of celebrities*, and *pictures of random people*. Comparing these results with the accumulated gaze plots, the highest attention has been placed on elements containing images. With a total of 1003 transacted fixations during the first 20 s, 60% (= 606 fixations) of all fixations can be attributed to pictures. Additionally, when analysing 'total fixation durations', 60% (= 7.54 s) of all available time was spent looking at pictures.

3.2.2 Pictures of Famous People Do Not Receive the Highest Attention

Compared to the results of Djamasbi et al. (2010) emphasizing the placement of pictures containing famous people on retail websites, our results strike quite to the contrary within the context of tourism websites. Although two pictures of the royal family were shown on the website, pictures of random people as well as a large picture containing a depiction of a popular London sight were given more attention.

Statements from the RTA recordings suggest a quite biased perception of such pictures: e.g. '*I am not very interested in the royal family*' or '*I cannot identify with such pictures in the same way I can relate to those pictures, showing unfamiliar people in situations I could actually see myself in*'. The quotes above may be backed up with our eye-tracking results. From a total of 606 pictorial fixations, 53% of them (= 324 fixations) were caused by images of random people, 30% (= 180 fixations) by the large picture of a popular London sight, and 12% (= 73 fixations) by both pictures of royal family members. Similar results were obtained concerning the 'total

fixation duration'. The average time spent looking at pictures is 7.54 s per person. In addition, the AOI 'pictures of celebrities' receives the third rank order with an average fixation duration of 0.9 s per person (4.11 s for pictures of unfamiliar persons and 2.24 s for the large picture). Taking the 'time to first fixation' into account, likewise the time to fixate on pictures with random persons took an average of 0.38 s, followed by 1.27 s for the large pictures and 4.94 s for images of the royal family.

3.2.3 Social Media Is Not Perceived as an Important Element Within the First Impression

Social Media was ranked with a mean value of 6.94 on a scale from 1 = very important to 10 = very unimportant. Asking the participants what they expect from the website prior to the eye-tracking experiment, none mentioned any social media sources. Furthermore, with a mean score of 3.50, participants rather disagree with the statement 'social media content is an important information source on homepages'. The AOI 'Social Media' did not receive any fixations within the first impression timeframe of 60 s. Some participants stated in the RTA that 'it is a website element, which is nice to have, but you do not really need it for your holiday planning'.

3.2.4 Destination Websites Are Rather Seen as a Platform for Information than for Booking Intentions

Participants were asked what their overall expectations are with regard to potential booking functionalities on a destination website. Results illustrate that participants utilize destination websites mostly as a source of information prior to their holiday booking ($m = 5.69$) in order to get an idea about the destination ($m = 5.94$). Although participants indicate both the desire to browse through the website further in order to gain additional information ($m = 6.13$), looking for booking options ($m = 5.0$) is far less important to them. It is noteworthy though that participants tend to see booking options as an important feature of a destination's website ($m = 5.0$). With a mean of 5.69, participants state that they would use 'Visit London' as a source of information for their next holiday when travelling to London in the future.

3.2.5 During the Phase of First Impression, Website Elements Embedded in Lower Parts of a Website Are Not Perceived

A website's length defines itself through the number of screens it consists of. In the case of 'Visit London', the total length of the site comprises four screens. Considering the 'number of fixations', results show a consistently declining number of fixations with an increasing number of screens. With a percentage of 71%, the majority of fixations were made within the first screen (= 710 fixations), followed

by 23% (= 237 fixations) within the second and 6% (= 56 fixations) within the third screen. The fourth, and last, screen did not attract any attention. As some of the participants clicked on further links after a short while of viewing the website, the average 'total duration spent' per person was 14.42 s. Thereof 10.04 s can be ascribed to the first screen, 3.71 s to the following screen, and 0.67 s to the third. All fixations made on the third can be ascribed to two participants. All others did not scroll down to reach this part of the website.

3.2.6 Differences Exist Between Men and Women Within the First Impressions

For the purpose of examining gender-specific differences, two heat maps were created to show all accumulated fixations of female or male participants (Figs. 2 and 3: showing only the first two website screens). Regarding the 'total fixation count' of 1003, female participants accounted for 56% (= 561 fixations).

Comparing the colour coding of individual AOIs (green = low fixation count; red = high fixation count), disparities can be detected in six of them: (1) medium-sized captions are viewed by female participants seven times more often (= 14 fixations) than by male participants; (2) the navigation bar accumulated 22 fixations, double as much from female attendants than from our male (11 fixations); (3) female participants examined the logo of the destination more intensive (= 24 fixations) than male participants (4 fixations); (4) the large image of the sight, showing the Tower of London, attracted more men (119 fixations) than women (61 fixations); (5) large captions received a higher fixations count from female attendees (141 fixations) than from male attendees (61 fixations); and (6) the portrayal of random persons gathered 174 fixations, a slightly higher count than by female participants (men = 150 fixations).

Analysing the 'total visit duration' of both gender groups, a shorter time span can be perceived regarding the male participants. The average visit duration of a male participant amounts 13.54 s before clicking on further links. Female attendees scored a slightly longer website visit duration with 15.30 s. Four out of eight men left the first page of the website under 10 s, compared to two out of eight female participants.

4 Limitations and Conclusions

Before summarizing the contributions of this study, it is important to point to its limitations. First of all, although the sense of hearing can have a substantial impact on the perception, the triggered emotions, and consequently the first impression of a website, the focus was solely laid on the sense of sight (Kotler et al. 2009; Krishna 2012). Further limitations lie in the convenience sampling—not giving every single member of the target group the same opportunity of being part of the sample (Bryman and Bell 2011). Hence, a generalization of the results must be handled

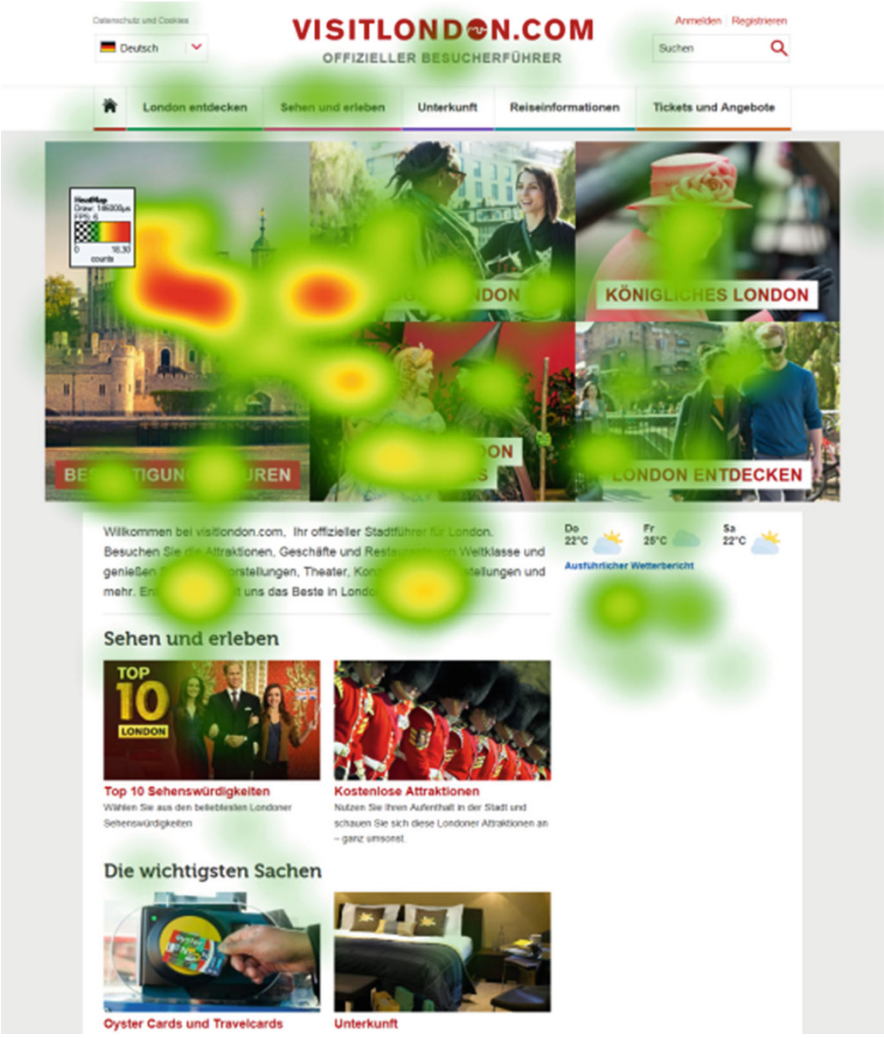

Fig. 2 Heat map of male participants

carefully as the 16 subjects cannot be seen as representatives of Generation Y. In addition, choosing exclusively only one website for this study presents another limitation. In order to detect if these results are applicable to other destination websites, the same experiment with the same task should be conducted using further destination websites (Nielsen and Pernice 2010).

Nevertheless, the results of this study are noteworthy. On the visitors' interest towards the attraction of pictures of celebrities, our findings disagree with the works of Djamasbi et al. (2010) or Yoo and Alavi (2001), where pictures attracted a great deal of attention. In contrast to the retail sector, destination websites consider

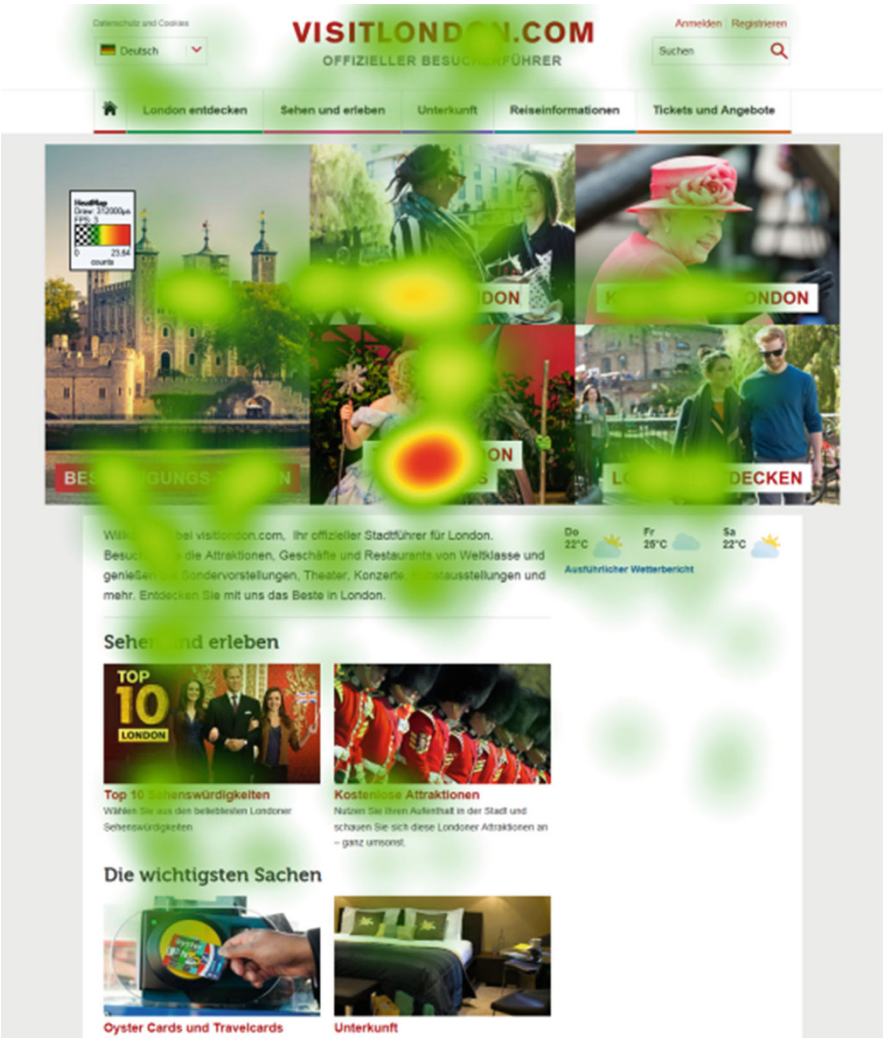

Fig. 3 Heat map of female participants

pictures of (random) persons as an important emotional trigger and an easy navigation during the phase of first impression as equally important (Djamasbi et al. 2010; Xiang et al. 2015). Although Loda et al. (2009) state that tourism websites lack credibility and trustfulness, respondents report the value of destination websites as a credible and reliable information source within the pre-questionnaire ($m = 6.0$). After the eye-tracking experiment, however, the NPS of minus 6% shows a low persuasive power of the website. RTA and the post-questionnaire additionally reveal that Generation Y is actively stated the importance of user-generated content for them to enhance credibility, which confirms findings of Kaplan and Haenlein (2010).

Members of Generation Y mostly regard touristic websites as an information platform, allowing them to improve their holiday experience by retrieving detailed information, quick tips, as well as recommendations for planning activities, free of charge. Even though Generation Y is known for their great affinity to social media technology (Djamasbi et al. 2010; Xiang et al. 2015), members of this generation seem to neglect these aspects when visiting destination websites. Hence, for planning an upcoming holiday, social media does not play a central role. In order to analyse Generation Y's perception of touristic websites more precisely, it is necessary to conduct studies that examine the effects of the first impression on general intentions, e.g. travelling to a certain destination further. In this context, it is advisable to take auditive stimuli into account as well as studies that scrutinize cultural differences. Taking the lack of studies contemplating Generation Y and its perception of touristic websites into consideration, there are plenty of opportunities for scientists to provide a deeper understanding of the research subject from different perspectives.

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Measurement of Visual Attention to Advertising Using Eye-Tracking Techniques

Arghavan Hadinejad, Dung Le, Jiangsu Ma, and Noel Scott

Abstract Eye-tracking techniques can determine where within an image a respondent is looking by measuring fixation time within an area of interest (AOI). This chapter details the results of four recent eye-tracking experiments conducted by the authors. The first presented participants with an image of a composite advertisement containing eight different day trip package and found a significant relationship between visual attention to a particular package (as measured by fixation time) and subsequent intention to purchase. The second study demonstrates that visual attention to an image can be manipulated through the use of textual information. The third experiment analyses the effectiveness of two versions of a tourism print advertising which confirms that advertisements with less text attracts more attention. The fourth experiment investigates the effectiveness of a promotion on a hotel website which did not attract the attention of participants. Together these studies confirm the efficacy of eye-tracking for tourism marketing effectiveness studies.

Keywords Eye-tracking · Attention · Advertising · Tourism

1 Introduction

One characteristic of today's marketing is that customers are inundated with a great deal of information and hence attention management is a key to successful advertising (Davenport and Beck 2013). As a result, it is important to determine the effectiveness of advertisements and the ability of images in attracting consumers' attention (Wang and Sparks 2016), especially in tourism which depends heavily on

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the use of images to present its products and experiences (Rakić and Chambers 2010). Pictorials used in advertisements play an essential role in communicating information on potential travel destinations and shaping the image visitors have of a place (Coghlan et al. 2017). Thus, measurement of the attention paid to promotion and advertisements is critical subjects and is an indicator of advertising effectiveness.

There are two general approaches to assess advertising effectiveness in tourism, before and after the marketing material is used (Scott et al. 2016). While changes in destination awareness, visitation, and visitor expenditure are measured after the advertising stimuli are launched, a diagnostic approach entails evaluation of marketing materials prior to their implementation in the market. A diagnostic approach allows the advertising material to be improved prior to use in the market, but maybe more costly as it requires additional consumer research. Tourism scholars typically conduct advertising effectiveness research using self-report methods. The self-report approach, which asks participants to express opinions through questionnaires based on recollected experiences, has been criticised for allowing retrospective reflection (Li et al. 2015). An emerging body of research highlights the objectivity and usefulness of real-time measurements, presenting an opportunity to use these techniques in combination with existing self-report measures to explore customer experiences in tourism generally (Kim and Fesenmaier 2015) and in their reaction to advertising as discussed here. Eye-tracking techniques allow researchers to measure real-time attention to and interest in pictorial and textual advertisements such as blog posts or travel brochures (Duchowski 2002).

2 Real-Time Measurement of Visual Attention Using Eye-Tracking

Due to recent technological developments, there has been a rapid increase in the application of methods to measure attention using eye track movements. Eye-tracking is a technique based on using eye movement as an indicator of an individual's attentional focus. Eye-tracking equipment provides a way to find out where a respondent's eyes are fixating and moving within an image. Eye-tracking provides real-time data about which parts of an advertisement respondents are attending to (Lee and Ahn 2012). Fixation duration (the amount of time a person spends to watch or analyse an item in a stimulus), fixation count (number of fixation), and saccades (eye movement between fixations) are the common eye-tracking measures (Wang and Sparks 2016), which indicate an individual's visual attention. The results of eye-tracking can be illustrated in either a heat map or a gaze plot. A heat map indicates those parts of a stimulus (e.g. an advertisement) that a number of participants attended to. A gaze plot visualises participants' eye movement between different parts of a stimulus.

Recently, tourism scholars have adopted eye-tracking to measure visual attention (Scott et al. 2017). An example is a study of the difference between Australian and Chinese respondents in reacting to tourism stimuli (Wang and Sparks 2016). The findings of this research revealed that Australian participants gazed at advertising stimuli more frequently and longer than the Chinese did. A similar study using eye-tracking has been conducted on the visual attention towards tourism photographs with text and participants' perceived advertising effectiveness (Li et al. 2016). This study found that text embedded in tourism photographs attracted participants' attention irrespective of an understanding of the language.

Eye-tracking methods are useful to analyse the effectiveness of advertising stimuli prior to their launch in the market in a diagnostic approach to improve the material (Scott et al. 2016). However, the application of eye-tracking in pre-launch effectiveness analysis in tourism is in its infancy. Therefore, this chapter aims to provide information on four recent experiments concerning the application of eye-tracking in tourism marketing effectiveness. This chapter contributes to tourism literature by its application of a physiological tool, eye-tracking, to analyse visual attention towards tourism advertising. This chapter provides applications of eye-tracking to the real-time and objective measurement of attention to tourism advertisement. It provides practical implications for tourism industry practitioners in terms of assessing advertising effectiveness prior to launching a product in the market.

3 Method

In each of the following experiments, a convenience sample of students from an Australian university was used. Participants responded to a notice, advertising a short research study, for which they received a gift voucher if they attended. After completing an informed consent form, the participants entered the experiment room and were seated in front of a computer monitor on which the instructions and stimuli were presented sequentially and also received verbal instructions (e.g. participants should turn off the distracting electronic devices; not talk when stimuli are displayed; and minimise head movements during the experiment). Participants were debriefed after completing the experiments. Data was collected using a Tobii 120 eye-tracking system with a 96 dpi, 17″ monitor having a resolution setting of 1024 × 768 pixels connected to a computer. The Tobii 120 eye-tracker measures the position of the participant's eyes with approximately 0.5 degrees of accuracy and a sample rate of 120 Hz. The Tobii 120 eye-tracker uses near-infrared light-emitting diodes, and a high-resolution camera to detect pupil centres and corneal reflections. The camera is unobtrusively mounted on the monitor frame to allow more natural respondent head movement. Before running the actual study protocol, the eye-tracking system was calibrated to the participant's eyes, using known points shown on the monitor. A five-point calibration check was undertaken. Five red circles were displayed on the

monitor as the fixation targets, and the participants were asked to follow a spot moving between the five circles with their eyes.

3.1 Experiment 1: The Relationship Between Attention to Tourism Packages and Intention to Purchase

Twenty participants with normal eyesight took part in Experiment 1 and viewed three panels each of eight advertisements containing information about day trip packages (see Fig. 1) taken from an Australian tourism website. Participants were asked to view each panel for 5 seconds and then were asked to record their preferred package of the eight possible choices.

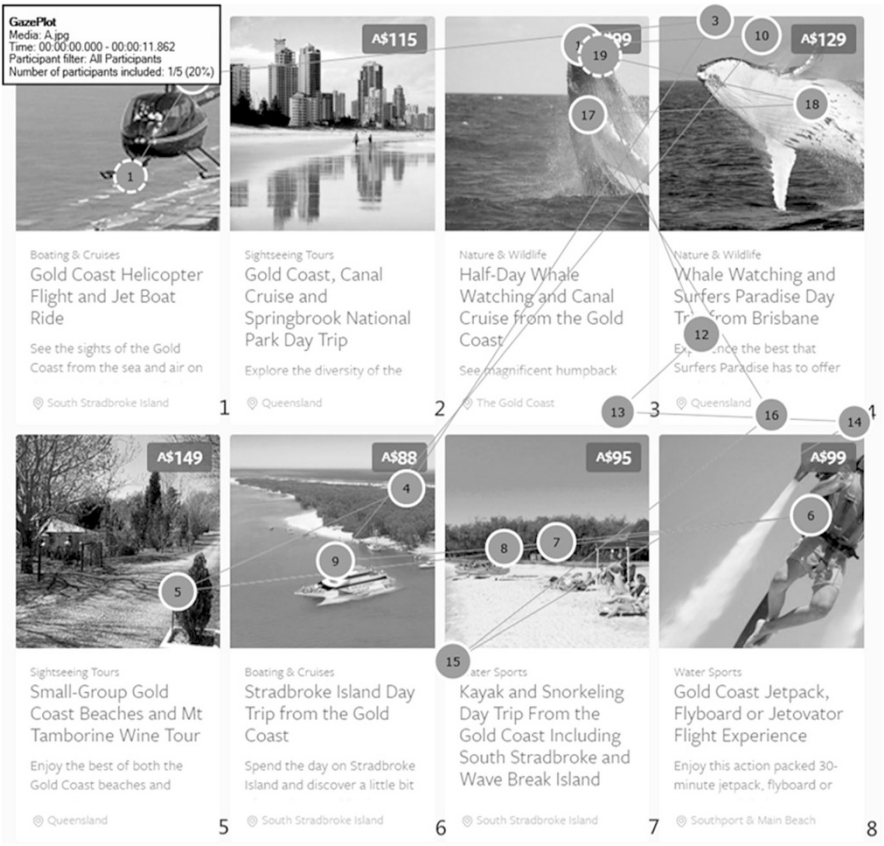

Fig. 1 Respondent scan path for experimental stimuli

Table 1 Eye-tracking study topics and sample size

	Correct match between AOI with the highest total fixation duration and final choice
Panel 1	12/20
Panel 2	8/20
Panel 3	17/20
Overall views	47/60

The findings are shown in Table 1. The overall ratios for the correct match between the highest area of interest total fixation duration and the final choice was 47/60 (78%).

The findings indicate that fixation duration in the area of interest predicts intention to purchase in 78% of exposures compared to an expected 15% based on probability. This study has practical implications for marketing managers as the length of time that attention is paid to a choice alternative is an indicator of product interest. This study also indicated that eye-tracking provides valuable information to analyse the effectiveness of an advertising stimulus. In addition, this research confirmed the efficacy of eye-tracking to measure the respondent's attention to AOIs within marketing stimuli.

3.2 Experiment 2: The Effect on Visual Attention of Manipulating Textual Information

In Experiment 2a, researchers presented 20 participants with an image (see Fig. 2) and asked them to view it while their eye movements were recorded using eye-tracker. Participants were able to view the image for 20 s. In Experiment 2b, participants were presented the textual cue statement followed by the same image as in Experiment 2a. In Experiment 2c, participants were shown a different textual cue, again followed by the same image. In other words, this study aimed to compare unprompted viewing of the tourism stimulus (Experiment 2a) with viewing cued to red flowers (Experiment 2b) and to mangrove trees (Experiment 2c). The eye-tracking equipment was used to analyse fixation and gaze locations. This technique identified fixations and saccades to group these with areas of interest (see Fig. 2).

As the heat map in Fig. 2a demonstrates, participants' fixations were initially on the centre of the image (Fig. 2a) and then moved to the red flowers of the flame tree (Fig. 2b) in response to the cue statement 'red-orange flowers', and in Fig. 2c, there is more fixation is on the mangroves. These findings indicate that a verbal cue can direct attention to a specific area of interest within a marketing stimulus. The cue statement directed participants' attention to the red flowers in the bottom right

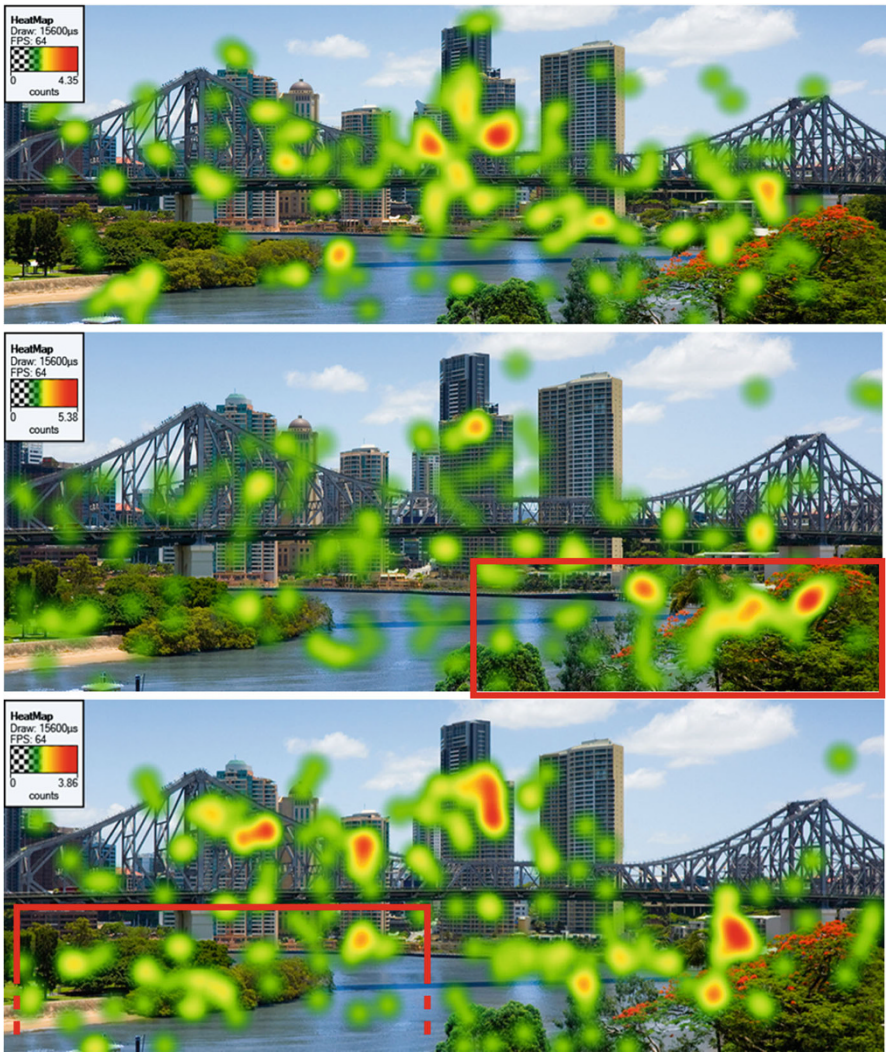

Fig. 2 (**a**) Unprompted viewing map. (**b**) Red-orange flowers cue heat map. (**c**) Mangrove cue heat map

corner. Less attention was directed to the mangrove trees in Fig. 2c perhaps due to the inability of participants to identify these trees in the image. In total, this study indicated that participants' attention can be manipulated through the presentation of textual cues.

3.3 Experiment 3: The Effectiveness of Tourism Print Advertising

In research previously reported in Scott et al. (2016), Tobii eye-tracking was used along with a self-report questionnaire to evaluate the effectiveness of two versions of a tourism advertising stimulus (block and text ad) in a laboratory setting. Some 25 participants viewed two static tourism advertisements, prepared by a marketing company to be published in a tourism magazine in an A4 format. After viewing both advertisements, students answered a set of questions on the likeability of advertisements. The eye-tracking software analysed total time spent on viewing a page, fixation duration, and fixation count (see Fig. 3).

Figure 3 shows the fixations and saccades of students while watching two versions of advertisements. The findings of this study were analysed in terms of the number of saccades and fixation time per advertisement. Results (Table 2) revealed that the block ad received 12 saccades on average and the text ad received 36.9. The ANOVA test also confirms that there is a significant difference in saccade numbers. Fewer saccades on the block ad shows students put less effort in viewing this ad compared to the text one. Analysis of fixation time (Table 2) shows that students spent 10.52 s on average on the block ad while 7.64 s on the text ad. The findings indicate that ad type significantly affects the average time a person spends fixating. Fixation time reflects interest, which is positively related to attention and the time taken to obtain information and analysing it. In summary, the block ad attracted more attention than the text ad. This study also used a self-report measure to evaluate two advertisements in terms of likeability. The results of frequency analysis indicated that the majority of students liked the block ad better than the text advertisement.

Figure 4 shows a gaze heat map for each advertisement. The heat map indicates that students did not read all of the text in the text ad. This study confirms the efficacy of eye-tracking techniques for the evaluation of tourism stimulus. The results of eye-tracking are supported by the results of a self-report questionnaire which indicated a preference for the block advertisement. This study indicates that eye-tracking technology can be used in marketing research to diagnose the effectiveness of and preference for a marketing stimulus prior to launch in the market.

3.4 Experiment 4: The Effectiveness of a Promotion on a Hotel Website

This study assessed the effectiveness of a hotel's website promotion for a hotel chain. The promotion was for a loyalty programme and was located below the booking section of the website to attract customers' attention. This research asked ten participants to view a computer screen for about 15 min. Participants were asked to book a holiday on the Gold Coast for 2 adults and 2 kids, for 5 nights in the month

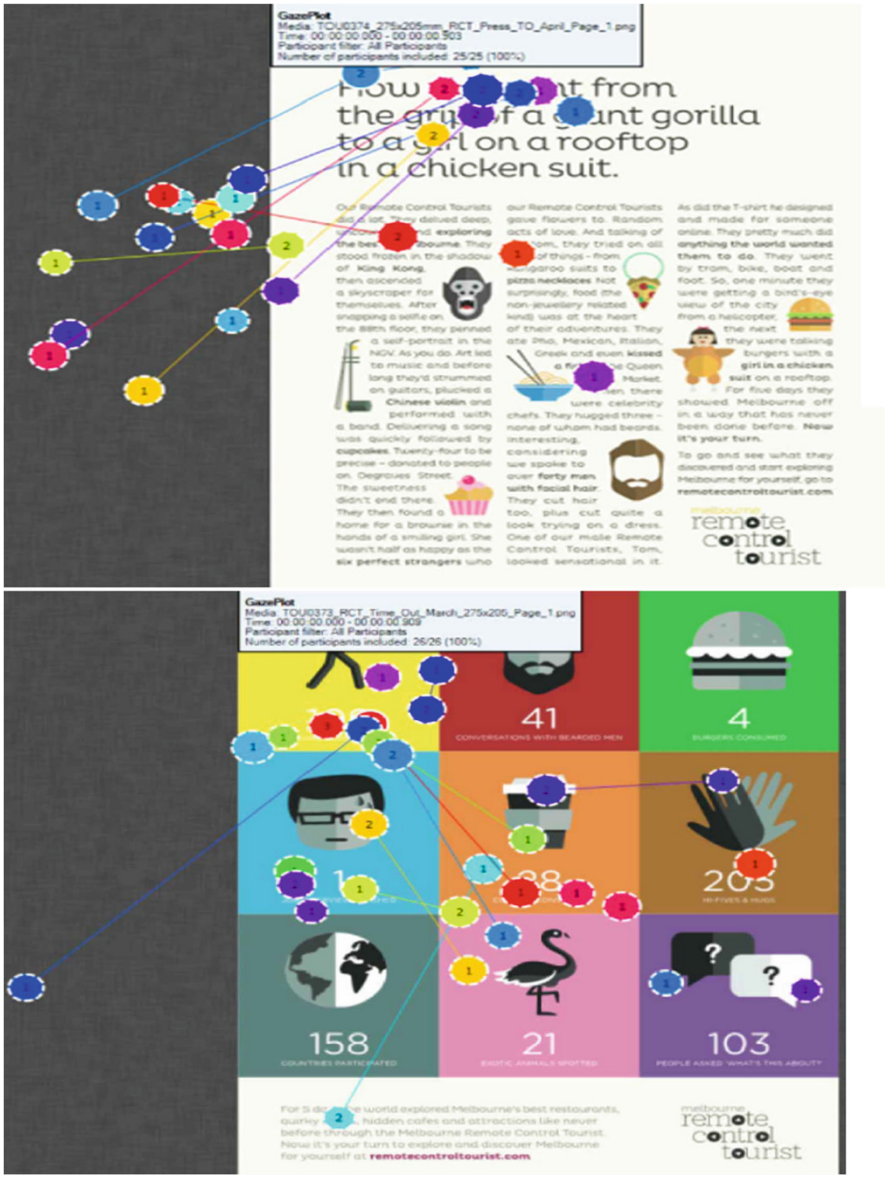

Fig. 3 Scan path on advertisements

of November 2018. This study investigated what participants paid attention to on the website. It collected eye-movement data using eye-tracking hardware as well as supplementary analysis software to track, aggregate, and analyse web clicks and behaviours. The gaze plot and heap map of this experiment is illustrated in Fig. 5.

Table 2 Saccade count and fixation time per advertisement

Group $N = 25$	Mean (Saccades)	Standard deviation (Saccades)	Mean (fixation time) $N = 25$	Standard deviation (fixation time)
Block	11.9936	7.83590	10.52	2.400
Text	36.8164	32.68637	7.64	3.487

df (1), mean square (89), F(10.3), Sig (0.002) (Saccades)
df (1), mean square (83), F(9.9), Sig (0.003) (Fixation time)

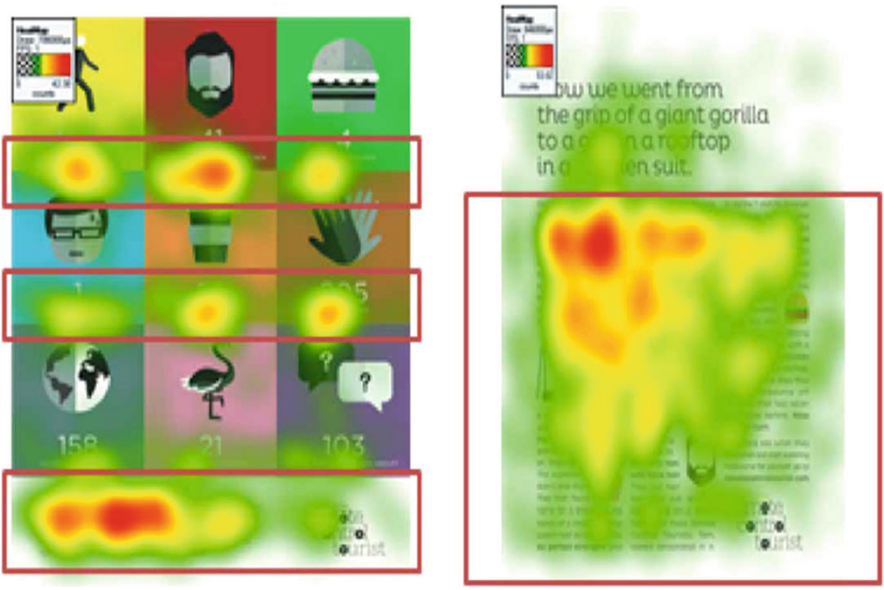

Fig. 4 Heat maps for block and text advertisement

The findings of this study indicate that participants more frequently fixated on the hotel search and booking panel. Participants directed attention to only a few parts of the website, and the promotion did not attract attention significantly as indicated by the gaze plot and heat map in Fig. 5. In other words, participants' eyes fixated on the booking panel of the website and paid the least attention to the additional promotion below it. This suggests that the hotel website designers need to find a better place for the promotion information. Clearly, the booking panel attracts more attention than the promotion on the Mantra Hotels website. This study confirms the utility of eye-tracking in problem detection prior to launching a new promotion in the market.

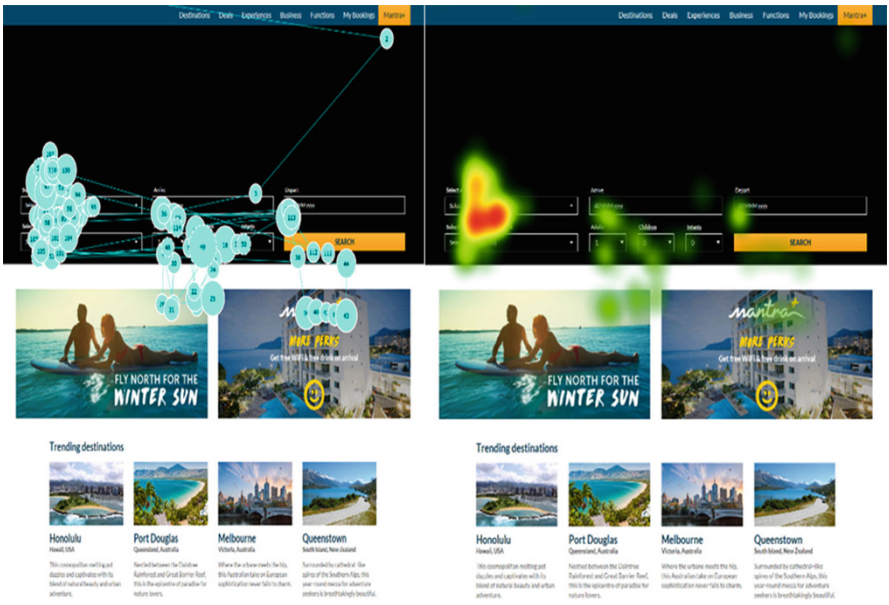

Fig. 5 Gaze plot and Heat map for the hotel website (black top section represents the booking panel)

4 Conclusion

This chapter provides readers with an insight into the application of eye-tracking in tourism studies. The results of the four experiments indicate the efficacy of eye-tracking in the real-time and objective measurement of participants' attention. The results of Experiment 1 illustrated that participants' attention can affect their behaviour and choice of purchase. The findings from Experiment 2 showed that embedding a text in a tourism stimulus could direct a person's visual attention which is consistent with prior literature (Li et al. 2016). Experiment 3 indicated that a block ad attracts more attention compared to an ad with textual information. The result of Experiment 4 revealed that a promotion on a hotel website could not attract the attention of participants which suggests a redesign of the promotion placement.

Clearly, these studies reveal how participants' visual attention can be directed by their goals. This shows that attention paid to tourism advertising is directed by an individual's goals as is confirmed in the broader cognitive psychology literature (Ma et al. 2013). In other words, if an individual is to book a hotel room, his/her attention will be directed to the booking panel. Alternatively, if a person is shown a textual cue regarding a particular part of the ad, he/she will look for and pay attention to that specific section of the stimulus. This is consistent with top-down goal-oriented attention discussed.

Together, these studies indicate the usefulness of eye-tracking for the evaluation of marketing stimuli. This chapter contributes methodologically to tourism literature by investigating the efficacy of eye-tracking in measuring real-time attention to and interest in advertising stimulus in the pre-launch stage. This chapter also provides valuable information for marketing experts to measure the effectiveness of their tourism products prior to launch in the market. This chapter presents implications for the use of text and image in marketing stimuli. However, the literature on the application of eye-tracking in tourism is still in its infancy and requires more research. For instance, future scholars need to employ the eye-tracking techniques to evaluate other stimuli than websites and print advertisements such as real-world tourism experience and virtual reality.

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User Experience Improvement for Online Travel Agencies Through Eye-Tracking: The Onlineweg.de Case Study

Jürgen Bluhm and Ralph Berchtenbreiter

Abstract Every transaction-orientated website such as the website of an online travel agency (OTA) has to perform. One of the most relevant KPIs to measure performance is the conversion rate, due to its direct impact on profitability. Good user experience and usability are essential for the conversion rate. Consequently, there is a high need to know which barriers on the website prevent transforming visitors to customers due to the lack of user experience and usability.

The goal of this case study is to give answers to which usability pitfalls can be identified on the website of the OTA onlineweg.de by using eye-tracking within the toolbox of user experience research methods. Therefore, booking processes, other essential customer processes, information architecture and given digital content of the portal will be analysed to understand the needs within the target group of millennials. The relevant needs of the target group will be modelled through personas and user tasks. Specific task setting is important for eye-tracking studies due to the fact that gaze behaviour depends essentially on users' goals using the website. These user tasks are tested and analysed via eye-tracking in the digital lab of the faculty of tourism. In addition, and to support the results of the eye-tracking study, more qualitative aspects of the user experience will be obtained by interviews. The findings are summarized in suggestions on how to improve usability, conversion rate and time on site of the website onlineweg.de.

Keywords User experience · Eye-tracking · Conversion rate optimization · Retrospective think aloud · Online travel agency

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1 Introduction

Online travel agencies (OTA) vigorously compete on the Internet for the attention, visits and ultimately bookings of travellers of the services offered through these intermediaries. One of the essential differentiators of the services provided by OTAs—besides the breadth of coverage of travel companies—is the ease of using these online travel portals, their usability. Poor usability directly translates into low conversion rates, i.e. low revenues and profits. For OTAs to grow, it is critical to remove any usability problems for the target customer groups, who demand the high margin travel products. Clearly, for improving the financial performance of an OTA, one needs to start with identifying high-margin travel products. Then for these products, the most promising customer groups must be characterized. And finally, the user experience for these identified customer groups when they shop on the platform must be continuously improved.

This chapter has several objectives. The first one is to identify usability problems for a real-life existing OTA (onlineweg.de), which prevent potential users who visit the page from booking a travel service. Problems that are the result of poor software and web design require changes to the existing structure. For communicating the case for change compellingly to the team members in marketing and IT of the firm, the study must generate objective, quantitative data. Eye-tracking generates such objective, quantitative data. The second objective is to quantify the economic losses that the usability problems cause for the firm, or, to express this in another way: the study will try to ascertain the economic gain that conversion improvements will be generating for the firm.

The third objective goes beyond this individual case study. Our aim is to make the process transparent, which leads to conversion improvements because understanding this process and learning the necessary steps involved is important in general for all the conversion improvements yet to come. Then our fourth objective concerns a commonly heard prejudice against eye-tracking that claims this method would be too advanced, sophisticated and time consuming to be of any practical use outside of the university. Therefore, it is our objective to prove that the educational demands for staff members of a firm, who are conducting usability studies with eye-tracking are at reasonable levels. A team of 14 young university students at the University of Applied Sciences Munich conducted many of the steps involved in gathering the qualitative data (through the so-called “Retrospective Think Aloud” technique) and the quantitative data through the eye-tracking method.[1] While they did receive training and on-going support for their project work from the authors of the present chapter, their work results used for the present study were substantial enough to

[1]Think aloud methods are often used when trying to detect usability problems. The most successful form of think aloud to use together with an eye-tracker is a retrospective think aloud methodology (RTA), which means that participants verbalize their thoughts after completing a task or a set of tasks. RTA allows the participant to complete a task on their own and in silence. More details can be found in the Tobii Technology AB (2009) Whitepaper on RTA.

prove that the necessary knowledge and skills can be learned and acquired within a relatively short period of time.

In order to achieve these objectives, our study will show in chapter "A Review of Eye-Tracking Methods in Tourism Research", a brief overview of the OTA onlineweg.de and its market environment in terms of the growth of e-tourism related to OTAs and the intensity of dynamic competition among them. We also focus on one of the key customer groups for onlineweg.de, which results from the identification of some of the travel products with higher margins. Thereby, the two essential elements of improving usability have been put in place: the travel products and the relevant customer groups. Chapter "Best Practices for Eye-tracking Studies: DOs and DON'Ts" gives a literature review of the relevant sources for conducting the applied research which follows in the subsequent chapters. The methodological issues are discussed in chapter "Eye Tracking: Evaluation, Potential and Limitations of Field Applications", which concern selecting and recruiting the test users and the process of gathering the qualitative and quantitative data through RTA and eye-tracking, respectively. Two different use cases are employed in our study and we present them in chapter "Knowledge Co-Creation through Eye Tracking in Tourism". The results of the eye-tracking analysis are discussed in detail in chapter "The Relevance of Eye-Tracking to Understand Users' Practices and Content Interpretation in Tourism-related Online Navigation" for both use cases separately. In addition to these results, in chapter "Areas of Interest on Destination Websites: A Generation Y's Perspective" we summarize the general assessment of the quality of onlineweg.de by the test users. From these results, we give in chapter "Measurement of Visual Attention to Advertising Using Eye-Tracking Techniques" a number of recommendations on how to improve the conversion rate. This chapter answers the question of whether we did achieve our objectives.

2 The Market Environment of the Multichannel E-Commerce Company Onlineweg.de

Onlineweg.de is not just a self-service online portal for booking travels. It also serves travel agents, who work in the firm's network of 1280 travel agent bureaus nationwide and who sell directly offline to customers. Such a multichannel approach has several advantages as compared to a pure online company. First of all, travel agents can help to sell higher margin products through bundling travel services, which reduces price transparency but also increases the recreational value for customers. Secondly, customers cannot search for truly innovative travel services because—by definition—they do not know the appropriate search terms yet. Papathanassis (2011), for example, discusses many of these innovations in the travel industry. Especially for innovative travels, do-it-yourself travels are oftentimes risky—in terms of quality uncertainty—and disappointing for travellers. Thirdly, travelling is information intensive in terms of quality characteristics that customers are often

not aware of before the start of the travel. And the suitability of a travel depends very much on personal preferences. Thereby, travel agents can add real value to travellers' vacation experience. Another countervailing trend for do-it-yourself travels which supports instead the latent demand for organized travels is the ageing of our society and the rising loneliness of elderly people, who can meet people with similar interests and mindsets through travel. These advantages of a multichannel approach to OTAs notwithstanding, the present study focuses on the market of younger unassisted self-service customers, who can easily switch between competing OTAs. The underlying assumption here is that they would be less forgiving when it comes to poor design of OTAs.

2.1 The Growth of E-Tourism in Germany

Our study will use a technology for improving conversion rates which is still rather novel for the tourism industry as will become obvious from our literature review in chapter "Best Practices for Eye-tracking Studies: DOs and DON'Ts". For a number of years, the academic community has been researching the potential and actual impact of information and communication technologies on tourism. For example, the articles in the yearly conference proceedings of the International Federation for IT and Travel & Tourism (IFITT) document the lively academic discussions among scholars from various academic fields. In the 2015 edition edited by Tussyadiah and Inversini (2015), two of the articles deal with eye-tracking applications in tourism.

Overall, the growing research in this area is supported by the growth of the travel and tourism industry worldwide and by the information intensity of travel choices. The latter offers a large number of productive applications for ICT. What seems simple is anything but: Few consumer choices are as complex and information intensive as holiday trips. And the internet is ideally suited to serve these information needs globally. As users' experiences with online information sources grow, so does the use of specialized tourism information sources like, for instance, Tripadvisor.de.

2.2 Dynamic Competition Among Online Travel Agencies

After gathering information about the next tourist destination, consumers can stay on the Internet and book their hotel and trip through online travel agencies (OTAs). Since many businesses in the travel and tourist industry like airlines apply price discrimination based on passenger data to optimize their revenues, consumers use Internet technology to minimize their expenses by comparing rates provided by OTAs. Since online booking has grown into a large market, there are several providers that compete vigorously for market share.

Figure 1 shows the Internet search volume on Google for three of the largest OTAs in Germany from the beginning of 2004 to September 2017: HRS (Hotel

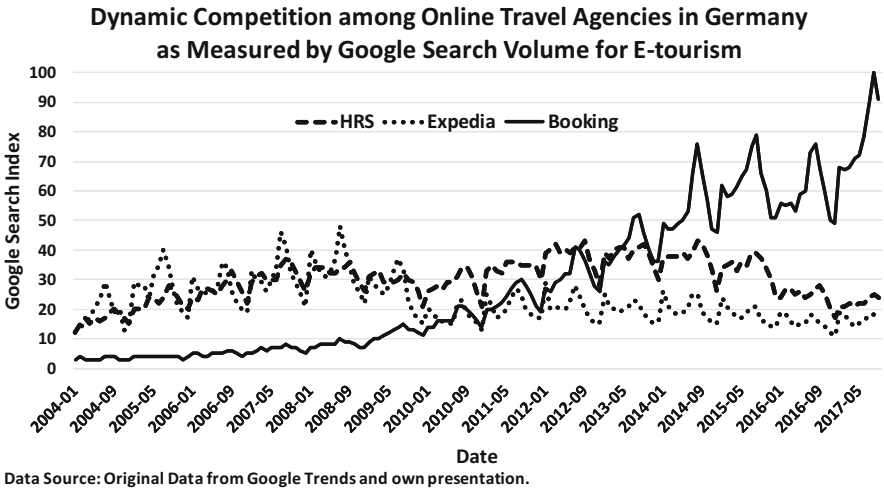

Fig. 1 The growth and decline of three OTAs in Germany

Reservation Service), Expedia and Booking. The search volume is an indicator of their market shares. The graph shows that the market leader position changed three times during the time period covered by the data. Expedia was the leader among the three up until August 2008. Then between September 2008 and March 2013, HRS became the market leader, and after that Booking, which had a rather late start but a very consistent growth path, left its competitors behind and took the undisputed Number One position. This shows how intense dynamic competition is in the OTA market and how difficult it is to maintain market leadership.

The set of hotels that are included in each of the OTAs are very much the same, but what differentiates them are dimensions like the information provided and their usability. For an OTA, improving the usability is not just a "nice to have" feature, but a matter of competitiveness of the highest priority. The owners demand an honest and blunt analysis of their site's usability and do not welcome the systematic underreporting of usability problems, which might please the management but hurt the bottom line of the firm. The best way to prevent the systematic underreporting of usability problems is the application of eye-tracking, instead of exclusively relying on the so-called "think aloud" technique, which can result in underreporting of usability problems.

2.3 Highlighting a Key Target Group for Onlineweg.de

For the process of continuously improving the usability of a website it makes sense to focus on a group of more internet savvy users because if they have problems, all others will. Therefore, for the target group of the present study "Generation Y", also

called Millennials, was chosen. This population cohort was born between 1980 and 1999 and raised during unprecedented levels of peace and prosperity. They largely lack any direct personal experiences with major economic or political crises in Germany like the famine after WWII or the cold war. They also could not gain such experiences indirectly through the eye-witness reports of their parents and grandparents anymore. This makes it difficult for them to properly comprehend the fragility of peace and democracy outside of their home country.

At the same time, they are more actively using the Internet, social media and computer technologies than older generations do. According to a recent market study by the German market research firm GfK (2017), this group is relatively higher in booking travel online. They book more than 50% of their trips online, and they prefer shorter and cheaper trips. Travel packages are less popular among this age group than among older people. They prefer to organize their travel themselves.

3 Literature Review

While the use of eye-tracking in academic research has been going on for decades, its application in tourism research is still somewhat recent. Yet for usability studies, eye-tracking has become a well-established method. An important issue for hotels is the online available reviews of former customers and their impact on new bookings. Aicher et al. (2016) show with their eye-tracking study that rating symbols are given higher attention and therefore priority on hotel review platforms than written comments, and the ratio of positive and negative reviews only partially impacts customers' booking decisions. The dark side of reviews of prior customers is fake reviews and their impact on competitors. Lappas et al. (2016) addressed in their study the impact that different attack strategies using fake reviews can have on the ranking of hotels. Using a large database, they show the enormous vulnerability of the competitiveness of individual hotels to fake reviews.

How can tourist destinations that invested heavily in new attractions and infrastructure but that are not yet trendy attract new customers? Search engine optimisation is quite powerless here because it completely depends on what people are searching for. The only way out is to use online advertising that draws the attention of potential customers. Unfortunately, the eye-tracking evidence about the ineffectiveness of banners is so unanimous that it resulted in coining a new term: "banner blindness". Despite these negative results, Hernández-Méndez and Muñoz-Leiva (2015) conducted an eye-tracking study about the effectiveness of different designs of online advertisements for the hospitality industry. Their results show differential attention to text versus images and static versus animated banner advertising. Another source of inspiration that travellers receive for visiting new destinations is social media sources. In using eye-tracking, Marchiori and Cantoni (2015) studied tourism-related web browsing behaviour on social media pages that is formative for travellers' preferences for travel destinations.

Noone and Robson (2014a, b) examined individuals' eye movements during the two major stages while booking a hotel online, which are browsing and deliberation of actually booking a hotel. Their studies reveal the differences in attention that customers devote to the different information items during different phases of the purchase choice process. Pan et al. (2013) and Pan and Zhang (2016) studied the factors that influence consumers' attention when selecting a hotel, such as the page position of hotels, the number of options and the images presented. It turned out that images reduced the problem of information overload and helped to increase the hotel's appeal to customers when it does not excel in terms of other criteria. Hao et al. (2015) also used eye-tracking for identifying the elements (a large main picture and little text) that make hotel websites visually appealing to Chinese generation Y customers.

Vryona (2014) studied in his doctoral dissertation, where he used eye-tracking, the process of customers' decision-making when they make hotel online reservations. He identified the so-called Customers' Critical Information Requirements (CCIRs) which impact customers' decision-making process when they book their hotel online. Aldi (2015) examined in her master thesis the usability of the booking procedure on three four-star hotel websites, which are all located in Lugano (Switzerland). She derives from the results of her eye-tracking analysis a series of usability guidelines that are applicable to the design of the hotel booking process.

On the methodological side, it is important to note that the common use of the so-called "think aloud" technique in usability studies can have very serious shortcomings if it is used without eye-tracking. These shortcomings can result in *systematically underreporting* the true usability problems for the target users. The methods' shortcomings can arise, for example, from (i) a high-power distance between the usability analyst and the user, or from (ii) problems of users' lacking reading comprehension, which falls short of the level of reading competencies required for the text. The first problem has been pointed out, for instance by Email and Ahmad (2014), who conducted usability research with and without eye-tracking for websites in Malaysia. They (2014, p. 268) write:

> Due to the power distance that is already present in the Malaysian culture, the user during the Think Aloud (TA) process sees the moderator as a supervisor and hence has a tendency to be afraid in disagreeing in the effectiveness, efficiency and satisfaction of degree of usability of a website under test. This is one reason why Think Aloud (TA) technique alone may not be suitable and reliable in usability studies in Malaysia.

The German society has become increasingly diverse over the last two decades, and the share of people from countries with a much higher power distance than the one which is common among German-born university graduates has been growing continuously. That share is even higher among younger population groups like the millennials than among the total population.

The magnitude of problem (ii) is largely overlooked in public as well as academic discussions. Usability professionals typically have a university degree and most of their friends and acquaintances have received a similarly advanced education. This often results in selected attention towards the groups to which they belong

themselves and lack of understanding for other groups. According to the so-called "Level One" study (Grotlüschen and Riekmann (2012)), there are about 20 million people in Germany whose reading competencies are too low to comprehend relatively simple texts, which typically can be found in written information published by businesses and government authorities. In other words, one in four people in Germany cannot understand the texts on a normal webpage! *The complexities of the German language are a usability barrier of the first order.* And that is true qualitatively and quantitatively. Yet highly educated UX professionals should not expect to receive an honest answer from test users when they ask the question: "Now, did you understand the text well?" If they did, they will say "Yes.", but if they did not because they lack the reading competency, they will rarely if ever admit this since such inabilities are highly stigmatized in a society that is built on education. *Both problems (i) and (ii) result in systematic underreporting of usability problems, but eye-tracking will reveal them truthfully for obvious reasons*.

However, the potential applications of eye-tracking in the tourism industry far exceed its use for usability studies. There are at least five other applications that immediately come to mind here. One of the recent technological advances is the use of augmented reality through smart glasses in museums. And eye-tracking is used in smart glasses for the control of the augmented reality presented. Another application is visual merchandising and the design of hotel rooms and hotel entry halls. As is well known, the first impression of the interior architecture has an important and lasting impact on the visual appeal and, therefore, on the brand image of luxury hotels. Eye-tracking also records the sequence of fixations and thereby tracks peoples' very first looks. Tourism services are experiential services that address the emotions, and the emotional value of these services translates into financial value. Emotional reactions can be directly observed through the changes of the pupil with eye-trackers. A further application of eye-tracking in the tourism industry can solve a common problem that travellers encounter in airports and railway stations, which is spatial orientation. Eye-tracking with mobile eye-trackers has been successfully employed for improving the way-finding usability of the interior design of these buildings. And finally, eye-tracking has been used for improving the design and usability of geographic maps. Clearly, eye-tracking applications in the tourism industry are not limited to usability studies. However, our chapter is focused on the use of eye-tracking for improving the usability of online travel agencies, and we, therefore, limit our literature review to publications in this area.

4 Methodological Approach

For our study, we applied qualitative sampling where only a small number of test users are included, yet for each of them, detailed qualitative information was gathered through the Retrospective Think Aloud (RTA) technique (i.e. showing the respondents their gaze replay and discussing this aloud) and eye-tracking, which was then analysed in depth. Such an approach is suitable for usability studies

because their aim is not to infer averages of important characteristics of the total population, but to identify as many usability problems as possible, since any such problem can result in a lost conversion.

Our methodological approach combined the Retrospective Think Aloud (RTA) technique for gathering subjective data as well as eye-tracking for quantitative, objective data in order to reveal as many usability problems as possible. Before we go into the details of applying these two methods, we cover the selection of test users, their recruitment and the process of gathering data from them.[2]

4.1 Selecting the Test Users

For selecting the test users, we applied qualitative sampling, where we made sure that the personal characteristics of the people selected coincide with the characteristics of the target group. For achieving this, we used three socio-demographic characteristics:

- Age
- Gender
- The highest educational degree achieved

We included 21 test users (TUs) in our sample with the following distribution of the socio-demographic characteristics:

- Gender: 11 female and 10 male TUs
- Age: Born between 1980 and 1989, 11 TUs and 1990–1999, 10 TUs
- Highest educational degree achieved:
  - 14.3% of the millennials are still in school (3 of 21 TUs)
  - 14.3% of the millennials have 9 years of school (3 of 21 TUs)
  - 33.3% of the millennials have 10 years of school (7 of 21 TUs)
  - 38.1% of the millennials have a high school diploma (8 of 21 TUs)

4.2 Recruiting the Test Users

Test users were recruited through social networks and by directly approaching individuals, who might be suitable for inclusion. Each of them filled out a questionnaire, which determined the suitability of the person for becoming a test user.

[2]Good introductions to performing an eye-tracking analysis for a usability study can be found in books like Bergstrom and Schall (2014), Bojko (2013), in Duchowski (2007), Pernice and Nielsen (2009) and in the articles by Bojko (2005) and Katsanos et al. (2010).

4.3 Data Collection

The test persons were invited to the Digital Lab of the Tourism Department of the University of Applied Sciences Munich. In order to provide a comfortable and relaxed seating position, height-adjustable seats were used. Before beginning the eye-tracking test, the eye-tracker had to be calibrated by applying the so-called five-point calibration. Following this, the gaze points were analysed, and in case the calibration turned out to be imprecise, the procedure was repeated. The screen then showed a description of the task. Furthermore, the test users received printouts describing the tasks.

The use cases were always conducted in the same sequence. After completion, the Retrospective Think Aloud (RTA) technique was applied and each test user then watched the recorded video of their own session including their own gaze replay. Using some written instructions test users were asked questions—including two open questions—about suspected usability problems. The video recordings during the task completion and the discussion of the RTA were recorded.

5 The Use Cases Studied

Specific user tasks are important for eye-tracking studies due to the fact that gaze behaviour depends essentially on users' intentions using the website. These use cases are tested and analysed via eye-tracking in the digital lab of the faculty of tourism. In addition, and to support the results of the eye-tracking study, more qualitative aspects of the user experience have been obtained through interviews. The findings are summarized in suggestions on how to improve usability, conversion rate and time on site of the website onlineweg.de.

The selection of user tasks applied two criteria: relevance for the target group of millennials and profitability for the OTA per customer. Thereby, two user tasks were set: (1) a city trip with the railroad including a musical ticket and (2) a travel package below € 300. These tasks were checked in a pre-test. Because the original tests took too much time, use case (1) was simplified to a more straight-forward hotel booking process.

5.1 Characterization of Task (1)

The test users were tasked with booking a city trip to Hamburg. The choice of a particular arrival and departure airport were excluded (because flight bookings are irrelevant for this OTA). The city trip was to take place in July because this month is ideal for such trips. Furthermore, the test user is supposed to make a reservation for two travellers in a hotel with at least four stars and should select the first hotels that

appear to keep the case simple. The task ends as soon as the request for personal data appears. For the first task, test users needed about 15 min:

- Theme: city trip
- Destination: Hamburg
- Time: July
- Number of overnight stays: 1
- Quality of the hotel: at least 4 stars
- Number of travellers: 2

Usability Challenge
When booking a hotel, the selection of the search frame (search mask) is decisive. On the start page of onlineweg.de appears a search mask, which should be used for booking travel packages. At this point, it is important that the user finds the search mask for hotels. Otherwise, he will be offered flights only, which does not correspond to the task. The second source of problems arises when choosing a hotel to select the option "dates and prices" instead of "hotel description". Here, the user finds no option for booking the selected hotel but has to return to the list of hotels.

5.2 Characterization of Task (2)

The task set here was to book the cheapest travel package for two people below € 300. The travel should go to Turkey since there are right now—for obvious reasons—many extremely cheap offers. The time window was set to be September, the number of overnight stays at least five, and the quality of the hotel at least three stars. The departure airport was left open since this added flexibility offers the option to realize a lower price. The meals option included breakfast and dinner. The test user was tasked with selecting the cheapest offer suggested. Again, the use case ended as soon as the input of personal data is requested, and the time requirement to complete the case was also about 15 min:

- Theme: cheapest travel package
- Destination: Turkey
- Time: September
- Number of overnight stays: at least 5
- Quality of the hotel: at least 3 stars
- Number of travellers: 2

Usability Challenge
As for the first task, when starting onlineweg.de the search mask for travel packages opens. The test user then has either the option of using this search mask through selecting the appropriate price range, or can use the search mask of the category "travels up to € 300". One hurdle in this task is the selection of the period and the duration of the travel. Both items have to be entered separately and during our initial analysis, the travel duration was often overlooked and not changed. This can make it

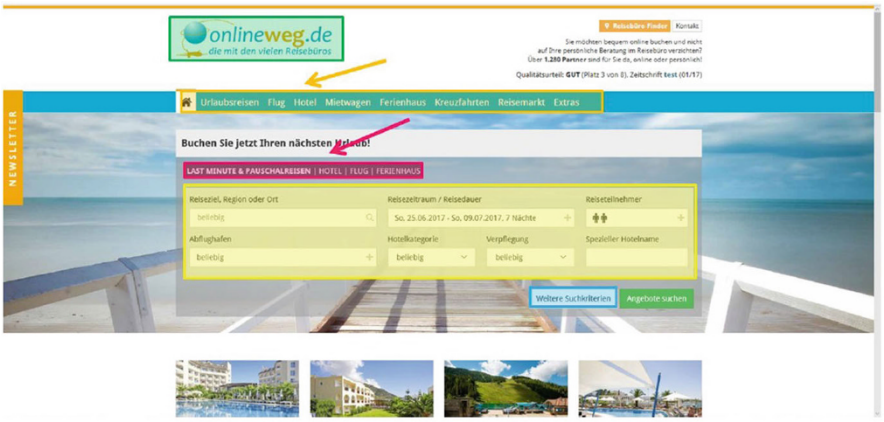

Fig. 2 Areas of interest on the main page

difficult for the test user to find a travel with five overnight stays. At the end of the booking process, the total price is shown for both travellers, while up to then only the price per person is displayed, which can lead to confusion.

6 Results of the Eye-Tracking Analysis

In order to conduct an eye-tracking analysis, so-called "areas of interest" (AOIs) have to be specified.[3] These areas are set manually and are placed at specific regions within the video recordings. Thereby, the attention different users give these AOIs can be objectively recorded, compared and statistically analysed. On the main page of onlineweg.de, seven such AOIs were defined, which are highlighted by colours in Fig. 2: the logo (green), the upper list with options (orange) with the selection option "hotel" (orange arrow), the lower list with options (pink) with the selection option "hotel" (pink arrow), the search field (yellow), and the button for "more search criteria" (blue). The latter is especially relevant for detecting problem no. 1. Several different eye-tracking metrics were chosen: time to first fixation, fixation time, visit duration, time to first mouse click and mouse click count.

6.1 Task (1)

Task (1) did consist of 21 test users. According to the recorded eye-tracking data, all noticed the search field (yellow). This AOI had been discovered for the first time

[3]For conducting the eye-tracking study, we used an eye-tracker from Tobii, model X2-60.

after 3.6 s on average and was selected with a mouse click after 9 s. Only 10 test users noticed the upper list with options (orange) after 14 s. The average fixation lasted 0.65 s, but only three test users looked at the button "hotel" (orange arrow), and only they clicked on this button and did not move through the search field (yellow).[4] Out of 20 test users, 18 noticed the lower list with options (pink) and had at least one fixation in this AOI with the fixation lasting 0.4 s. Only five test users paid attention to the selection option "hotel" (pink arrow) and only one of them clicked on this button.

Consequently, 17 test users (80%) worked their way through the search field, and only 4 were choosing the hotel button. The RTA confirms this problem. Seventy-five percent of the test users went through the search field (yellow) and said they had not noticed the hotel buttons. The rest did not pay any attention to it. One-quarter of the test users which searched via the search field (yellow) then later noticed that by following this path they could not finalize their purchase. The short fixations on the upper and lower list with options (orange and pink, respectively) and the comments during the RTA session suggest that they did not notice the hotel buttons and, therefore, went through the search field. It is, however incorrect to view this as a "user mistake" because users have expectations on how to proceed on such e-commerce websites, and when the designers did not anticipate the users' expectations and how they are accustomed to navigate such sites, then one should rather speak of a "designer mistake", especially if the majority of users proceeded this way.

Another problem occurred because the button for booking can be accessed only through dates/prices but not through the hotel description. In summary, four test users terminated the booking task because of problem no. 1 and eight test users arrived at an unintended result. Therefore, 60% of the users would not have booked any travel.

6.2 Task (2)

The total number of test users in task (2) is 20 because the data from the test user no. 17 had to be excluded from the analysis. None of them used the button "Travels below 299", which would require the use of the upper list with options (orange) including the selection option "hotel" (orange arrow). Eighty percent of the test users began the task via the search mask for travel packages. Nineteen out of 20 noticed the search field after about 3 s. There were 10 and 12 test users with fixations at the upper and lower list with options, respectively, which is less than in use case (1). Probably because of the task of booking a travel package many went immediately to this search field.

Fifteen percent of the test users used the sequence of buttons holiday travel → package travel. One test user completed the wrong task and booked a hotel instead of

[4] All data given in seconds here refer to average values across all test users.

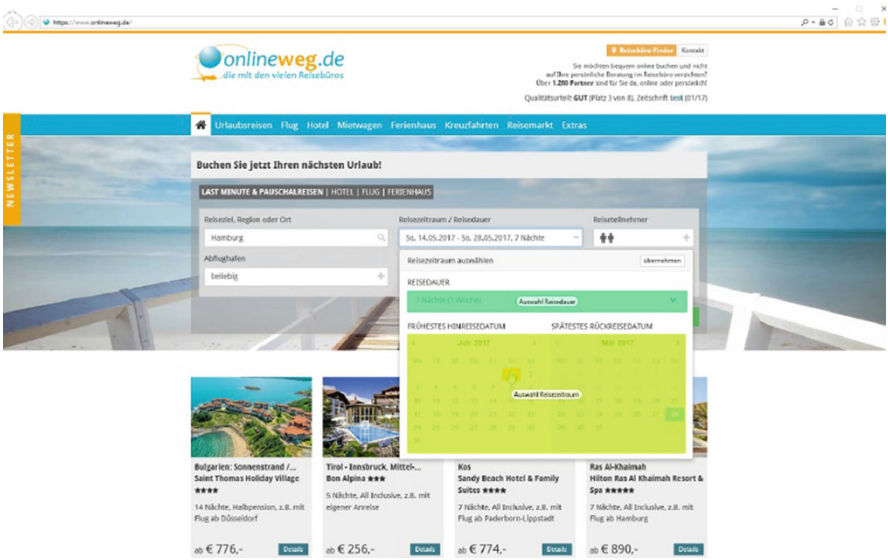

Fig. 3 Areas of interest on the main page—selection travel dates within the dropdown menu for the travel duration and the travel dates

a holiday package. Problem no. 3 did concern the entry of the travel dates and the travel duration. One-quarter of the test users filled out only one field. Some of the test users did notice the field "travel duration", but did not click on it. This leaves 75% of the test users who filled out the travel dates and the travel duration, but 46% of them did not completely fill out the required fields (for example, instead of precisely 5 nights, the input read 5–8 nights), or test users were initially confused by the system. For the selection "travel duration" fixations from all test users were recorded. Figures 3 and 4 give screenshots of these fields in the dropdown menu that cause these problems when choosing the travel dates and the travel duration, respectively.

When we look at the heat map for the use case (2) (Fig. 5), we notice that the fields "travel dates" and "travel duration" (Fig. 6)—which open up as a dropdown when clicking on these field in the search field (yellow) on the first page—belong to those AOIs that received the second largest attention. This is surprising because the data showed that only 75% of the test users clicked on these fields.

Several intensive centres of fixations within the dropdown menu of the travel duration become visible in the heat map (Fig. 6). The largest such centre occurs at the default option of 7 days in the upper highlighted area. The second-largest centre is the selection option 5–8 nights, which leads to one of the major problems. Much lower attention was given to the option of 5 nights, which was a part of task (2). The apparent complexity of the choice of the travel dates and the travel duration was not only confirmed through erroneous data input and overlooked fields but also through the concurrent RTA. Another potential problem, which was no. 4—lacking

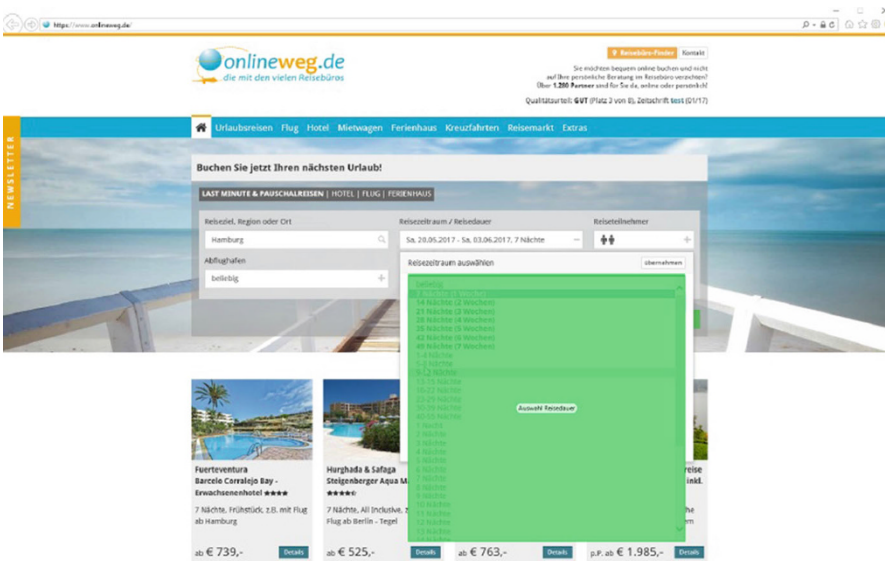

Fig. 4 Areas of interest on the main page—selection travel duration within the dropdown menu for the travel duration and the travel dates

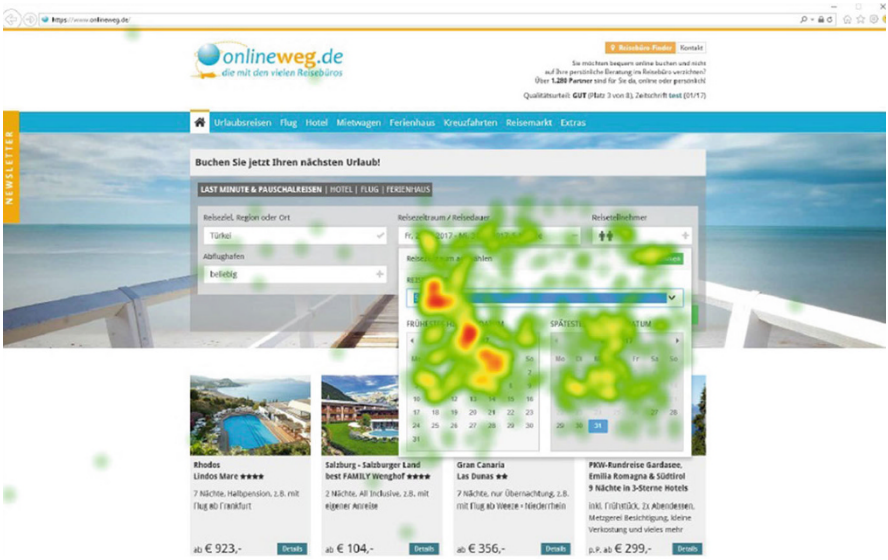

Fig. 5 Corresponding heat map for the travel dates within the dropdown menu

comprehension of the total costs of the travel—was not relevant because all test users viewed this as easily comprehensible. All in all, 25% of the test users could not complete task 2 or reached a wrong result in the end.

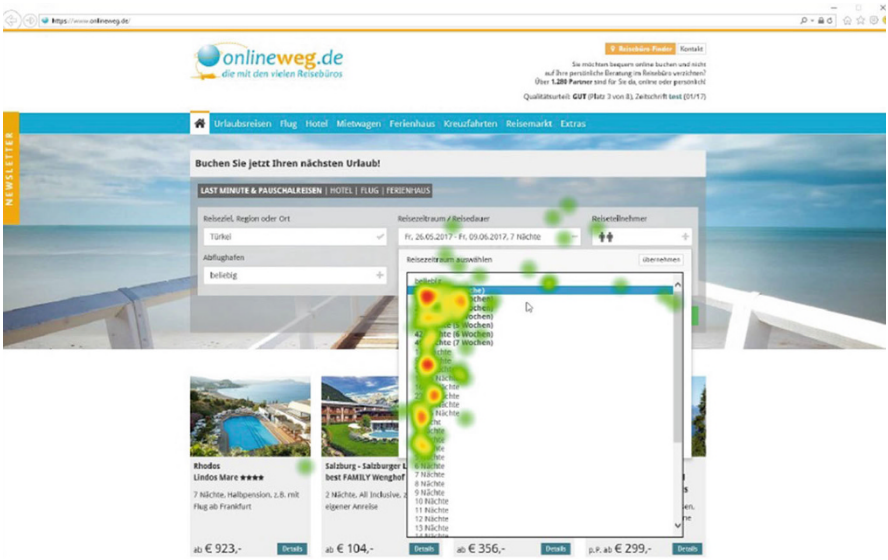

Fig. 6 Corresponding heat map for the travel duration within the dropdown menu

Table 1 Areas of interest metrics

Area of interest		Use case (1)	Use case (2)
Dropdown menu for travel duration	Time to first mouse click	0.46 s	1.03 s
	Visit duration	2.66 s	3.12 s
Selection for travel duration	Time to first mouse click	6.51 s	6.54 s
	Visit duration	1.85 s	1.85 s

Since all test users first completed use case (1) and then use case (2), one might suspect some learning effects could reduce usability problems. Eye-tracking data also records time data such as the time to the first mouse click and the visit duration, and one can detect such learning effects from changed time data recordings between the two cases. And indeed, from the eye-tracking time data it was apparent that the test users noticed all lists, buttons or the search fields on the first page faster in task (2) than in task (1), i.e. the time to first fixation was lower.

However, for one of the usability problems (the choice of travel duration) the time data from the eye-tracking recordings, which are shown in Table 1, does not reveal any obvious differences between the two tasks. The time data of the eye-tracking recording clearly reveals from the longer visit duration within the dropdown menu (3.12 s) as compared to the visit duration for the selection of the travel duration (1.85 s) that test users were confused, resulting in the wrong data entry which resulted from these comprehension problems.

7 General Assessment of the Quality of Onlineweg.de by the Test Users

Besides the information obtained from the test users through eye-tracking and RTA, their judgement of the quality of this OTA and their willingness to book a travel with onlineweg.de is, of course, also important for the owners of the firm. Besides these standard answers as reported in Tables 2 and 3, test users also gave open text answers assessing the strong and weak points of the website.

The most important objective of the present study is the improvement of conversion rates. For achieving this objective, every negative statement, complaint or critical point needs to be taken very seriously. For different people, different problems might be a condition sine qua non. If, for example, 40% of test users were voicing problems that are all different, then the average share of users for each complaint will be rather small, but disregarding each of the problems would then result in a loss of conversion of 40%, which is anything but small. Consequently, maximizing conversion rates requires to "win'em all", i.e. to win all customers and to listen to each of them.

Positive (3 test users)
- Clarity of the website
- Very good pictures and customer reviews for the hotels
- No banner ads

Negative
- Confusing (30% of the TUs).
- Too many different options/paths lead to the same result (2 TUs).
- Could not find the price selection option (2 TUs).
- The search criteria do not adjust automatically (2 TUs).
- The travel duration did not adjust automatically from the input of the travel dates (2 TUs).
- The input of the dates is easier on competing OTAs (1 TU).
- It takes too much time to finish the booking process (1 TU).
- No choice option for the hotel category was given (1 TU).

Table 2 Judgement of the quality of onlineweg.de

Judgement	Share of answers (%)
Good and no complaints	30
Good but with some complaints	30
Mediocre/average	20
Bad	20

Table 3 Judgement of the quality of onlineweg.de

Willingness to book a travel	Share of answers (%)
Yes	60
No	20
Maybe	20

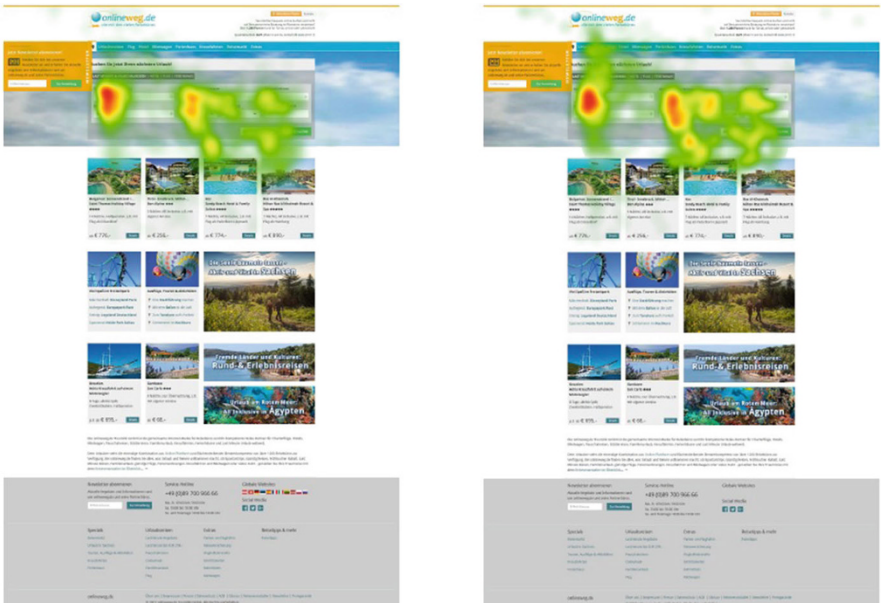

Fig. 7 Heat map of the start page

- The hotel button was not clear enough (1 TU).
- Some of the fields' functions are unclear (1 TU).

Other eye-tracking recordings indicate that in both tasks test users only looked at the upper third of the start page (Fig. 7). Yet this might be also due to the fact that the test users did not freely surf around but were completing a given task. More importantly, 20% of the test users could not remember the logo or the name of the firm, which is confirmed through the eye-tracking data because in use case (1) and (2) just 6 test users, respectively, looked at the logo with a fixation duration of 0.25 s.

8 Recommendations for Improvements

First of all, one should emphasize that web-form design is anything but trivial. There are many details that make it or break it. Yet user-friendly web-form design is the key step for a high conversion rate, or put another way around: A user-*un*friendly web-form design costs firms a lot of money. It therefore really pays off, to first learn about the dos and don'ts of web-form user-friendliness, before designing a web-form. Or, if there are already web-forms in place at the firm's website, one must evaluate the existing ones in a customer-oriented, self-critical way, comparing the realized design with the recommendations given in the literature about the principles of web-form design principles, such as Wroblewski (2008).

Several studies have used eye-tracking for examining the usability of web-forms. For example, Bergstrom and Schall (2014) devote an entire chapter (Chapter 5: Forms and Surveys) to web-forms in their book about eye-tracking for the improvement of user experience design. While there are many guidelines for web-form designs, much of it is just based on personal opinions of usability professionals and anecdotal evidence from usability testing, as pointed out by Bojko and Schumacher (2008). They systematically evaluate the layouts of five different web-forms through a combination of usability and eye-tracking. Thereby, they measure objectively user behaviour and their eye movements and gather users' subjective self-reports. Seckler et al. (2013, 2014) also used eye-tracking for evaluating the usability improvements of 20 guidelines for the design of interactive online forms. Their studies show that improving the design of web-forms results in faster completion times, fewer form submission trials and fewer eye movements. They also combine their eye-tracking study with user interviews, which show increased satisfaction. Another issue of usability of website design besides web-forms, which is especially relevant for websites with many sections like onlineweg.de, is navigation. In using eye-tracking, Leuthold et al. (2011) evaluated how different navigation systems impact user performance, navigation strategy and subjective preference. The different navigation systems they considered in their eye-tracking study varied with respect to their navigation designs (vertical versus dynamic menus) and the complexity of the tasks they have to serve (simple versus complex navigation tasks). It turned out that vertical menus were more user-friendly since eye-tracking recorded objectively that users needed fewer eye fixations and completed tasks faster and more successfully.

In our own study, we used the RTA technique and the eye-tracking method, which revealed a number of usability problems of the web-forms of onlineweg.de. These problems unnecessarily reduce the conversion rate. Two problem major areas have been identified and for those, we present more in an exemplary than in a comprehensive fashion some recommendations for improvements.

Hotel Booking

The booking process was frequently terminated because by using the wrong search mask, test users received no or wrong results. A button for "hotels" should be highly visible in the upper and lower search mask. Thereby, visitors would be directly guided towards the appropriate search mask and the booking process would become much easier.

Travel Package

The location of the search mask for travel packages on the start page simplifies the booking process for such travels. However, the input of the travel time and the travel duration is not user-friendly because these two fields have to be filled out separately. This is an unnecessary complication since the system can be programmed to calculate the travel duration automatically once the dates have been specified. Often one field is overlooked or disregarded, which causes results that customers do not want.

Impatient customers will terminate the booking process. They do not want to learn the website's booking system, but correctly expect that the website's designers and developers should learn instead how customers typically proceed. This is a good example of how incomplete software development reduces the financial results of the firm. There are numerous ways to complete the unfinished software development task and to bring the user-friendliness up to the standards of its competitors. Here, the old word: "Customer is king" truly holds. It is not the customer who has to adjust to the software developer, but vice-è-versa.

9 Conclusion

Now, did we achieve our objectives which we outlined in the introduction? Our first objective is the identification of usability problems for a real-life existing OTA, the company onlineweg.de. The results of the two set tasks unambiguously show that the very beginning of the booking process is already hampered because users are typically unaware of the problem that they are in the wrong search mask. Another problem arises from the difficulty of choosing the duration and time period of the travel, which caused confusion and frustration with most users. This confirms the presumed problem no. 1 (wrong search field) and problem no. 3 (wrong input of duration and time period of the travel). Even users from the group of millennials, who are the most Internet savvy got lost in the booking process because of these problems and would have most likely terminated their booking process. In conclusion, we might say that a simple, immediately transparent booking path is critical for a high conversion rate on OTAs. Even the very beginning of the booking process should minimize users' efforts and must avoid any frustration or confusion in order to keep the termination rate as low as possible.

Our second objective is to quantify the economic gain quantitatively that conversion improvements will generate for the firm. Our study shows that these gains will be very substantial. In task 1, 60% of the users would not have booked any travel! And in task 2, 25% of the test users could not complete the booking process successfully or reached a wrong result in the end.

The term "conversion rate optimisation" brings the attention of the business community to the simple fact that "search engine optimisation" is certainly not enough to guarantee online business success. We understand "conversion rate optimisation" as "conversion rate *improvement*" and it is the ongoing process of continuing improvements that matter. Therefore, the issue is not to "optimize" the conversion rate because the optimum cannot be really specified. The task is rather to continuously *improve* the conversion rate. Customer groups change as new and innovative tourist services enter the offered product portfolio. Navigation experience and expectations of customers also change over time due to changes in competitors' website design. And technologies change over time like the growing use of mobile devices with their small displays for purchasing online. Using eye-tracking research

to continuously improve the conversion rate is therefore adamant for any online shop, and specifically of course for the tourism industry.

With our third objective, we made the steps for administering a usability study with the eye-tracking method transparent, since it is this process that is important for future applications of usability studies with eye-tracking for OTAs, rather than the individual case. All in all, the results show that it is the combination of the Retrospective Think Aloud (RTA) technique and the eye-tracking method which reveals:

- Where users stumble upon usability problems
- Where users became aware of such problems
- What users noticed and what they overlocked and therefore, were unaware and could not voice them in the RTA session

What makes the individual case of a real-life usability study with eye-tracking valuable (like the one presented here) is the fact that it reveals typical problems of imperfect websites and suboptimal business practice—instead of discussing ideal and imaginary business worlds that are so often far away from business realities. Our case study shows that the eye-tracking method is an efficient and effective solution for studying users' behaviour and perception. From the data gathered (fixation, duration, and their sequence) one can infer the visual perception of users. In this case study, the eye-tracking data recorded clearly revealed how most of the users overlooked in task (1) the button for hotels in the upper as well as in the lower list of commands. This led to erroneous booking results. Moreover, task (2) nobody booked through the option "travels up to € 299", which the eye-tracking explained by the lack of any recorded fixations there. Additionally, fixations of the dropdown menu for the travel duration was also nearly zero.

Finally, with our fourth objective, we sought to demonstrate convincingly that the research technology and methodology for usability studies using eye-tracking has sufficiently matured so that entry-level researchers with a rather limited time budget can generate productive results. Such studies will be adopted into business practice more often if incumbent employees participate in this work. We report here about the study results of a group of 14 university students, which shows realistically what novice eye-tracking researchers can accomplish at the beginning of their learning paths within a limited amount of time.

Last but not least, during our eye-tracking study, the conversion bottleneck of this particular OTA became apparent: the usability problems of its web-forms. Thereby, our study adds to the academic literature devoted to improving the usability of web-forms that are pivotal for conversion rates by using eye-tracking as a research method.

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Areas of Interest for a CSR Certificate on Touristic Websites: An Eye-Tracking Experiment Using the Example of TourCert

D. Reiser and M. El Mahgoub

No one can lie, no one can hide anything, when he looks directly into someone's eyes.

(Paulo Coelho 2014, online)

Abstract The way that tourists give visual attention to websites is a key topic in tourism research as it can determine the success of a tourism business. In particular under the current regular 'information flood' potential customers switch off their attention to potential facilitators for a buying decision such as a certification that demonstrates the positive environmental, social-economic behaviour of a tour operator. Recently, sustainability has become important in the relationship between buyer and seller of touristic products. At the same time, the number of logos (and certifications) on websites that certify a particular sustainable product management has increased. It is therefore important for certified sustainable businesses in tourism to gather information on how far potential customers recognise a particular certificate to facilitate a positive buying response.

The chapter aims to show if the strategic location of a certification symbol on a website as well as the provided information about the certificate can increase the attention to the certificate and therefore facilitate a booking decision through the application of eye-tracking research.

Keywords Eye-tracking · CSR certificates · TourCert · Attention · Sustainable tourism · Websites

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1 Introduction

The way that tourists give visual attention in general (Wang and Sparks 2016) and to websites and social media in particular, is a key topic in tourism research (Muñoz-Leiva et al. 2018). Especially, the unnumbered amount of visual information and interactions that humans are subjected to on a regular basis (Davenport and Beck 2001) make it impossible for the human brain to process all those stimuli (Scott et al. 2017), including certifications on touristic websites while searching for a potential holiday trip. Accordingly, if a tourism business wants to improve the usability of its website and the positive recognition of its marketing stimuli, it needs to understand how customers look at their sites and find information (Scott et al. 2017). It is therefore for example important for certified sustainable businesses in tourism to gather information on how far potential customers recognise a particular certificate to facilitate a positive buying response. Eye-tracking as 'the process of identifying where someone is looking and how' (Bojko 2013, p. 4) to 'indicate the locations of a viewer's (overt) visual attention' (Duchowski 2007, p. 141) has a high potential to identify if a certification is gazed upon and therefore helpful in supporting this particular response.

This chapter deals with the effective website communication of Corporate Social Responsibility (CSR) certificates in tourism. Particularly, it aims to show how a strategic location of the certification symbol on a website as well as the provided information about the certificate can increase the attention to the certificate and therefore facilitate a booking decision. Furthermore, as a by-product, it points to the reality that even people with particularly strong knowledge in sustainable tourism, in this case, students of a subject as sustainable tourism, do not recognise a sustainable certificate more than people, who are not trained in this area. In order to research those aspects, an eye-tracking experiment 'that can help us to know about user interests' (Sari and Santoss 2016, p. 5) with an additional questionnaire using the CSR-certificate TourCert is utilised.

After a brief introduction to certificates, this chapter describes the set-up and the execution of the experiment to allow an understanding of the circumstances as well as the two parts of the research. An extended general explanation of the eye-tracking process is omitted as it will be dealt with in other parts of this book (if you need more information please see Duchowski 2017 or Bojko 2013). The next step contains the description of the results, followed by their interpretation. Some concluding remarks will conclude the chapter.

2 Certifications and Certificates in Tourism

In general, certifications (and accompanying certificates) are processes of quality control (respectively their symbols). They have a history that goes at least as far back as the middle ages when particular symbols signified special characteristic of a good

or service. At the end of the thirteenth century, European craftsmen were organised in so-called guilds (unions) that developed strict rules for product quality. The enforcement of those standards was done by inspection committees, which marked flawless goods with a special symbol—a certificate of a particular standard of quality (ASQ 2017; Weiermair and Pikkemaat 2004). Such quality standards remained an important element of the provision of goods and services since then.

Today, certifications or quality symbols are used as markers to differentiate goods and services according to their quality or other characteristics in an easily understandable fashion, often via a symbol (Freyer and Dreyer 2004). This is also the case for the service industry 'tourism and hospitality'. Unfortunately, the increasing demand pressure within the tourism industry regarding management models that favour elements such as high-quality standards or sustainable tourism management has led to a confusing number of certifications. This makes the effective communication of the fulfilment of those standards as a differentiator and facilitator for a positive buying decision difficult.

Globally, there are more than 140 tourism certifications (arbeitskreis tourismus & entwicklung et al. 2014). In Germany, for example there are 34 certification systems that award 44 certificates mainly regarding environmental management and sustainability behaviour of certified tourism businesses (Strasdas 2016). One of those certification schemes is TourCert.

The TourCert corporation was founded in 2009. It is a partnership under the German Civil Code (GbR) that developed a CSR reporting system in cooperation with the forum anders reisen e.V. (an association of small- and medium-sized enterprises in Germany). It awards the TourCert label for sustainability and corporate social responsibility for tour operators, destinations, hotels and travel agencies. In 2015, it was transformed into a non-profit private limited company (gGmbH) (TourCert 2017). Certified enterprises are allowed to use the Tour Cert symbol for marketing purposes in printed and online media.

In the context of those increasing numbers of certification schemes and certificates, it remains questionable in how far certification symbols are recognised to create a change in a customer's mind to positively influence a buying decision. Elements such as the positioning of the symbol may have a vital impact on its detection and therefore on the connected business attributes. Consequently, the question could be asked how CSR certificates on tourism websites can be used to communicate effectively with customers by answering the following sub-questions:

What is the optimal placement of a certificate on a website?
In how far do customers inform themselves about the certificate on websites?
In how far play the tour description and the certificate on the website an important role if a customer has to decide between a certified and a non-certified product?
Is this decision influenced if potential customers were presented with additional information about the certificate?

Those questions were researched with the help of an eye-tracking experiment. Its set-up and execution are described in the following section.

3 Basics About Eye-Tracking

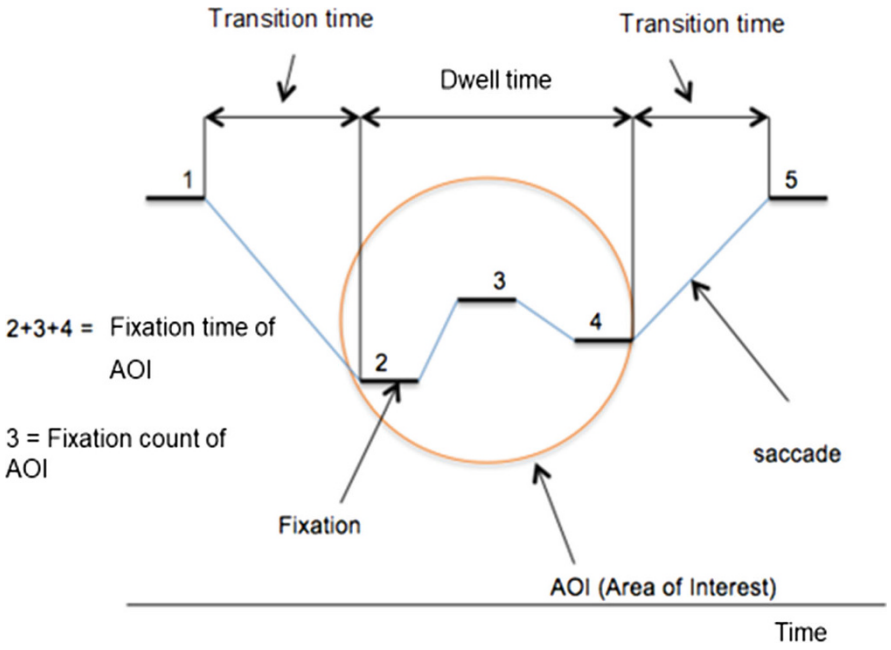
In order to provide the reader with a general understanding of the eye-tracking method, relevant information is given before the application of the method is explained. First, the scientific history of eye-tracking will be outlined, before the basics of current eye-tracking technology will be explained.

With an eye tracker, various questions can be evaluated using recorded eye movements. As a result, relationships between eye movements and neurological processing processes in the brain can be understood from a cognitive–psychological perspective (Leibniz Institute for Knowledge Media 2015a; Duchowz). Horsley (2014), for example points out that examining eye movements provides an opportunity to develop new research methods. Different groups can be compared with respect to their eye movement and the relationship between visual, cognitive and physiological processes can be explained.

There has been tremendous growth in eye-tracking methodology in recent years. In the last 20 years, eye-tracking technologies, software and data analysis have been enhanced and improved. There are now fourth-generation eye-tracking technologies around (Duchowski 2017). Additionally, more than 2000 articles and papers on eye-tracking research have been published on Google Scholar in 2011 alone (Breeze et al. 2014). This shows that although eye-tracking research is a fairly new research method, it has evolved rapidly and is becoming increasingly popular in science and many other fields. However, this was not always the case, as can be seen when researching the historical background of eye-tracking.

The first eye tracker was built at the end of the nineteenth century to capture human eye movement and the response to stimuli. In the beginning, there were major technical difficulties in creating the devices. In an experiment conducted by Huey in 1898, subjects' heads were fixed with waxed rails to keep their heads as still as possible. In doing so, Huey watched the short, left-to-right glances the subjects made while reading a text, and jumped to the left at the end of the line to the beginning of the new line, reading each line. In 1901, Dodge and Cline introduced the principle to photograph the reflections of an external light source from the Fovea Centralis00. This technique provided subjects with more comfortable conditions than in the past. It thus remained the dominating method for many years (Holmqvist et al. 2011; Duchowski 2007). From 1948, the subjects' heads no longer had to be fixed. Hartridge and Thompson allowed a more flexible movement by attaching the devices to the subjects' heads. In the following years, the technologies were further developed by computer and camera technologies and were always becoming more practicable.

In the 1950s, the devices approached today's devices. Not only the comfort but also the precision of the measurement results had been improved by the development of systems with lenses, mirrors or electromagnetism (Holmqvist et al. 2011). Nowadays, the eye-tracking hardware is installed directly on the monitor and works completely with non-contact using infrared technology. Thus, the subjects are not impaired in their natural movement sequences (Leibniz Institute for Knowledge



Graph 1 Schematic representation of a visual movement (after Mahgoub 2017)

Media 2015a). The research method is now used in many industries, such as psychology or market research (Löffel 2015).

In an eye-tracking experiment, it is important to find out about the principle of the human eye. The schematic representation on Graph 1 shows an example of the sequence of a gaze movement that runs from point 1 to 5. The area of interest (AOI) is an area of interest, for example, of an object that is determined by itself.

The terms are explained below (see also Graph 1). The definitions are based mainly on Holmqvist et al. (2011), the Leibniz-Institut für Wissensmedien (2015a, b), Zimmermann (2014a, b) and the SMI Handbook (2016).

As soon as the eye focuses on a specific point (fixation point) and holds it visually, it is called a fixation. Even moving objects can be fixed. Neurologically useful information is passed on to the brain (Leibniz Institute for Knowledge Media 2015b). The duration of the fixation is considered as an indicator of cognitive activity. The duration is determined by each individual fixation. Fixation for searching and orientation takes about 100–200 ms (Zimmermann 2014a). The eye, however, never remains completely calm, but always makes shaky movements. The jump from one fixation to the next is called a saccade. Mostly a saccade lasts between 30 and 100 ms. No information is collected during these reflexive eye movements (Zimmermann 2014b). However, usable information that is sent to the brain can also be further evaluated during the saccade phase (Leibniz-Institut für Wissensmedien 2015b).

In order to gain knowledge about certain objects, the so-called AOIs (Areas of Interest) can be investigated. For example, saccades indicate the number and duration of fixation of an object, allowing the absolute and relative frequency of fixations to be measured (SMI 2016). Multiple consecutive fixations and short saccades within an AOI are called Dwell Time. It can be displayed as an absolute or average duration of observation (dwell time/average dwell time) (SMI 2016). The number of fixations that hit an AOI and occur within an AOI is defined as fixation count. It is true that objects that are relevant for the subject are fixed more frequently than if they are irrelevant for the subject (Löffel 2015). Nielsen and Pernice (2010) have also come to realise that users usually think of what they are looking at simultaneously. They equate fixation with attention, whereby attention is defined as 'focused mental engagement on a particular item of information. Items come into our awareness, we attend to a particular item, and then we decide whether to act' (Davonport and Beck 2001, p. 20). The conclusion is that the longer and the more often you look at a certain element, the higher is your awareness about it.

Secondary research provided the theoretical analysis of CSR certification and eye-tracking. Thus, necessary background knowledge was obtained. Denscombe (2010) recommends this as a methodical approach. The research is an eye-tracking experiment. This is a standardised observation because a plan determines in advance exactly what should be observed, at what time and at which place the observation takes place and how to record the observed is (Kaya 2009). Basically, an experiment takes a measurement under controlled, non-natural conditions. It can serve to identify the cause of a phenomenon or to observe the influence of certain factors (Denscombe 2010).

In order to investigate the importance of the visibility of a sustainable tourism logo to facilitate a buying decision, the visual perception and the level of knowledge of the TourCert certificate and the certificate are examined as a decision criterion. It fits well into the two top research areas in tourism using eye-tracking: consumer attention to marketing information and advertisement perception (Scott et al. 2017). It adds the dimension of a sustainability certification as marketing information on tourism websites. Only one similar research in the food industry came to the attention of the authors (Samant and Seo 2016).

This requires a method whereby objective measurements can be made and objective results achieved. Observations by technical equipment such as an eye tracker fulfil this requirement. In addition, this instrument allows the detection of situations that the test subjects themselves are unaware of. Nevertheless, when building the experiment, it should be noted that subjects may change their behaviour if they know they are being watched. To do this, it is important to schedule time and interact in minimal interaction with those to be examined, so that they are hardly noticed and notice as little as possible of the observation (Denscombe 2010). In a laboratory experiment, possible interferences can be kept away and the examination can be repeated (Kaya 2009).

Especially for the investigation of web pages, the eye-tracking as a method offers for example to trace the search behaviour of users by video recording and image capturing of the paths of the gaze on a website (Düweke and Rabsch 2011). The

fixation duration and number indicators can provide information on what the user is interested in and what is important to him or how much attention he devotes to specific areas (Leibniz-Institut für Wissensmedien 2015b). Thus, an eye-tracking method can achieve particularly meaningful results and has not yet been replaced with any other test method (Düweke and Rabsch 2011). But there are a number of challenges, first of all the internal validity of the results due to the laboratory conditions and the small sample size (Scott et al. 2017). However, apart from being a time, cash (e.g. equipment and software) and planning intense form of research, eye-tracking can also not reveal some other factors, such as what a subject feels or thinks while looking at an object. For example, a person may only briefly consider an object (in the peripheral vision) because it is known to the subject (Land 1999) and/or an object is considered for a long time because it is not understood (Nielsen and Pernice 2010). Additionally, subjects may show a bias (e.g. political correctness, social expectation) because they are aware of being involved in a research study (Scott et al. 2017). Since these factors (attitude and knowledge) play a role in the determination (in particular for the hypotheses 2a to 2d that follow later) it makes sense to integrate additional questions and tasks into the experiment. In the construction of the questions, general criteria that apply to the compilation of questionnaires, according to inter alia Albers et al. (2009).

4 Set-Up, Conduction and Result of the Experiment

For the experiment, three stationary eye trackers (SMI RED250 mobile) from the Rhine-Waal University of Applied Sciences (HSRW) were used. The eye-tracking system was developed by SensoMotoric Instruments (SMI). The SMI software Experiment Center, iViewX and ReGaze helped setting up the experiment as well as collecting and saving data (see Image 1 for set-up).

Overall, the study applied an experimental nomothetic case-study research within-subjects in a laboratory setting (for more information see Duchowski 2017). It was prepared and conducted in the HSRW laboratory. In the experiment centre, several stimuli were deployed via stimuli-settings to measure 'number of fixations, fixation durations, and gaze switching behaviors, [to] provide insides into the cognitive state of the user during the evaluation task' (so-called process measures of objective metrics) (Duchowski 2007, p. 216). Those stimuli contained texts, pictures, questions or interactive webpages. Within this context, the experiment was intended to be set up in such a way that the participants did not know that the TourCert certificate was the intended target of the study for as long as possible in order to limit potential biased results (see Image 2 for four sub-experiments regarding the placement of the logo).

Overall, the experiment consisted of two parts. The first part used a nine-field matrix and a segmentation of the examined website into different areas of interest in order to analyse the hypothesis 1 that the participants tend to focus more on the upper

Image 1 HSRW Laboratory booth (Source: Mahgoub 2017)

left area than on the rest of the websites. Such a good hypothesis statement was seen as vital to conduct the experiment (Duchowski 2017).

Firstly, a nine-field matrix without any background was presented to examine whether subjects generally would be more inclined to look at the top left area or not. Then the homepage of the travel business a&e erlebnisreisen (see above) was issued to the subjects with the information to look at the page. In each case, their eye movements were recorded.

The a&e-erlebnisreisen homepage was selected as a basis because it displayed all the characteristics of a typical touristic website with regards to structure, content and provided information. Additionally, the website was equipped with clickable TourCert-Certificates, which for the experiment were positioned in four different areas of the site (upper left, upper right, lower left, incorporated in the text of the tour description) for different groups. The lower right was excluded as previous research by Nielsen and Pernice (2010) found in their research that this is the least viewed priority spot for websites, while the upper left had the highest use, the upper right and the left centre a very high use and the lower left a medium-high use. Each of the

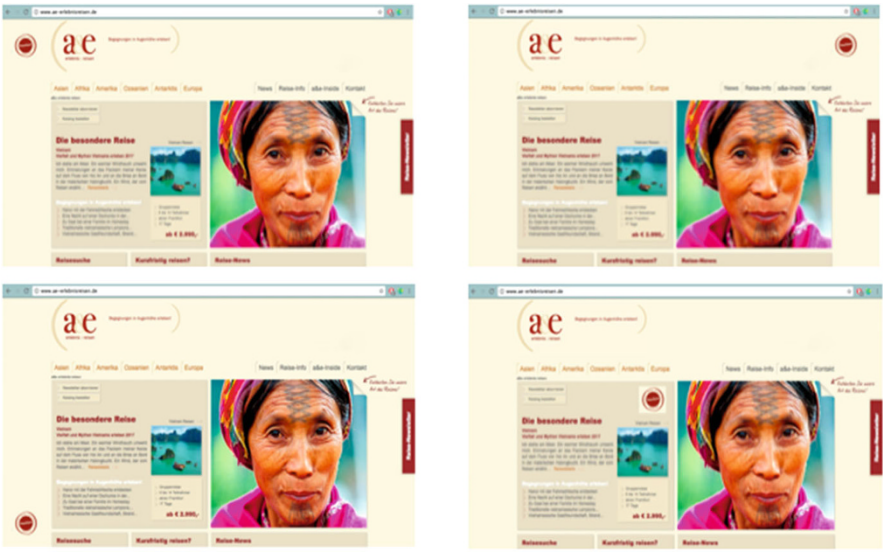


Image 2 Four sub-experiments, four different logo placements. Clockwise: Top left (TL), top right (TR), on the ad (OA), bottom left (BL) (Source (excluding logo placement): www.ae-erlebnisreisen.de 2017)

four positions of the certificate was considered an area of interest (AOI) and therefore researched as a new sub-experiment and tested with a group of 9–10 participants.

Using the AOI-Editor from the BeGaze software, it was possible to define and record one or more AOIs (areas of interest) for the experiment (including the later analysis). The four above-mentioned areas were defined, i.e. the TourCert-logo, as AOI. Different data like the average fixation length on the AOI could then be measured and displayed. This enabled to find the AOI with the highest visual attention value. This should be sufficient to evaluate the optimal placement of the TourCert-logo and also answer the question, whether placement of 'TL' would receive the most attention.

A further question as to which extent the possibility to inform oneself about the certificate was used to gain further information about the certificate had not been formulated as an own hypothesis. It was primarily conducted to observe whether the participants used the clickable TourCert-Certificate to receive more information or not. The subjects got the opportunity to interact with the website www.ae-erlebnisreisen.de that was installed via the function Screen Recording. Subjects could also click on the logo of TourCert-Certificate to gather information on a new website about the sustainability of the tour operator. Moreover, half of the participants (19) were presented a text mentioning the sustainability behaviour of the tour operator, the other half received a text that indicated the information about the tour without mentioning sustainability. The idea was to examine if the participants would voluntarily research information on the (displayed) certificate and sustainability. In

addition, it was tried to verify if mentioning sustainability would result in more clicks on the TourCert logo to specifically look for information on sustainability.

The second part of the experiment focused on whether and to which extent the representation of a specific offer of a tour influenced the decision-making. In this respect, three hypotheses were formulated:

2a: If the subjects received information about the certificate or they already knew the certificate, there was a higher probability that they decide in favour of a certified tour.
2b: Subjects who put a high value on sustainable tourism, decided with a higher probability for a CSR-certified tour.
2c: The title and the tour description have a higher influence of the travel decision if a buyer has no knowledge about the certificate.

For this part of the experiment, two identical tour offers were created (same destination, price and picture) only differing in the description, title and the existence of a certification. Each of the 38 participants was requested to decide for one of the offers and give reasons for their decision. Afterwards they were informed about the TourCert-Certificate and received the same task again. To analyse the hypotheses 2a–c it was first asked what kind, how many and which certificates (not only in tourism) the participants already knew. Here, eye-tracking and clicks were being recorded and saved via Screen Recording. The experiment was closed by asking demographic questions (age, gender) and asked for the study course of the subjects.

5 The Experiment

After setting up the experiment in the Experiment Centre of the university, a pre-test with ten participants was conducted. In doing so, it was possible to modify the experiment using observations and feedback given. It became also clear that one individual run would last between 15 and 20 min and it demonstrated that three subjects could be tested simultaneously with just a short delay for calibration and validation of the eye tracker.

After the pre-test, the platform hroot (‘hroot’ is a database created by the University of Hamburg. ‘hroot’ (means ‘Hamburg registration and organisation online tool’) was used to search for 40 German-speaking participants. Due to the fact that students of the HSRW were among others enlisted in hroot (as this tool was used in previous instances for finding participants), it was assumed the subjects with the specification asked for would be students of similar age from the local university. This turned out to be the case.

Overall, 38 of the 40 asked participants took part in the experiment (as an incentive the participants received 10 Euros each). The participants were randomly divided into four groups (respectively 9–10 samples per group). Despite the fact that this is a small group, it nevertheless follows Nielsen theory that the minimum number of participants for eye-tracking usability is 6 (Nielsen Norman Group

2018), and that 38 (or nine for the sub-groups) are therefore sufficient. However, Scott et al. (2017) reviewed 17 tourism papers that described eye-tracking research. The number of participants there ranged from 12 to 63 with an average cell size of 11.

6 Results

Displaying the nine-field matrix to the participants demonstrated that the top left area of the matrix received the largest and longest amount of attention from all four groups (Image 3). It confirms previously stated research.

However, when the actual homepage of a&e-erlebnisreisen was shown, the result differed. By looking at the heat maps of the web pages from the four sub-experiments on Image 4 below, it becomes clear that all four groups focus much more on the text block about the journey than on the top left corner. The area above the picture of the woman, the price and linked information also receive a high visual attention.

In order to evaluate hypothesis 1, the TourCert-certificate was defined as AOI. Therefore, the parameters 'fixation count' and 'fixation time in milliseconds (ms)' were used because the number and duration of fixations can reveal information on the attention and perception of a relevant object. In this case, the AOI was the TourCert-certificate of the respective sub-experiment and it was named accordingly (TL, TR, OA, BL).

Table 1 shows the indicators 'fixation count' and 'fixation time (ms)' of each individual subject, who fixated the AOI at all. It becomes clear that only nine

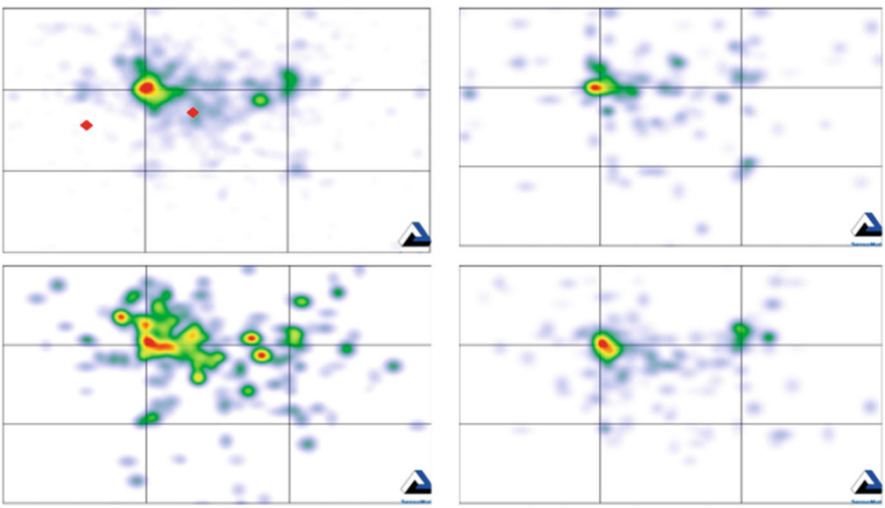


Image 3 Heat maps of the four sub-experiments (TR, TL, OA, BL)

Image 4 Heat map of the four sub-experiments (TR, TL, OA, BL)

Table 1 Display of the fixation stats 'fixation time (ms)' and 'fixation count' from the four test groups

	OL	OR	AR	UL
Fixation count	P4c.4: 1	P1.3: 1	P3.4: 1	P2.4: 2
		P1.5: 1	P3.7: 2	P2.8: 2
			P3.8: 3	P2.9: 2
Fixation time [ms]	P4c.4: 100.1	P1.3: 100.1	P3.4: 133.4	P2.4: 350.5
		P1.5: 634.1	P3.7: 650.2	P2.8: 367.1
			P3.8: 883.8	P2.9: 508.8

subjects even fixated the AOI of the certificate. AOI 'TL' was fixated by a single subject (P4c.4) once for 100.1 ms. 'TR' was fixated by two subjects once each. Subject P1.3 fixated TR for 100.1 ms as well, whereas P1.5 fixated it longer for a total of 634.1 ms. AOIs 'OA' and 'BL' were fixated by three subjects each for a total of six fixations. However, their average fixation time varies. 'OA' was fixated by average 555.8 ms, whereas 'BL' only had an average fixation time of 408.8 ms per subject. It became already obvious that only a very small number (nine) looked at the TourCert logo overall.

Further insight into the different positions of the Tour Cert-logo (TC) and the respective attention can be delivered via KPI (key performance indicators) such as sequence, entry time, dwell time, hit ration revisits, average fixation, first fixation and fixation counts of/on the TC logo. Table 2 shows the average stats of all subjects from each respective group (highest value highlighted in bold).

Glances count (sequence) is the amount of fixations on an AOI. It increases by one for each time a glance travels on the AOI and creates a fixation. Revisits indicate the number of glances cast on the AOI by an individual subject. However, since only

Table 2 KPI of AOI 'TourCert-Logo'

TC-Logo	OL	OR	UL	AR
Sequence	6	*10*	6	**3**
Entry time	12281.0 ms	*21024.1 ms*	11265.4 ms	**2807.3 ms**
Dwell time	*12.5 ms (0%)*	73.4 ms (0.3%)	176.4 ms **(0.9%)**	**187.1 ms** (0.7%)
Hit ratio	*1/8 (12.5%)*	2/10 (20%)	**3/7 (42.9%)**	3/9 (33.3%)
Revisits	*0.0*	*0.0*	0.7	**1.0**
Average fixation	*12.5 ms*	73.4 ms	**87.6 ms**	83.7 ms
First fixation	*12.5 ms*	73.4 ms	**75.1 ms**	64.8 ms
Fixation count	*0.1*	0.2	**0.9**	0.7

Annotation: *TC* TourCert; *TL* top left; *TR* top right; *BL* bottom left; *OA* on advertisement (in-text)

a few of the subjects fixated the certificate, it makes sense to add the average fixation stats.

The difference between 'dwell time' and 'fixation time' is, that 'dwell time' includes saccades. Therefore, the dwell time is usually longer. Accordingly, the difference between 'dwell time' and 'fixation time' decreases if the AOI is smaller.

Unfortunately, the 'hit ratio' shows that only a total of 34 subjects were even recognised by the eye-tracking system and the test groups were therefore of different size (8/10/7/9 subjects) (see also Scott et al. 2017 who state that the sight of between 10% and 20% of participants cannot be tracked). It appears as if the eye-tracking technology did not work as anticipated. The reasons why four subjects were not recorded is unknown.

The table shows that the AOI 'OA' and 'BL' share the highest relative part of subjects fixating the AOI at all (33.3% and 42.9%, respectively). TC-certificate 'OA' took the least time until it was being fixated (average 2807.3 ms 'entry time'). It also shows the longest dwell time (average 187.1 ms). However, on a relative basis compared to the fixation duration of the whole trial, the TC-certificate 'BL' was being looked at longer ('dwell time' [%]) though. Both placements also show the highest average fixation duration per subject (87.6 ms BL, 83.7 ms OA). 'BL' also shows the longest first fixation (75.1 ms). The AOI 'TL' on the other hand shows the lowest stats for almost all indicators (except for 'sequence' and 'entry time'). This is because only one subject even fixated this AOI at all. Therefore, the placement of the certificate in the top left area scores the lowest amount of attention compared to the three other placements. This means that the stats do not indicate that a placement in the top left area would yield higher AOI-stats than any other placement. Therefore, hypothesis 1 cannot be verified for the homepage of a&e erlebnisreisen.

The second question was to what extent the subjects used the possibility to gather information on the certificate. As mentioned before, the subjects had the opportunity via a&e erlebnisreisen inside or via clicking on the certificate on the interactive page (www.ae-erlebnisreisen.de) to gather information about the certificate or about the sustainability report on another webpage. Results show that only 5% of the subjects clicked on the TourCert logo. Even though, 13% of all subjects clicked on a&e

inside and then on CSR-Nachhaltigkeit (CSR-sustainability). Overall, just 23% of the subjects registered the certificate at all. That means that only a small number of participants used the opportunities to gain information from the front page.

7 Analysis of Results

Overall, it needs to be recognised that the results provide only an indication of the importance of certifications on websites. Further and more detailed research is needed to gain a much deeper understanding. Nevertheless, the general results from the experiment can be summarised as follows:

- Certificates on touristic webpages only gain a small amount of visual attention.
- Certificates that are placed close to a journey advertisement gain more attention than certificates that are placed, i.e. close to the company logo.
- An unintended result was the fact that the students from the study subject sustainable tourism (6 students) showed a slightly lower recognition and importance of/for certificates as other respondents.

At first, the presentation of results was made via the nine fields matrix. It indicated that subjects generally looked more to the top left area. That would strengthen the assumption that subjects would tend to look there first and focus on it most intensively.

This kind of visual behaviour was also somewhat mirrored when participants were just looking at the homepage in question, but the layout of the page must be taken into account here. In the left area, the text of the ad was situated, which took high attention. The reason is that the subject has to look at it longer to read the text. In addition, the heat maps show a visual behaviour similar to the 'F-shaped pattern'.

This indicates that people will actually read a small block of text with travel information and suggest this raises the attention of prospective customers. Additionally, all groups of subjects looked at the top left area to find the company logo. According to Nielsen and Pernice (2010), most webpages place their logo in that area, so it is assumed that consumers would expect it there and look at it first by habit. It does not seem to make a big difference if another logo is situated close by. Even so, the non-recognition of the logo could also be linked to the advertising saturation levels, followed by banner blindness that leads to a decrease in the clicks on additional information (Muñoz-Leiva et al. 2018).

When the certificate was displayed in different parts of the page to the subgroups, the results concerning the highest visual attention changed. Certificate placements in the bottom left area and in the journey advertisement yielded a higher amount of attention. It is assumed that this placement does not match the page layout and therefore causes more attention. That possibly leads to the fact that more subjects registered the certificate at this location compared to other placements. Another reason can be that a placement close to the journey advertisement 'Die besondere Reise' (the special journey) can be a reason for the higher amount of visual attention.

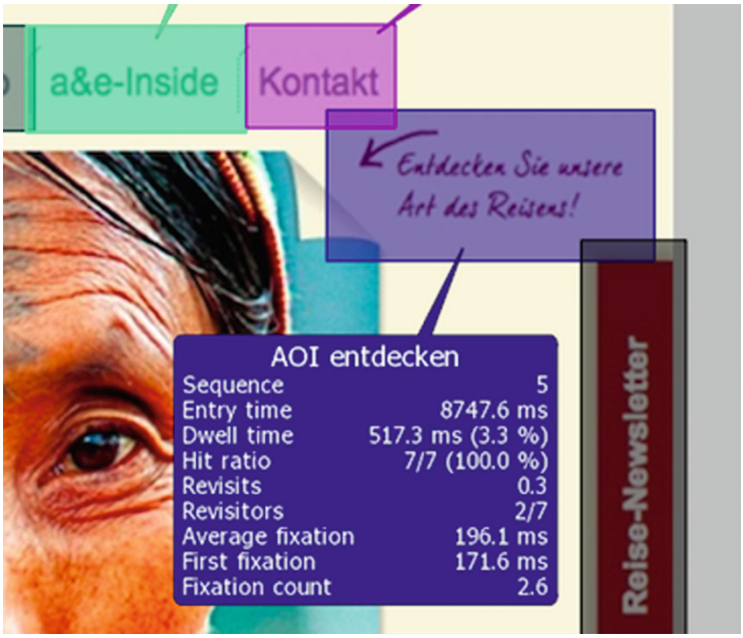


Image 5 AOI 'discover' from sub-experiment BL

It is possible that customers look at it by accident while focusing on the advertisement itself. That would explain the similarly high stats of the placement on the advertisement (OA).

Data also show that many subjects looked at the sign 'Entdecken Sie unsere Art des Reisens!' (Discover our way of travelling!) on the right side above the picture, which is shown in Image 5 above. In this area, the picture looks folded and an arrow persuades into thinking that there is something hidden behind it and that it is possible to click on it. The higher amount of attention by the subjects confirms that they probably have the intention to trigger their customers' curiosity to gain more information. If the certificate was placed in this area, it most likely would have attracted a similarly high amount of attention.

8 Conclusion

Certificates at touristic websites are rarely visually recognised. When they are placed next to the tour description, they receive the most attention. Knowledge about a certificate increases the probability to choose a respective offer, while a lack of knowledge leads to an increased orientation on the basis of the description. Finally, knowledge or imparting of it right before the decision process increases the probability to decide for a certified offer.

The research made clear that participants focused on the top left corner when shown the nine-field matrix (hypothesis 1). However, when the homepage of a&e erlebnisreisen was displayed, this changed somewhat. There participants focused on the written advertisement of the offered tour and on the bottom left. It appears as if the focus is much more dependent on the website itself as on general attention given to specific areas on a website in general. Even if it could be argued that there must be some habitualised way of looking at websites in general, this needs far more research with a much bigger number of participants.

In the second part, the authors tried to develop the idea if participants interested in sustainability are more likely to choose a certified tour, can neither be confirmed nor be rejected as only a very small number seems to be interested in the TourCert logo at all as well as a small difference between those groups who have the term sustainability in the description of the tour and those who have not. Rather it could be said that certification logos are not registered in any large way (hypothesis 2b). Their effectiveness can therefore be called into question. As a consequence, participants concentrate on the description to inform the travel decision (hypothesis 2c). However, when the participants received information about the certification, they tended to select the certified tour (hypothesis 2a). Even though, because of the small amount of applicable data, it can be assumed that there is a generally low perception of the certificate. Moreover, the formulation of the task and the lack of a web-function (search and booking option) could have influenced the results.

The results of the experiment lead to the assumption that hypothesis 2a to 2b should not be evaluated separately. The awareness of the certificate increased when more information was provided. Nevertheless, the participants did not tend to be more interactive. Thereby, it seems to be regardless of whether they claimed to be interested in sustainability or not. But, it has to be considered that according to literature a 'social answer behaviour' does exist. Meaning that people tend to choose an answer, despite the given anonymity, that they think is socially accepted. Also, other research shows that people not necessarily apply what they answered in reality. Furthermore, the results also indicated that some participants had problems understanding the tasks.

Nevertheless, the research helps to evaluate visual advertisement in the form of a sustainability certificate after it was implemented. It shows how customers react and interact (in this case rather not) to visual stimuli such as a CSR certificate when making a buying decision.

Davenport

Davenport and Beck (2001, p. 20) define attention as 'focused mental engagement on a particular item of information. Items come into our awareness, we attend to a particular item, and then we decide whether to act'.

Eye-tracking is a relatively new technique for the study of visual attention and perception in tourism research. Previous studies used self-report methods to evaluate

the effectiveness of visual advertisements after the campaign had been implemented (Kim et al. 2005; Morgan et al. 2012).

Fixed data collection equipment uses an infrared light source and sensors located in a fixed position such as the frame of the computer screen. Scott et al.

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Acquiring Sustainability Information in Holiday Travel

Dirk Schmücker, Friedericke Kuhn, and Eric Horster

Abstract This series of studies applies classical experimental designs to eye tracking measurement. The field of study is the attention for sustainability-related information in tourism products. Data show that sustainability labels alone receive relatively little attention in a realistic environment. As a result, it seems advisable to think about additional ways to relate sustainability information to consumers. It could be shown that implicit information, again, yields a higher share of attention than labels. Therefore, the design and informational transmittance of products combining sustainability and experiential value to the customer seem to be worthwhile as one of those alternatives. Care should be taken of the price argument because attention towards prices rises as soon as sustainability information becomes available. Data do not suggest to dispense with ecolabels. They do suggest, however, that a change in informational environment (i.e. directing consumers to sustainability issues) and the additional use of experience-related information aspects would increase the attention for sustainability information in tourism.

Keywords Sustainability · Experimental design · Nudging · Holiday travel

1 Introduction: Objective and Framework

Research has identified a growing demand for sustainable holiday products, as more and more consumers set importance on the sustainability performance of the products they purchase and on their personal ecological footprint (Bergin-Seers and Mair

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2009; Miller 2003). Also in Germany, a growing acceptance of and demand for sustainable tourism has been detected, as 32% of the population set importance on ecological, resource-efficient and eco-friendly holidays, while 38% of the population regard social compatibility as important when travelling (Günther et al. 2014). At the same time, more than 150 ecolabels related to tourism have been developed (Hamele and Núñez 2016) and suppliers have adopted communication methods to encourage consumers to buy the more sustainable alternative (Font and McCabe 2017; Hardeman et al. 2017).

However, the actual purchase of more sustainable holiday travel products is not as high as it could be if a positive attitude would be converted into actual buying behaviour. Between a positive attitude towards sustainability and actual buying behaviour, a gap becomes visible (Günther et al. 2014; Juvan and Dolnicar 2017; Juvan et al. 2016; Weaver and Jin 2016; Wehrli et al. 2011), and there is evidence of a cognitive dissonance within tourists' mental and practical performance (Higham et al. 2016; Juvan and Dolnicar 2014).

Starting from this point, we implemented a number of studies investigating the role of information about sustainable alternatives. We used different experimental approaches, among them Information Display Matrix (Schmücker et al. 2017b), eye movement tracking and online choice experiments.

With this chapter, we want to show that eye movement tracking can be successfully implemented in an experimental setting for tourism research.

2 Study Design and Data Collection

2.1 Study Design

We used a within-subjects experimental design with 33 respondents. Data collection for the eye tracking study was sequenced into three main steps, namely a pre-experimental questionnaire, the actual eye tracking experiments and a post-experimental questionnaire. Each respondent went through three sets of eye tracking experiments. Each set was presented in two different formats, the difference in the two formats coming from the specification of the independent variable (Table 1). In sets 1 and 2, the independent variable was the information contained in the stimuli. In set 1, half of the stimuli were equipped with sustainability labels, the other half

Table 1 Three sets of eye tracking experiments

Set no.	Real-world example used	Independent variable
1	booking.com	Information: sustainability information vs. neutral information
2	jahnreisen.de	Information: sustainability information vs. no sustainability information
3	opodo.de	Instruction: "best offer" vs. "most sustainable offer"

had more neutral labels. In set 2, one-half of the stimuli exhibited sustainability labels, while the other half had no labels at all. In set 3, the independent variable was the instruction: Respondents were asked to choose the "best offer" versus the "most sustainable offer".

The stimuli for the three sets were taken from real-world travel websites available in the German market (firstly, the German version of booking.com; secondly, the booking site of the German Thomas Cook subsidiary Jahn Reisen, jahnreisen.de; thirdly, the German version of the booking site opodo.de). More specifically, we used screenshots of the search results page from the three websites. Each screenshot showed three products (in sets 1 and 2) or detailed information about one product (in set 3). These three websites were chosen because they actually show sustainability information also in the real world (Kapferer and Laurent 1986).

To analyse each of the screenshots (stimuli), one or more areas of interest (AOI) were defined. AOIs are those spots on the screenshot which are of particular interest for this research, e.g. the sustainability labels and the neutral labels in set 1.

2.1.1 Set 1

For the first set, which investigated the independent variable "available sustainability information", ten screenshots (stimuli) derived from the website "booking.com" were prepared for data collection. Each stimulus presented three accommodation offers, and each offer was equipped with one AOI, resulting in a total of 30 AOIs for data analysis (Fig. 1 and Table 2).

The first sequence allows for a comparison of respondents' visual attention towards sustainability information set by side to neutral information which is rather

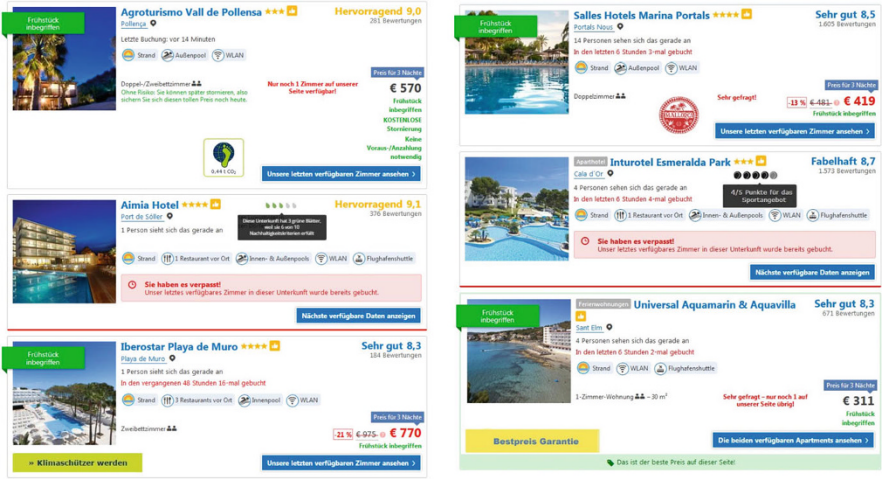

Fig. 1 Example stimuli for set 1 with sustainability information (left) versus neutral information (right)

Table 2 Properties of eye tracking stimuli (set 1)

Website: booking.com	Independent variable: type of added information	AOIs	Stimuli	Total number of AOIs
Search result page	Sustainability information	Carbon footprint, green-leaf ranking, climate protection activist	5 screenshots	15 (3 per screenshot)
Search result page	Neutral information	Mallorca label, sports ranking, best price guarantee	5 screenshots	15 (3 per screenshot)

Table 3 Properties of eye tracking stimuli (sequence2)

Website: jahnreisen.de	Independent variable: type of sustainability information	AOIs	Stimuli	Total number of AOIs
Search result page	Sustainability information available	Ecolabels (EU-Ecolabel, FairtradeTourism label, Atmosfair label, Ecocertified tourism), name and place, description, details, price, photos	Six screenshots	96
Search result page	No sustainability information available	Name and place, description, details, price, photos	Six screenshots	78

void of relevant content. The chronology of stimuli was arranged so that respondents would alternately look at one stimulus with sustainability information and one stimulus with neutral information. Respondents were instructed to look at the offers the same way they would do it at home and name the offer that they like best.

2.1.2 Set 2

The second eye tracking sequence also examined the independent variable of "available sustainability information", for which 12 screenshots derived from a search result page of "jahnreisen.de" were prepared. Again, three offers per stimulus were presented, whereat only half of the stimuli obtained sustainability information (Table 3).

According to set 1, instructions were to look at the offers the same way they would do it at home and name the offer that they like best. This sequence allows for an analysis of respondents' visual attention towards the different types of information identified in working paper FINDUS 2 (Schmücker et al. 2017b) in comparison to sustainability information (Fig. 2).

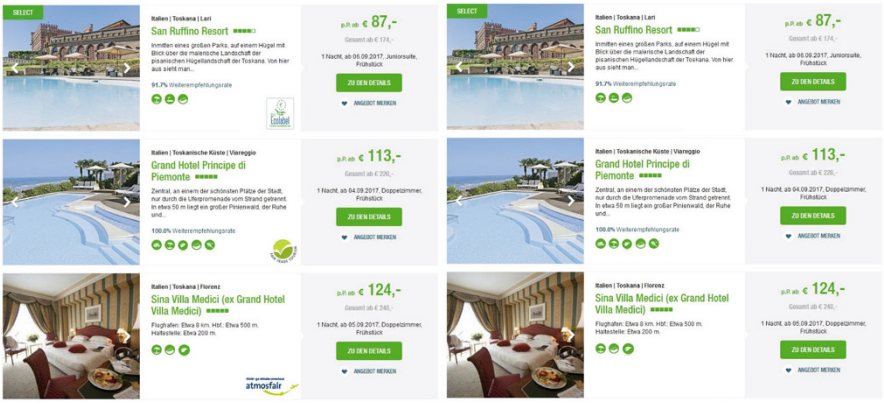

Fig. 2 Example stimuli for set 2 with sustainability information (left) versus no additional information (right)

Table 4 Properties of eye tracking stimuli (sequence3)

Website: opodo.de	Independent variable: type of instruction	AOIs	Stimuli	Total number of AOIs
Specific accommodation offer	"Best" offer (personal opinion)	Carbon footprint label, ecolabels, implicit information (text), summary of sustainability performance	Six screenshots	20
Specific accommodation offer	Most sustainable offer (personal evaluation)	Carbon footprint label, ecolabels, implicit information (text), summary of sustainability performance	(same stimuli as above)	20

2.1.3 Set 3

The third sequence of the eye tracking experiments dealt with the second independent variable of "instruction". Here, a number of three accommodation offers with sustainability information were shown to respondents in two runs with different instructions. Due to the technical restrictions of the eye tracking software, each offer had to be divided into individual screenshots so that each offer was divided into two relevant stimuli for data analysis.

We extracted specific accommodation offers from the website "Opodo.de", as opposed to the first two sequences which focused on result pages. Different types of sustainability information were added to the stimuli as shown in Table 4. First, the instruction was for respondents to look at the offers and select the one that they like best. Second, they were instructed to look at the same offers again and identify the offer they evaluate as the "most sustainable" (Fig. 3).

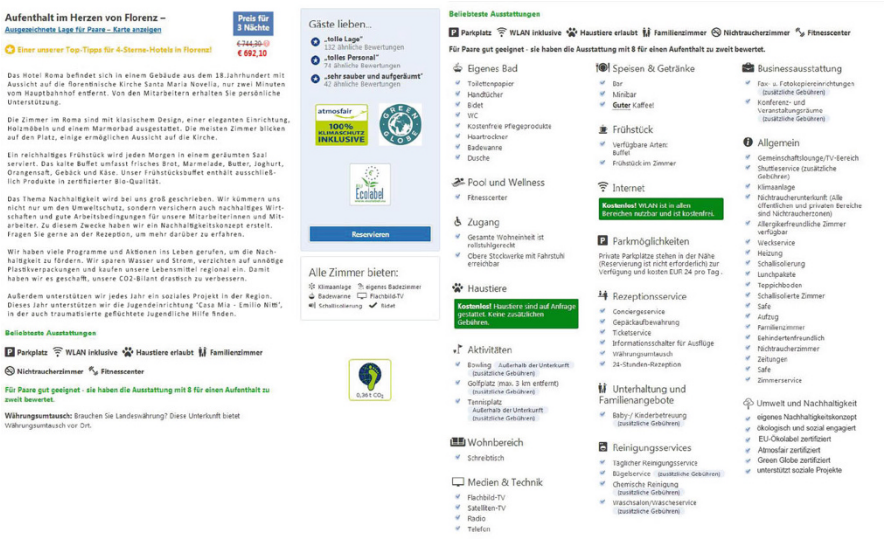

Fig. 3 Example stimuli for set 3 (identical for both conditions)

2.1.4 Pre- and Post-experimental Questionnaires

The pre-experimental questionnaire enquired the demographics and other structural data of the sample, as well as respondents' involvement with holiday travel in accordance to Laurent and Kapferer's Consumer Involvement Profile (Schmücker et al. 2016), and their attitudes towards different aspects of holiday travel derived from the annual Reiseanalyse (Kapferer and Laurent 1986).

After the eye tracking experiments were completed, respondents were asked to fill in a post-experimental questionnaire. Here, their involvement with sustainable products was enquired using the same standardised scale as in the pre-experimental questionnaire (2017). Further, the respondents' attitude towards sustainable development according to Frate and Biasutti's (Dunlap and Van Liere 1978; Dunlap et al. 2000; Fleury-Bahi et al. 2015; Lundmark 2007) scale was enquired. This relatively new scale was developed with regard to the new environmental paradigm (NEP) ((UNESCO 2005) and the UNESCO framework of sustainability (Girden 1992).

2.2 Data Collection and Data Analysis

2.2.1 Data Collection

Data were collected in the month of July 2017 in Hamburg. Forty-one respondents were recruited by a professional recruitment service and were invited to a centrally

located studio. Each respondent received a monetary incentive of EUR 30. The results of eight respondents could not be used because the recording of eye movement did not work properly due to the physiological form of eyelids etc. Thus, 33 respondents produced usable recordings for data analysis.

The data collection was accomplished by using a Tobii X2-30, working at 30 Hz, together with the data collection software Tobii Studio 3.4.7. Stimuli were presented on a portable computer with standard screen resolution. The X2-30 system's main advantage is that the respondents do not need to wear any equipment such as helmets or glasses, which would restrict movement and affect the natural gaze direction. Rather, all the technical equipment needed is built into a little black box placed below the screen of the laptop. Thus, the respondents' gaze was not affected by the equipment used in this study, and naturally occurring eye movements were measured.

Raw data were aggregated also by using the Tobii Studio 3.4.7. software for eye movement tracking data. Further, an online survey tool was used to collect demographic data as well as data regarding respondents' attitudes towards and involvement with sustainable products and holiday travel in general.

2.2.2 Data Analysis

For the main hypotheses, we used a within-subjects design with each subject going through three sets of experiments. Two conditions were used in each of the three experimental sets. Consequently, we tested for within-subject differences between conditions using t-tests for paired samples. Because independent variables change between the sets, each set can be treated as a new experiment. Therefore, inflation of alpha error is not an issue and Repeated Measurement ANOVA would not be suitable for this kind of analysis (Shapiro and Wilk 1965).

For the moderating variables (attitude, involvement), we split the groups using a median split and subsequently used independent samples t-tests (because now we do no longer report on the differences between two states of the same person, but rather on the differences between two groups of persons).

For testing in the within-subject designs, we used Student's T-test applied for paired samples, if assumptions on normality using Shapiro–Wilktest (Wilcoxon 1945) were met, and Wilcoxon's rank-sum test (Welch 1947) if assumptions on normality were violated. For additional hypotheses testing *between* groups under the same condition, we used Welch's T-test (Mann and Whitney 1947) if assumptions on normality were met and the Mann–Whitney Test (Delacre et al. 2017) if not. We did not use Student's T-Test because Welch's T-test is robust against inequality of variances (JASP Team 2018).

For statistical testing and principal component analysis of the CIP scales, we used JASP 0.8.6 (Etz and Edelsbrunner 2016; Etz and Vandekerckhove 2017) (which in the background uses R for statistical computations), and double-checked all results with IBM SPSS Statistics for Windows.

As Bayesian statistics momentarily gains more widespread usage (Dienes 2011; Dienes and Mclatchie 2017; Morey et al. 2016) and is described as the superior form of hypotheses testing by its supporters (JASP Team 2018; Morey and Rouder 2015; Rouder et al. 2009) we did not only rely on classical ("frequentist" or "orthodox") statistical methods but double-checked our main results with Bayesian statistical methods readily available in JASP (Dienes 2011; Van de Schoot et al. 2014, p. 844, Table 1; Wagenmakers et al. 2017b; Table 1).

Without digging too deep into the mathematical differences between the two schools, there are a number of relevant advantages to Bayesian approaches compared to classical testing, among them invariance against pre or post hoc theory formulation, invariance against multiple testing and invariance against rejecting versus accepting the null hypotheses, which is of major importance in classical testing (as suggested by Dienes and Mclatchie 2017).

We report the Bayes factor (Rouder 2014; Wagenmakers et al. 2017a; Table 1), recurring to values of approximately 1, 3, 10, 30 and 100 indicating no, weak/anecdotal, moderate, strong and very strong evidences, respectively (Rouder et al. 2009). The Bayes factors represent the posterior odds of one hypothesis versus the other. For example, BF_{01} represents the posterior odd for H_0 compared to H_1 or, more precisely, the probability for H_0 given the data divided by the probability for H_1 given the data (Jeffreys 1961). A BF_{01} of 10 would mean: The observed data are ten times more likely to occur under the null hypothesis than under the alternative hypothesis. BF_{10} would then be the inverse of BF_{01}. All Bayesian analyses in this chapter used a Cauchy distribution prior with a width of 0.707 (JASP default), unless otherwise specified. The recommended prior distribution width of 0.707 leads to lower BF values and thus is more cautious or conservative compared to the original suggestion for a value of 1 (Wagenmakers et al. 2017a, b). Readers interested in reading and interpreting JASP outputs with reference to Bayesian statistics are referred to recent papers by the JASP developers (Günther et al. 2014).

As dependent variables (indicators), we used the following indicators:

- FC (Fixation Count): The number of fixations touching the area(s) of interest (AOI), absolute values and in percent of the total
- FD (Fixation Duration): The length of fixations touching the area(s) of interest, absolute values (in seconds) and in percent of the total

A *fixation* is defined as the eye's rest of 60 milliseconds (ms) and more on a given spot. Tobii's software also produces a different metric, called "visit", which encompasses all "touchpoints" of the gaze path in relation to the AOI. We did not use the "visit" metric because we are mainly interested in those fixations with a chance of leading to conscious perception on the side of the respondent.

Areas of interest (AOI) are those areas displaying the relevant information. The AOI boundaries were, of course, not visible to the respondents.

2.3 Respondent Profiles

The following paragraph is dedicated to the demographic descriptive statistics of respondent profiles. We have an established sample of 33 persons who are showing high involvement with holiday travel, but only moderate involvement with sustainable products in general. Attitudes towards sustainable holiday travel are slightly more negative than found in the population. Although, as a general rule, respondents do not reject sustainable alternatives, and sustainability appears to play a certain role in holiday and non-holiday choice processes, these respondents cannot be expected to actively search for sustainable options in choosing their holiday hotel. Obviously, inter-individual differences exist between respondents, which will be addressed later.

These results were anticipated in advance and are in line with the main target group of the whole study (1986).

2.3.1 Structural Data

Structural key data on age, sex and employment status and holiday travel activities of the respondents can be compared to the German-speaking population. Table 5 shows that age and sex distribution in our sample come reasonably close to the values in the population. In the sample, however, there are fewer persons who are currently not employed and, as a consequence, the number of long and short holiday trips is higher compared to the overall population.

Table 5 Structural data, FINDUS sample versus German population

	Respondents	Holidaymakers booking online 2016	Holidaymakers Mediterranean 2014–2016
N	33	2112 (19.0 mill.)	3282 (29.6 mill.)
Male, %	55%	53%	50%
Age (avg.)	41.2	41.1	43.5
Employment status, %			
Full-time	64%	54%	55%
Part-time	24%	15%	13%
Not employed	12%	31%	32%
Average number of trips, last 12 months			
Holiday trips (5 days and more)	3.0	1.4	1.2
Short holiday trips (2-4 days)	3.9	1.1	1.0

Source for population data: Reiseanalyse 2017, © Forschungsgemeinschaft Urlaub und Reisen e.V.

2.3.2 Involvement with Holiday Travel and Sustainable Products

Involvement profiles were collected for "holiday travel" (pre-experiment survey) and "sustainable products" (post-experiment survey) using a shortened version of Laurent and Kapferer's (Schmücker et al. 2017b) CIP. Results show that respondents are highly involved with holiday travel, but only moderately involved with sustainable products. On a 5-point involvement scale, average scores can range from 1 (highly involved) to 5 (not at all involved). Table 6 shows that involvement scores for holiday travel had a sum score of 20.27 (SD = 6.16) on a scale of 12 to 60, involvement scores for sustainability a sum score of 27.73 (SD = 3.96). Wilcoxon's rank-sum test is highly significant ($W = 508.5$, $p < 0.001$). The structure and level of answers are largely comparable to those from the respondents in the FINDUS IDM/IDW experiments (Biasutti and Frate 2017).

Further, results show that the majority of respondents is only moderately concerned with sustainability issues when taking a holiday trip (and even less with

Table 6 Average CIP involvement scores

Dimension	Involvement items	Holiday trips (ex-ante survey)	Sustainable products (ex-post survey)	*p*
Interest	I1 . . . are important to me	1.33	2.00	**<0.001**
	I2 . . . interest me a lot	1.12	1.97	**<0.001**
	I3 . . . leave me completely indifferent (reverse)	1.22	1.61	**0.022**
Pleasure	P1 It is fun to take/use . . .	1.09	1.73	**<0.001**
	P2 Taking/using . . . is a bit like giving a gift to ourselves	1.46	2.39	**<0.001**
	P3 It is pleasure for me to take/use . . .	1.15	2.09	**<0.001**
Sign	S1 You get an impression of someone depending on if/how he uses . . .	2.30	2.46	0.429
	S2 It tells about the personality if/how someone uses . . .	2.00	2.42	0.031
	S3 It tells others about what type of person I am using . . .	2.36	2.67	0.125
Risk	R1 It is no problem when you choose the wrong . . . (reverse)	1.79	2.54	**0.004**
	R2 It is annoying to choose the wrong . . .	2.18	3.30	**0.002**
	R3 If one realises that one has chosen the wrong . . . it is disturbing	2.36	2.55	0.547
	Score	20.27	27.73	**0.000**

Numbers are means from a scale of 1 = Completely agree through 5 = Completely disagree; *p* values are from paired-samples t-tests using Wilcoxon signed-rank test; item order was randomised during the interviews

ecological aspects compared to social aspects). Most involvement scores are significantly higher (i.e. smaller numbers) for holiday trips compared to general sustainable products. This is true for all items except the sign values and risk value 3.

2.3.3 Attitudes Towards Sustainable Holiday Trips

Firstly, the respondents' attitude towards sustainable development in general was enquired using the German translation of a standardised scale (Dunlap and Van Liere 1978; Dunlap et al. 2000; Fleury-Bahi et al. 2015; Lundmark 2007). This relatively new scale was developed with regard to the new environmental paradigm (NEP) (Schmücker et al. 2017a). The scale has 15 items with pseudometric values 1 through 5, with value 1 indicating "completely agree", and 5 indicating "completely disagree". Results show that respondents have a positive attitude towards the three dimensions of sustainability (all values are below the theoretical mean of 3.0), without reaching into extremes (Table 7).

Additionally, attitudes towards 11 aspects of holiday travel were collected using a standardised scale from the German Reiseanalyse (Kuhn 2017). It covers questions about attitudes towards, among others, booking and packaging, pricing, and special needs during a holiday. Two of the items cover the ecological and social aspects of sustainability. Using this standardised scale for attitude measures prevents priming of respondents and reduces social desirability bias. Table 8 shows that the members of our sample have a slightly more negative attitude towards these aspects compared to the overall population.

Furthermore, we asked our respondents a factual question about the importance of sustainability for their last holiday trip. For this question, we can use reference data from the German-speaking population from the Reiseanalyse 2014. The comparison is, however, slightly skewed because the original question was longer, and therefore, the two columns on the right of Table 9 do not add up to 100%. The table shows, however, that the percentages for the first two items are comparable, while the last item "not at all interested in sustainable travel", has considerably lower values in the FINDUS sample compared to the population.

In addition to the results reported here, further analyses can be found in the thesis of one of the co-authors (Meehl 1978).

3 Results

3.1 Overview of Hypotheses

The experimental setup was chosen based on the following hypotheses:

Table 7 Sample results for a NEP-type scale

Dimension	Item	Mean	SD
Environment	1. When people interfere with the environment, they often produce disastrous consequences.	1.76	0.97
	2. Environmental protection and people's quality of life are directly linked.	1.64	0.82
	3. Biodiversity should be protected at the expense of industrial agricultural production.	1.84	0.71
	4. Building development is less important than environmental protection.	2.73	1.57
	5. Environmental protection is more important than industrial growth.	2.06	0.90
Economic	6. Government economic policies should increase sustainable production even if it means spending more money.	1.39	0.70
	7. People should sacrifice more to reduce economic differences between populations.	1.39	0.61
	8. Government economic policies should increase fair trade.	1.49	0.80
	9. Government economic policies should act if a country is wasting its natural resources.	1.49	0.80
	10. Reducing poverty and hunger in the world is more important than increasing the economic well-being of the industrialised countries.	1.76	0.79
Social	11. Each country can do a lot to keep the peace in the world.	1.52	0.71
	12. The society should further promote equal opportunities for males and females.	1.76	0.97
	13. The contact between cultures is stimulating and enriching.	1.36	0.60
	14. The society should provide free basic health services.	1.46	0.62
	15. The society should take responsibility for the welfare of individuals and families.	1.67	0.74

Pseudometric scale, 1 "completely agree" through 5 "completely disagree"

H1 (zero case): Sustainability information clues *are not viewed* more frequently or longer compared to the same format with other (neutral) clues present (to be tested on set 1).

H2 (attitude): Sustainability information cues are viewed more frequently or longer if the attitude towards tourism sustainability is positive (to be tested on set 1).

H3 (availability): Visual attention towards other types of information decreases with the availability of sustainability information (to be tested on set 2).

H4 (instruction): Sustainability information clues *are viewed* more frequently or longer if the respondent is instructed to choose the most sustainable alternative compared to the neutral instruction (to be tested on set 3).

H5 (instruction–attitude): The instruction effect from H4 will be intensified if the attitude towards tourism sustainability is positive (to be tested on set 3).

As additional moderating variables, we enquire about the attitude towards sustainability and the involvement with sustainable products. We hypothesise that a more positive attitude towards sustainability and a higher involvement with

Table 8 Attitudes towards sustainability aspects in holiday travel

	Respondents (%)	Holidaymakers booking online 2016	Holidaymakers Mediterranean 2014–2016
N	33	2112 (19.0 mill.)	3282 (29.6 milll.)
My holiday trips should be as ecologically compliant, resource-efficient and eco-friendly as possible			
1—Completely agree	15	20	20
2	30	33	29
3	21	34	37
4	27	10	10
5—Completely disagree	6	4	3
My holiday trips should be as socially compliant as possible (. . .)			
1—Completely agree	21	23	24
2	46	37	33
3	21	32	33
4	12	7	7
5—Completely disagree	0	2	2
TOP 1: Completely agree (for one or both items)	27		
TOP 2: Agree (for one or both items)	67		
TOP 2, but not TOP 1	39		

Numbers are percentages; Data on the two aspects shown were collected within a frame of nine other attitude items not related to sustainability issues. Source for population data: Reiseanalyse 2017, © Forschungsgemeinschaft Urlaub und Reisen e.V.

Table 9 Importance of sustainability for the last holiday trip

	Respondents	Holidaymakers booking online 2016	Holidaymakers Mediterranean 2014-16
N	33	2112 (19.0 mill.)	3282 (29.6 milll.)
Sustainability was the key criterion.	0	2	2
Sustainability turned the balance because offers were equivalent in other aspects.	9	2	1
Sustainability was one aspect among others.	36	11	9
Sustainability was of no importance for that particular holiday trip.	55	28	25
I am not at all interested in sustainable travel.	0	27	28

Numbers are percentages. Source for population data: Reiseanalyse 2014, © Forschungsgemeinschaft Urlaub und Reisen e.V.

sustainable products lead to viewing sustainability information clues more frequently or longer, while involvement with holiday travel does not. To separate attitude and involvement groups, we use a median split.

3.2 H1 (Zero Case)

H1(zero case): Sustainability information clues are not viewed more frequently or longer compared to the same format with other (neutral) clues present (to be tested on set 1).

In set 1, mean fixation counts and mean fixation duration regarding the presented stimuli overall do not differ highly between the two conditions of sustainability labels versus neutral labels. Stimuli with sustainability labels were fixated on with a mean of 247.2 times and mean fixation duration of 63.2 s. Stimuli with neutral labels were fixated on with a mean of 237.5 times and mean fixation duration of 59.8 s. This shows that respondents vary a lot regarding the time they require for information intake; however, the presence of sustainability information does not appear to have an impact on the fixation counts and duration on overall stimuli (Table 10).

Further, the fixation counts and durations on the AOIs were measured more specifically. Overall, respondents have fixated on AOIs concerning sustainability labels with a mean of 7.1 times and mean fixation duration of 2.0 s across the five stimuli. Concerning AOIs appointed on neutral labels, respondents have fixated with a mean of 6.3 times and mean fixation duration of 1.7 s across the presented stimuli. This shows that sustainability labels were fixated slightly more often and slightly longer compared to labels displaying neutral information.

Given the relatively large amount of available information on the screenshots and based upon the results of the IDM/IDW studies, we do not assume to have higher, or at all different, rates for the sustainability labels compared to neutral labels.

None of the classical tests yields significant results. However, it must be noted that we tested for the alpha error with the assumption that the null hypothesis (H_0) represents identical means between the two groups. *Not rejecting* the H_0 is quite

Table 10 Descriptive results of fixations on stimuli (set 1)

	Condition 1. sustainability labels	Condition 2: neutral labels	Paired samples *T*-value	Two-sided *p*	Two-sided BF_{10}
Fixation count (total)	$M = 247.2$ (SD = 137.4)	$M = 237.5$ (SD = 135.4)	0.909	0.370	0.273
Fixation duration (total)	$M = 63.2$ (SD = 40.1)	$M = 59.8$ (SD = 38.8)	1.183	0.245	0.353

Table 11 Paired samples test results for fixations on the "labels" AOI in set 1

	Condition 1: sustainability labels	Condition 2: neutral labels	Paired samples *W*-value	Two-sided *p*	Two-sided BF_{01}
Fixation count	$M = 7.06$ (SD = 5.60)	$M = 6.33$ (SD = 5.81)	297.5	0.182	2.42
Fixation duration	$M = 1.99$ (SD = 2.04)	$M = 1.67$ (SD = 1.89)	381.0	0.074	1.39
Fixation count %	$M = 2.58$ (SD = 1.41)	$M = 2.39$ (SD = 1.44)	326.0	0.426	4.22
Fixation duration %	$M = 2.66$ (SD = 1.85)	$M = 2.35$ (SD = 1.56)	333.0	0.358	3.38

different from *accepting* the H_0 in the classical (frequentist) paradigm, or, as attributed to Ronald A Fisher, "null hypotheses are only to be rejected and never accepted" (Etz and Vandekerckhove 2017; Rouder et al. 2009).

Therefore, we took the same data for a test using Bayesian inferential statistics. In the Bayesian paradigm, both perspectives can be taken: Support for H_1 compared to H_0 would be indicated by a large Bayes factor BF_{10}, while support for H_0 compared to H_1 would be expressed by a large Bayes factor BF_{01} (Schmücker et al. 2017b). Note that the last column in Table 11 shows the BF_{01} (not BF_{10}), thus the factor in favour of the H_0 (not the H_1). From the results, we find a very weak support for the H_0 (e.g. fixation count results are 2.4 times more likely under the H_0 than under the H_1), i.e. some support for our assumption, that in terms of visual perception there really is no difference in displaying sustainability labels or some other labels instead.

3.3 H2 (Attitude)

H2 (attitude): Sustainability information cues are viewed more frequently or longer if attitude towards tourism sustainability is positive (to be tested on set 1).

In order to test the visual attention towards sustainability information against the a priori attitude towards sustainability, we used the attitude scale reported in Table 8. Group 1 was with a positive attitude (either ecologically or socially on the points 1 or 2 of the 5-point scale), group 2 was with no positive attitude. Group 1 was two-thirds of the sample; group 2 was one-third of the sample.

3.3.1 Fixation Counts

A repeated-measures ANOVA with a between-subjects factor was used, with the two conditions as repeated measures and the two attitude groups as between-subject factor. Although means of fixation counts for sustainability labels in the positive-attitude group are higher than in the low-attitude group, this is also true for the non-sustainability labels (Table 12). Thus, splitting the respondents into two groups does not add much information to the measurements. Consequently, the analysis yielded an F ratio of only $F(1,31) = 0.096$, $p = 0.759$.

3.3.2 Fixation Duration

As to fixation duration on the "labels" AOI, we find no significant difference in a repeated measures factorial ANOVA with the two conditions as repeated measures cell and the two attitude groups as between-subject factors. Although again mean values in the positive attitude group are higher for sustainability labels, they are also higher for the neutral labels, compared to the non-positive attitude group. The mean difference on this main effect yielded an F ratio of $F(1,31) = 0.202$, $p = 0.656$ (Table 13 and Fig. 4).

Table 12 Repeated measures ANOVA for attitude groups (fixation counts)

Fixation count	Percentage of respondents	Condition 1 (mean of AOI "labels")	Condition 2 (mean of AOI "labels")
Positive attitude towards sustainability (top 2)	67	$M = 7.23$ (SD = 5.91)	$M = 6.59$ (SD = 6.12)
No positive attitude towards sustainability	33	$M = 6.73$ (SD = 5.16)	$M = 5.82$ (SD = 5.21)
All respondents	100	$M = 7.06$	$M = 6.33$

Table 13 Repeated measures ANOVA for attitude groups (fixation duration)

Fixation duration	Percentage of respondents	Condition 1 (mean of AOI "labels"	Condition 2 (mean of AOI "labels")
Positive attitude towards sustainability (top 2)	67	$M = 2.13$ (SD = 2.25)	$M = 1.74$ (SD = 2.11)
No positive attitude towards sustainability	33	$M = 1.72$ (SD = 1.59)	$M = 1.52$ (SD = 1.43)
All respondents	100	$M = 1.99$	$M = 1.67$

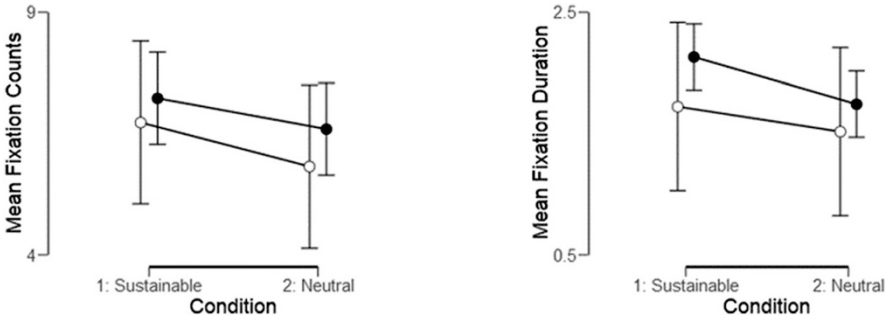

Fig. 4 Means of fixation counts and fixation duration in Top 2 attitude groups (black) and non-positive attitude groups (white), with error bars representing the 95% error interval

3.4 H3 (Availability)

H3 (availability): Visual attention towards other types of information decreases with the availability of sustainability information (to be tested on set 2)

In set 2 we wanted to see, if and where visual perception rates for non-sustainability information go down if a sustainability label is added.

3.4.1 Fixation Counts

First, we checked for the differences between the two conditions regarding the fixation counts on AOIs. With a mean of 267.36 fixations, condition 1 exhibiting sustainability labels is fixated on slightly more often than condition 2 without any labels with a mean fixation count of 254.79. The fixation counts on details, price, and name and place are higher when sustainability labels are displayed. Further, fixation counts on descriptions and photos appear to be lower when sustainability information is available (Table 14).

When we measure fixation counts, we can see that details receive some more information attention ($W = 356$, $p = 0.011$), while photos receive some less attention when sustainability information in available ($W = 141.5$, $p = 0.013$) (Table 15).

3.4.2 Fixation Durations

Furthermore, we checked the differences in fixation durations between the two conditions. Condition 1 is viewed slightly longer compared to condition 2. Overall,

Table 14 Descriptive results of fixation counts on AOIs (set 2)

	Condition 1: With Ecolabels				Condition 2: no additional labels			
Fixation counts	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*
Ecolabels[a]	0	14	4.58	*4.54*	–	–	–	–
Name and place	0	157	45.60	*41.37*	2	141	44.12	*39.82*
Description	0	165	52.52	*53.54*	0	243	58.88	*61.72*
Details	0	74	18.15	*16.52*	0	43	13.52	*12.16*
Price	0	80	27.15	*19.32*	0	62	24.30	*16.46*
Photos	9	170	71.0	*39.18*	6	171	79.67	*36.73*
AOI sum			219.35				220.49	
Other fixations			48.01				34.30	
Total	57	663	267.36	*174.47*	50	730	254.79	*162.72*

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
Italics values in table refers to "Standard Deviation"

Table 15 Significance test results or fixation counts between conditions 1 and 2

	Paired-samples	Two-sided	Two-sided
Fixation counts	*W*	*p*	BF_{10}
Ecolabels[a]	–	–	–
Name and place	296.0	0.346	0.234
Description	227.5	0.495	0.474
Details	356.0	**0.011**	**3.860**
Price	324.5	0.058	0.639
Photos	141.5	**0.013**	**1.862**
AOI sum			
Other fixations			
Total	365.5	0.129	??

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
W is the Wilcoxon's rank-sum test

ecolabels were fixated with a mean duration of 1.32 s across the six stimuli. Overall, the additional labels appear to lead to a minor reduction in fixation duration on name and place, descriptions and photos on one hand, and to an increase in fixation duration for details and prices on the other hand. These differences will be further analysed in the following chapter (Table 16).

Interestingly, the additional labels do lead to a minor reduction in fixation duration for name and place, descriptions and photos on one hand, and to an increase in fixation duration for details and prices on the other hand. Note that price is the only item showing a highly significant difference by classical standards and a moderate support for H1 over H0 in Bayesian statistics (Table 17): As ecolabels appear, attention for prices seems to go up.

Table 16 Descriptive results of fixation duration on AOIs (set 2)

	Condition 1: with ecolabels				Condition 2: no additional labels			
Fixation duration (s)	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*
Ecolabels[a]	0.00	4.25	1.32	*1.43*	–	–	–	–
Name and place	0.00	39.19	11.48	*10.49*	0.24	43.57	12.14	*10.91*
Description	0.00	78.53	15.36	*19.47*	0.00	78.27	17.47	*20.81*
Details	0.00	13.90	3.87	*3.56*	0.00	10.31	2.92	*3.14*
Price	3.30	29.11	7.24	*6.33*	2.29	39.60	5.82	*5.06*
Photos	0.00	36.00	17.56	*9.67*	0.00	20.86	18.89	*10.03*
AOI sum			56.83				57.24	
Other fixations			8.69				7.71	
Total	7.28	194.31	65.52	*42.53*	6.00	233.96	64.95	*46.44*

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
Italics values in table refers to "Standard Deviation"

Table 17 Significance test results or fixation duration between conditions 1 and 2

	Paired-samples	Two-sided	Two-sided
Fixation duration (s)	*W*	*p*	BF_{10}
Ecolabels[a]	–	–	–
Name and place	259.0	0.711	0.280
Description	187.5	0.155	1.506
Details	354.0	0.039	1.286
Price	403.0	0.002	8.220
Photos	183.0	0.083	0.495
AOI sum			
Other fixations			
Total	353.0	0.201	0.190

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism

3.5 H4 (Instruction)

H4 (instruction): Sustainability information clues are viewed more frequently or longer if the respondent is instructed to choose the most sustainable alternative compared to the neutral instruction (to be tested on set 3).

The analysis of this hypothesis is expected to shed light on the familiarity of respondents regarding the availability of sustainability information. The question hereby is whether respondents are able to locate and detect all the given sustainability information clues. Further, a conclusion regarding this hypothesis will clarify the way in which respondents make use of sustainability information in terms of repetitive fixations for a comparison of the given information across the alternatives of holiday offers.

3.5.1 Fixation Counts

Fixation counts under the two conditions of neutral instruction and sustainability instruction in set 3 were examined. Closely aligned to the descriptive statistics of fixation durations, the fixation counts on the overall stimuli were fewer under condition 2 with a mean fixation count of 213.93 compared to condition 1 with a mean fixation count of 300.77. However, fixation counts on most of the AOIs containing sustainability information increased under condition 2, as was expected (Table 18).

Subsequently, the Wilcoxon test has been conducted with the fixation counts on AOIs displaying sustainability information. Here, carbon footprint labels were fixated on significantly more often under condition 1 ($W = 106/30$ at $p = 0.047$ and $z = -1.98$), as well as implicit sustainability information ($W = 352/113$ at $p = 0.014$ and $z = -2.46$) and the summary of sustainability performance ($W = 339/12$ at $p = 0.00$ and $z = -4.15$). The only non-significant result here was for the ecolabels ($W = 229/96$ at $p = 0.073$ and $z = -4.15$) (Table 19).

Table 18 Descriptive results of fixation counts on AOIs (set 3)

	Condition 1: neutral instruction				Condition 2: sustainability instruction			
Fixation count	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*
Carbon footprint label	0	6	0.87	*1.38*	0	15	2.40	*4.45*
Implicit information	0	108	38.47	*35.88*	0	193	59.93	*57.91*
Ecolabels[a]	0	25	3.83	*4.87*	0	32	7.27	*8.24*
Summary of sustainability performance	0	44	5.40	*9.10*	0	52	14.70	*16.71*
AOI sum			48.51				84.29	
Other fixations			252.26				129.64	
Total	38	681	300.77		50	610	213.93	*146.77*

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
Italics values in table refers to "Standard Deviation"

Table 19 Results of Wilcoxon test (Fixation Counts, set 3)

	Condition 1: neutral instruction		Condition 2: sustainability instruction		Paired-samples	Two-sided
Fixation count	Mean	*SD*	Mean	*SD*	*W*	*p*
Carbon footprint label	0.87	*1.38*	2.40	*4.45*	106.00/30	0.047
Implicit information	38.47	*35.88*	59.93	*57.91*	352.00/113	0.014
Ecolabels[a]	3.83	*4.87*	7.26	*8.24*	229.00/96	0.073
Summary of sustainability performance	5.40	*9.10*	14.70	*16.71*	339.00/12	0.000
AOI sum	48.51		84.29			
Other fixations	252.26		129.64			
Total	300.77	189.13	213.93	*146.77*	76.00(372)	0.001

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
W is the Wilcoxon's rank-sum test

3.5.2 Fixation Duration

Overall fixation durations on the stimuli differed between the two conditions, whereat the first condition with a mean fixation duration of 83.61 s is viewed much longer than the second condition with a mean fixation duration of 55.39. It is to note that the same stimuli were shown in the two conditions, so that respondents were already familiar with the offers in condition 2, which resulted in shorter fixation durations on the overall stimuli. Very contrary to the fixation durations on the entire stimulus, fixation durations on most of the appointed AOIs with sustainability information increased under condition 2, apart from the carbon footprint label (Table 20).

The data were first checked for the assumption of normality with the Shapiro–Wilk test, which indicates that the data deviate from a normal distribution. Therefore, the non-parametric Wilcoxon test was selected for data analysis and interpretation. Results of the Wilcoxon test presented in Tables 19 and 21 show that all

Table 20 Descriptive results of fixation duration on AOIs (set 3)

	Condition 1: neutral instruction				Condition 2: sustainability instruction			
Fixation duration (s)	Min.	Max.	Mean	*SD*	Min.	Max.	Mean	*SD*
Carbon footprint label	0.00	11.85	0.18	*0.31*	0.00	1.19	1.09	*2.54*
Implicit information	0.00	50.23	10.20	*12.71*	0.00	42.56	15.87	*15.95*
Ecolabels[a]	0.00	8.78	0.75	*0.85*	0.00	3.59	2.49	*2.77*
Summary of sustainability performance	0.00	19.12	1.63	*3.10*	0.00	16.04	5.63	*6.93*
AOI sum			12.76				25.08	
Other fixations			70.85				30.31	
Total	6.67	243.91	83.61	*62.75*	4.08	160.72	55.39	*38.08*

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
Italics values in table refers to "Standard Deviation"

Table 21 Results of Wilcoxon test (fixation duration, Set 3)

	Condition 1: neutral instruction		Condition 2: sustainability instruction		Paired-samples	Two-sided	Two-sided
Fixation duration (s)	Mean	*SD*	Mean	*SD*	*W*	*p*	BF_{10}
Carbon footprint label	0.18	*0.31*	1.09	*2.54*	122.5	0.112	1.090
Implicit information	10.20	*12.71*	15.87	*15.95*	346.0	0.019	2.332
Ecolabels[a]	0.75	*0.85*	2.49	*2.77*	295.0	0.011	16.152
Summary of sustainability performance	1.63	*3.10*	5.63	*6.93*	271.5	0.004	25.389
AOI sum	12.76		25.08				
Other fixations	70.85		30.31				
Total	83.61	*62.75*	55.39	*38.08*	93.0	0.004	13.892

[a]EU-Ecolabel, Fairtrade Tourism label, Atmosfair label, Ecocertified tourism
W is the Wilcoxon's rank-sum test

sustainability information cues except for the carbon footprint label are viewed significantly longer under condition 2 compared to condition 1.

The carbon footprint label shows a non-significant test result ($W = 122.5/48.5$ at $p = 0.112$) and is therefore not viewed significantly longer when respondents are instructed to look for the most sustainable alternative. However, implicit information is viewed significantly longer ($W = 346$ at $p = 0.019$) as well as ecolabels ($W = 295$ at $p = 0.011$) and the summary of the sustainability performance ($W = 271.5$, $p = 0.004$). The same result structure applies also for the Bayes factors (Table 21).

The fact that overall fixation durations and fixation counts on the stimuli are higher under condition 1 compared to condition 2, whereat fixation durations and fixation counts on AOIs with sustainability information increase significantly under condition 2, shows that respondents have found the informational cues containing sustainability information relatively quickly when asked to look for the most sustainable offer.

3.6 H5 (Instruction–Attitude)

H5 (instruction–attitude). The instruction effect from H4 will be intensified if attitude towards tourism sustainability is positive (to be tested on set 3).

To further check whether there is a moderating or reinforcing effect from attitude on the instruction effect described above, we used a repeated-measurement ANOVA with the two attitude groups described in H2 as between-subjects factors. We use the "Summary of sustainability performance" as an indicator because this variable has shown the most variability in the previous analysis.

3.6.1 Fixation Counts

In fact, fixation counts on the "Summary of sustainability performance" AOI go up if there is a positive attitude towards sustainability. However, this mean difference can be seen under both conditions, and the main effect of attitude does only yield an F-value of $F(1,28) = 0.886$, $P = 0.355$ (Table 22).

3.6.2 Fixation Duration

Basically, the same argument is true when looking at fixation duration instead of fixation counts. While in the positive attitude group the mean fixation duration on the

Table 22 Repeated measures ANOVA for attitude groups (fixation counts)

Fixation count "summary of sustainability performance"	Percentage of respondents	Condition 1: neutral instruction	Condition 2: sustainability instruction
Positive attitude towards sustainability (Top 2)	67	$M = 6.05$ (SD = 10.74)	$M = 16.70$ (SD = 17.67)
No positive attitude towards sustainability	33	$M = 4.10$ (SD = 4.51)	$M = 10.70$ (SD = 14.64)
All respondents	100	$M = 5.40$	$M = 14.70$

Table 23 Repeated-measures ANOVA for attitude groups (fixation duration)

Fixation count "summary of sustainability performance"	Percentage of respondents	Condition 1: neutral instruction	Condition 2: sustainability instruction
Positive attitude towards sustainability (Top 2)	67	$M = 1.90$ (SD = 3.72)	$M = 5.85$ (SD = 6.89)
No positive attitude towards sustainability	33	$M = 1.08$ (SD = 1.12)	$M = 5.20$ (SD = 7.37)
All respondents	100	$M = 1.63$	$M = 5.63$

"Summary of sustainability performance" AOI is higher than in the low-attitude group under the sustainability instruction, the same is true under the neutral instruction. While the main effect of the two instructions is highly significant, the main effect of attitude is not, with $F(1,28) = 0.182$, $p = 0.673$ (Table 23).

4 Discussion

This series of studies applies classical experimental designs to eye tracking measurement. The field of study is the attention for sustainability-related information in tourism products.

It was found that in an environment of mass-market sun and beach tourism products, sustainability labels do not find much attention: Respondents view sustainability labels only in between 2% and 3% of all fixations and also between 2% and 3% of the view time. Sustainability labels are not viewed more often than other labels relating to destination, sports or price information. This small interest in such labels in a realistic environment is in line with previous research and thus with expectations.

As opposed to expectations, however, an a priori positive attitude towards sustainability has only a small and non-significant influence on visual perception of sustainability labels. The sheer amount of available and relevant information seems to supersede the influence of a positive attitude on sustainability. However, it is important to note that the "amount of visual attention" towards sustainability information as measured in this study does not make an indication on the

respondents' experience with and attitude towards ecolabels. As such, a high amount of visual attention towards sustainability information could either signify a high interest in ecolabels or very little knowledge about ecolabels and thus the need for a closer examination. Further, a small amount of visual attention towards sustainability information could indicate that respondents are familiar with a label and do not need to examine it closer on one hand, but could also indicate little interest in ecolabels overall on the other hand. Thus, the exact interpretation of what it means to direct attention to an ecolabel should be subject to further research.

Besides the question of how intensive *sustainability* labels are viewed, we also studied the viewing behaviour of *other* information clues when sustainability information is introduced. We found that in terms of the number of fixations, the importance of product details goes significantly up while the importance of photos goes significantly down. In terms of view time, reflecting the intensity of evaluation, we found that the attention towards prices goes significantly up as soon as sustainability information is added to the set of available information.

Lastly, we checked which sustainability information format would get more attention when pushing respondents to look out for sustainability information. As expected, attention to all sustainability-related clues (ecolabels, carbon footprint labels, implicit information and sustainability performance) increases when respondents are instructed to look for the most sustainable alternative. This implies that consumers seem to generally know where to find information on sustainability performance. However, sustainability labels (ecolabel, carbon footprint label) do not only have the smallest share in terms of view counts and view times, but also the least (and at times not even significant) increase when instructions are changed from neutral to sustainability focused, while other sustainability information, and here specifically the implicit information, is viewed significantly more often and longer. Again, the a priori attitude towards sustainability in travel does not have a significant main effect on view counts and times.

5 Conclusion

The data show again that sustainability labels alone receive relatively little attention in a realistic environment.

Results of testing hypothesis 1 showed that ecolabels do not experience significantly more visual attention than labels which are void of content and information. This shows that any type of label catches the glimpse of the consumer's eye; however, it is questionable whether such information is thoroughly taken in and interpreted.

Results on the second hypothesis test showed that those respondents with a more positive attitude towards sustainability seem to pay more attention to labels, regardless of whether the labels exhibit sustainability information or unspecific information. As such, the target group appears to be more mindful and attentive when looking for suiting holiday products.

Regarding the third hypothesis of this study, it becomes apparent that the availability of ecolabels leads to a minor reduction of attention towards name and place, descriptions and photos on one hand, and to an increase in attention for details and prices on the other hand.

The fourth hypothesis tested the influence of an instruction on the amount of visual attention towards sustainability information. Here, it can be seen that sustainability cues are easily and quickly detected by respondents when instructed to look for the most sustainable offer.

Results on testing hypothesis 5 showed, again, that those respondents with a positive attitude towards sustainability seem to be more mindful and put more effort into their information search than those with a less positive attitude towards sustainability. This is true regardless of the previous instructions given.

Overall, this study found that it seems advisable to think about additional ways to related sustainability information to consumers. It could be shown that implicit information, again, yields a higher share of attention than labels. Therefore, the design and informational transmittance of products combining sustainability and experiential value to the customer seem to be worthwhile as one of those alternatives. Care should be taken of the price argument because attention towards prices rises as soon as sustainability information becomes available.

Again, the data do not suggest to dispense with ecolabels. They do suggest, however, that a change in informational environment (i.e. directing consumers to sustainability issues) and the additional use of experience-related information aspects would increase the attention for sustainability information in tourism. Attention, however, can be seen as a prerequisite for perception, cognitive evaluation and decision-making.

It might be that simply the sheer number of more than 150 different ecolabels in the market leads to the fact that the average customer does not pay much attention to them. For this purpose, it might be a good idea to apply the methodology to different kinds of labels. This, however, needs to be tested in future research.

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The Museum Learning Experience Through the Visitors' Eyes: An Eye Tracking Exploration of the Physical Context

Mattia Rainoldi, Chung-En Yu, and Barbara Neuhofer

Abstract Experiences always need to be designed with the visitor in mind. In our society, museums hold a prominent place for human learning and experiences. Museum experiences have become a sophisticated blend of spatial design, exhibit curation, and multimedia selection, shaping the overall physical context of the visitor's experience. Driven by the question of how we can create effective visitor learning experiences in contemporary museums, a large-scale mobile eye tracking was conducted. Mobile eye tracking has recently entered tourism research as a novel method to study visitor behaviour in real-life environments and in a non-intrusive manner. The findings reveal that the physical context greatly influences the museum learning experience, and show significant differences in attention and engagement levels across the exhibition's elements. The study adds insights into the relationship between visitors' museum learning processes and the physical context and contributes to the model of contextual learning. Practical implications for museum experience design are offered with regards to spatial experience design and different visitor age segments.

Keywords Museum · Learning experience · Mobile eye tracking

1 Introduction

Museums offer liminal spaces that invite visitors to have engaging learning experiences. While experiences unfold, it has been common knowledge that maintaining visitors' attention in art galleries, exhibitions, and museums is not an easy task due to museum fatigue and satiation (Antón et al. 2018; Germak and Khan 2017). The former refers to a predictable tiredness that leads to the decrease of interests during the visit (Davey 2005). The latter suggests a lack of attention resulting from the

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repeated exposure to similar stimuli (Antón et al. 2018). Since visitors often spend the same amount of time centred on exhibits during the visit (Rainoldi et al. 2018), one central question for the design of these spaces (Hein 1998) is how to effectively facilitate learning experiences. With the advancement in information and communication technologies (ICTs), institutions and organizations have attempted to transform learning activities from traditional printed materials to technology-enabled formats (Pachman et al. 2016). This is supported by a number of studies showcasing that digital materials are valuable to learning and teaching (McGuinness and Fulton 2019; Henderson et al. 2017; Zwart et al. 2017). As opposed to traditional media that are static in nature, technology-driven elements attract higher levels of interest and attention (Venkatraman et al. 2018) and have been used as an effective tool to serve educational purposes (Henderson et al. 2017).

In the same vein, physical gallery spaces and museums have incorporated digital technology to aid visitor experiences by facilitating the learning process (Pallud 2017) and improving visitor engagement levels (Kounaves et al. 2016). Well-known examples can be seen from the application of interactive technologies in the Louvre Museum, Brooklyn Museum, and British Museum, among others. To effectively combine the old and the new, it is necessary to investigate the interaction between visitors and the physical context of an exhibition (Falk and Dierking 2013). While doing so, one also needs to bear in mind various visitor profiles, such as age differences and technology preferences. Younger consumers are often characteristics as tech-savvy, whereas older consumers might be reluctant to using technology-related objects (Douglas et al. 2018). Therefore, museum experience designers have to strategically create a diversified, interactive, and engaging platform for visitors (Falk and Dierking 2013).

If achieved, a positive museum experience could not only enhance the visitor satisfaction and revisit intentions (Kang et al. 2018) but also improve the extent of learning capability (Pallud 2017). Notably, earlier research has applied the Contextual Model of Learning (Falk and Storksdieck 2005; Lundgren and Crippen 2019; Hsu and Liang 2017; Rainoldi et al. 2018) as a suitable framework to study the complexities of the museum experience at a socio-cultural, personal, and physical level (Falk and Dierking 2013). This study has an interest in the physical context that is inextricably related to the design of museum learning experiences.

To investigate visitors' attention during the visit, the application of mobile eye tracking glasses has gained increasing popularity in tourism research (Scott et al. 2019) as it allows natural movement in real-world situations. For instance, Mokatren et al. (2016) explore the role of mobile eye trackers in enhancing the museum visitor experience. More recently, the study of Krogh-Jespersen et al. (2020) investigates visitors' visual attention in a science museum and discovers that the position of signage is related to the feeling of connectedness within an exhibition space. Nonetheless, given the potential benefits of mobile eye tracking, research on visitor real-life experiences is still in its infancy, not to mention the generational differences between visitors in the museum context.

Therefore, the current study aims to tackle the research gap by investigating the museum experience of visitors in different age groups. Specifically, this research

seeks to uncover the effectiveness of space design by examining different elements of an exhibition (e.g. textual information boards, traditional exhibits, and digital materials). By bridging the interdisciplinary fields of visual attention, contextual learning theory, experience design, and museum management, this research provides additional knowledge to the body of mobile eye tracking research in the context of tourism. Practically, it highlights the importance of effective object and space design for museums to provide a flow experience for visitors.

2 Literature Review

2.1 The Importance of Visual Attention

Attracting visual attention has been a key topic in the domain of tourism research (Wang and Sparks 2016; Scott et al. 2019). Specifically, visual attention refers to one's cognitive processing in filtering out the irrelevant information from all the visual elements (Kastner and Pinsk 2004). Notably, humans' eye movements are largely influenced by the nature of objects. For instance, pictures are more visually appealing than text (Lin et al. 2017), whereas digital contents are more attractive than traditional static materials (Venkatraman et al. 2018). In the age of the Internet, the application of technological-driven materials gains its popularity not only in marketing and advertising (Venkatraman et al. 2018; Beck et al. 2019) but also in education (McGuinness and Fulton 2019) and experience design (Neuhofer et al. 2014; Rainoldi et al. 2018). Specific to the tourism field, visual attention plays a crucial role in information retention (Goulding 2000) sightseeing, and interpretation (Scott et al. 2019). Additionally, the overall tourism experiences can be largely affected by attracting and holding one's attention (Ooi 2003). Similarly, other scholars highlighted the need for managing distractions within an environment to allow a more pleasant experience (Ooi 2003; Ellis and Rossman 2008; Wagler and Hanus 2018). Since eye movements often occur at an unconscious level (Kastner and Pinsk 2004), it is nearly impossible to study visitors' gaze attention with traditional research techniques, such as surveys or interviews (Scott et al. 2019). Recent research has therefore opened more experiential methods, and adopted eye tracking tools as an emerging technology in this particular context (Eghbal-Azar and Widlok 2012; Schwan et al. 2020; Filippini-Fantoni et al. 2013).

While the study of visual attention is not new in other disciplinary areas such as psychology or neuroscience, it is only recently that tourism research is embracing the benefits of the eye tracking technique (Scott et al. 2019). Apart from a more conventional practice to study tourists' eye movement in laboratory settings (Pachman et al. 2016), a wearable eye tracker is designed to capture natural gaze cues in real-life situations, such as in retail shops (Huddleston et al. 2015), urban environments (Kiefer et al. 2014), cultural heritage locations (Mokatren et al. 2018), and museums (Mokatren et al. 2016; Rainoldi et al. 2018). In response to numerous product and object presentations nowadays, designers have to be aware of the

selective attention resulting from the mental fatigue and satiation (Antón et al. 2018; Germak and Khan 2017). Earlier research underpinned that insights from visual attention could improve mobile learning (Mayr et al. 2009), and enhance visitor experiences (Mokatren et al. 2016). A typical example where tourism spaces have been designed with an educational purpose in mind are museums (Trofanenko 2010). Greater importance should, therefore, be attached to the learning–museum relationship in order to facilitate the overall visitor experience (Rainoldi et al. 2018).

2.2 Visitors' Gazes in the Museum Context

Museums are vital public spaces collecting and preserving historical and cultural objects (Falk and Dierking 2013), and improving social cohesion. By connecting past and contemporary events, museums also play a key role in learning and educational purposes (Trofanenko 2010). As one can imagine, arranging the collection of artefacts in different rooms and exhibitions has been a crucial task for the designers. What is equally important is to facilitate the individual learning experiences through an effective visitor flow (Hein 1998; Falk and Dierking 2013). Experiences by nature are however highly subjective at the time of their occurrence, and when evaluated (Neuhofer et al. 2014). This means that in human-centred design, it is critical to take individual differences into consideration. Individual visitor interests and preferences are far from being the same. For instance, Holdgaard (2012) revealed that older visitors are more interested in cultural heritage while younger visitors show a higher interest in natural history. Strohmaier et al. (2015) suggest that visitor paths visualization can be an effective way to help museum professionals improve the design of experiences. Similarly, a plethora of studies discussed the relationship between visitor movements and visitor experiences (Yoshimura et al. 2014, 2019; Tsiropoulou et al. 2017). The artefacts that attract visitors' attention thus become the fundamental elements in influencing one's learning and the overall experience (Bitgood 2006), which subsequently affects the satisfaction, revisit intentions (Kang et al. 2018), and the recommendation intention of the museum (Zanibellato et al. 2018).

With the gaining popularity of eye tracking research, this technique offers real-time information on an individual's perceptions and behaviours (Scott et al. 2019). In particular, wearable eye trackers have been applied in various real-life situations (Huddleston et al. 2015; Mokatren et al. 2018; Rainoldi et al. 2018). Although its application in the museum context could be traced back to the 1980s (Buquet et al. 1988), the complexity and sophistication of eye tracking technology in place today provides more valuable insights into visual attention and attentional processes (Knight et al. 2014). For instance, Mayr et al. (2009) discovered a pattern where visitors tend to scan across the exhibition walls before exploring a single artefact according to their interests. When focusing on an individual level, Filippini-Fantoni et al. (2013) found out that physical objects, photographic substitutes, attract more attention from younger visitors. Other than that, while intuition may suggest that

textual information is generally undesirable, a recent study claims that adults around 40 years old tend to perform deep reading once they notice the description presented around the artefacts (Schwan et al. 2020). However, it must be noted that most museum studies focus on very homogenous age group samples (Bartneck et al. 2007), which limits the understanding of how people in different age groups undergo their learning experiences. After all, mobile eye tracking technology has the potential to uncover visitors' unconscious mind, which can barely be described by themselves (Eghbal-Azar and Widlok 2012). Echoing the relation between visual behaviours and learning experiences (Mayr et al. 2009), it is thus necessary to deepen the understanding regarding which specific elements can facilitate the learning process in museums.

2.3 Contextual Model of Learning

In a free-choice setting condition, individuals' attention spans can be influenced by a wider socio-cultural and personal level (Dunlop et al. 2019). To investigate learning behaviours in the museum context, Falk and Dierking (2004) developed the Contextual Model of Learning. The framework covers three interrelated factors that influence visitor learning; namely, the socio-cultural context, the personal context, and the physical context. Specifically, socio-cultural dimensions refer to the interactions between one another, whereas personal contexts imply individuals' interests, backgrounds, and motivations towards the exhibition (Falk and Storksdieck 2005). Lastly, physical contexts relate to the orientation of the space and the design of exhibits (Falk and Storksdieck 2005). With a particular interest in the present study, it is the physical elements of an exhibition that are the most influential towards a visitor's overall experience (Falk and Dierking 2013). Nevertheless, one needs to bear in mind that none of the contexts remain constant throughout time and that there is an on-going interaction between all three elements (Falk and Storksdieck 2005).

Earlier literature has underpinned the Contextual Model of Learning as a theoretical framework in analyzing museum learning experiences. For instance, Hsu et al. (2018) applied the model to examine children's learning behaviours in a museum embedded in a virtual game. Moreover, Hsu and Liang (2017) discovered that physical sources and social interactions positively influence visitor satisfaction and motivation for continuous learning. With regards to the physical environments that can be controlled by museum professionals, it is worth noting that elements that are large in size and create multisensory experiences are the most memorable ones (Anderson and Lucas 1997). Other scholars pointed out that learning experiences are strongly influenced by the orientation of the physical environment, including the large-scale objects and the detailed information contained within it (Falk and Storksdieck 2005). Another study highlights the fact that the distance between the artefacts and the visitors should be carefully planned to allow a positive outcome (Bartneck et al. 2006). To facilitate the learning process through digital products, the study of Bartneck et al. (2007) reveals a surprising result where visitors' age

difference did not affect their usage. Yet, it appears that the elderly demonstrate a sense of difficulty when using the digital technology in the museum context (Bartneck et al. 2007). Nevertheless, given that the interaction between visitors and artefacts in a museum environment is critical, it is the purpose of this research to address the existing gap and understand the relationship between the physical context and the learning experience, and how age differences could affect visitors' experiences in a museum context.

3 Methodology

Since the museum learning experience appears to be influenced from the physical context and that the way individuals interact with the museum textual information, physical and digital elements seem to be shaped by one's age, this study aim was to unlock an in-depth understanding of learning processes on-site through an analysis of visual attention.

3.1 Sampling and Data Collection

For this study, participants were recruited in the entrance hall of Salzburg Museum over a 3-month period, between June and August 2016. A purposive sampling strategy was adopted for the recruitment of museum visitors. Visitors selected to take part in the study were required to (a) have knowledge of the German language, (b) have no visual impairment, and (c) being first-time visitors of the exhibition 'Bischof. Kaiser. Jedermann.' The exhibition focused on Salzburg's history and development from Roman times to today from the perspective of the local population.

Suitable participants were asked to take a screening survey to assess their motivation for the visit. Based on the Falk and Dierking's (2013) seven typologies of museum visitors the aim of such survey was to identify those 'explorers' visitors whose visit was motivated by an interest in the content of the exhibition and desire for learning. Following the selection processes, 41 visitors volunteered to take part in the study.

Participants equipped with Tobii Pro Glasses 2 were instructed—after the calibration of the eye tracking glasses—to independently walk through the exhibition at their own natural pace and according to their own personal interests and learning objectives. To guarantee a natural learning experience, participants were allowed to enjoy their museum visit together with eventual accompanying people. Tobii Pro Glasses 2 was chosen as the data collection tool because of its wearability enables participants to move freely and experience the museum in an unrestricted manner and in a natural environment. As a result, it enabled to attain an ecologically valid (Bojko 2013) dynamic snapshot of the museum learning experience by capturing the

participants' gaze as they move through the context in which they are immersed through the combination of a scene camera and infrared sensors.

Finally, a post-survey was used to collect demographic data as well as data regarding participants' overall museum experience. Eye tracking recordings were screened to ensure completeness and accuracy before been processed and analyzed in the Tobii Glasses Analyzer. Seven recordings needed to be excluded from the final analysis, due to incompleteness of the recordings or calibration inaccuracies.

3.2 Data Analysis

As museums are environments extremely rich in written information, objects, engaging media, and interactives (Falk and Dierking 2013), the process of data analysis focused on what attracts visual attention thorough an investigation of visitors' fixations. A fixation is thereby defined as a short pause between eye movements in which the attention is focused on a specific area of the visual field (Duchowski 2007). Fixation times are of particular interest for assessing learning processes because the length of a fixation is indicative of the brain information processing and cognitive activity that occurs at a particular moment in time (Bojko 2013).

Thus, for the purpose of this study, the fixations of 34 participants were analyzed in the four following steps. First, the 214,263 recorded fixations (Ø 6.301) extracted from over 25 h of data (Ø 45′23″) where mapped against the museum floor plan of the six analyzed rooms on which each element of the exhibition was previously categorized in following AOIs (Areas of Interest): (a) exhibition's information board, (b) room's information board, (c) exhibits case' information board, (d) exhibits, (e) video screens, and (f) touchscreens. Figure 1 demonstrates the example of Room 1 the categorization of the exhibition's elements into thematical AOIs.

Second, (a) time to first fixation (TFF), (b) total fixation duration (TFD), and (c) average fixation duration (AFD) eye tracking metrics were generated to explore by means of descriptive statistics to appreciate differences in visual attention across exhibitions elements (see Table 1). Third, based on these initial statistical results, a correlation matrix was computed to graphically present the different typologies of exhibitions' elements and their related eye tracking metrics as well as to visualize correlations between exhibition's elements (see Fig. 2). Finally, to discern any significant differences existing between visual attention on the different exhibition's elements and participant's age (based on percentile), a series of one-way analysis of variance (ANOVA) was conducted.

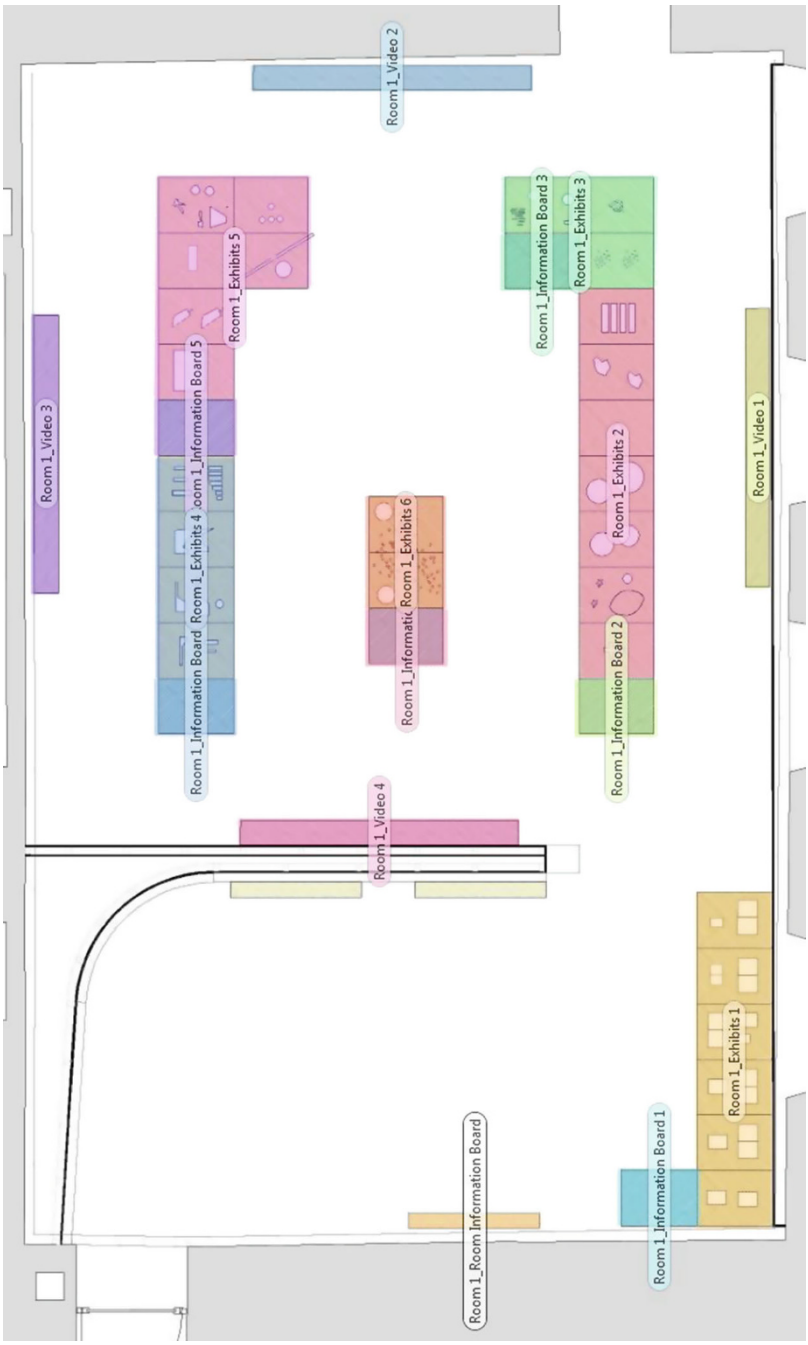

Fig. 1 AOIs Room 1

Table 1 Descriptive statistics of eye tracking metrics

	TFF		TFD	AFD
	[Min, Max]	*M* (SD)	*M* (SD)	*M* (SD)
Exhibits	[38.08, 349.45]	139.99 (69.81)	35.50 (21.47)	0.23 (0.05)
Exhibition's information board	[0, 4.10]	0.22 (0.76)	24.76 (15.20)	0.22 (0.05)
Exhibits case's information board	[20.03, 333.39]	160.06 (88.18)	13.60 (6.74)	0.20 (0.05)
Room's information board	[2.13, 182.50]	39.08 (36.06)	22.01 (10.38)	0.22 (0.05)
Video screens	[26.33, 222.40]	111.95 (55.70)	45.58 (33.33)	0.29 (0.06)
Touchscreens	[18.84, 598.90]	195.52 (123.09)	33.25 (26.54)	0.20 (0.05)

TFF time to first fixation, *TFD* total fixation duration, *AFD* average fixation duration; time in millisecond

4 Results

4.1 Descriptive Statistics

The analyzed data were collected from 34 museum learning 'explores' (14 males and 20 females), ranging from an age of 17 to 80. Participants were categorized into three different age groups based on percentiles, including 13 younger adults, 10 adults, and 11 older adults. The age range of younger adults was 17–29, whereas adults was 30–49. Older adults were ranged between 50 and 80 years old. The overall descriptive statistics of different eye tracking measures on the designated AOIs are presented in Table 1. The results show that most participants first look at the exhibition's information board with an average of 0.22 ms, which is placed at the entrance of Room 1. Next, the data reveal that participants tend to look into the general description first when they enter the rooms with differences between features. When comparing digital materials and exhibits, it appears that touchscreens had the shortest TFF from stimulus onset, followed by video screens and exhibits. Given that, touchscreens had the highest average TFF (195.52 ms). This implies that there might be only a group of museum learners that notice the touchscreens at the very beginning. With regards to the TFD, the results suggest that participants spent the longest time with video screens, exhibits, and touchscreens. However, the information board of different exhibits appears to be the least attractive. Lastly, the results imply that the AFD is similar across the AOIs, with video screens having the highest AFD. Interestingly, the AFD of touchscreens, as digital materials, was the same as the textual description (e.g. exhibits case' information board).

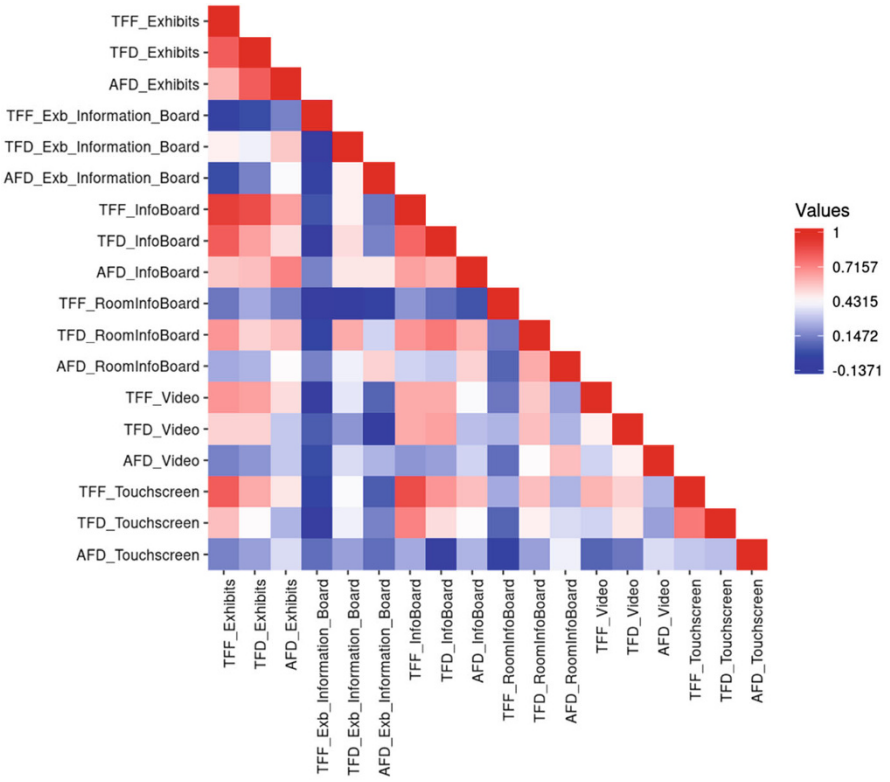

Fig. 2 Visual representation of correlation between different AOIs. *TFF* time to first fixation, *TFD* total fixation duration, *AFD* average fixation duration; time in millisecond; *Exb_Information_Board* exhibition's information board, *InfoBoard* exhibits case' information board, *RoomInfoBoard* room's information board; video= video screens

4.2 Main Analysis

Overall, the relationship between the eye tracking metrics of the designated AOIs are presented in Fig. 2. Colour transparency suggests the strength and direction of the correlation between two variables. Higher transparency implies a weaker relationship. A negative correlation is presented by blue; a positive correlation is presented by red; a correlation closed to zero is indicated by white. The results demonstrate that three eye tracking measures of the exhibits were (strongly) positively correlated with the eye tracking measures of the exhibits case' information board. However, it appears that the eye tracking metrics of video screens and touchscreens were (slightly) negatively correlated with the eye tracking metrics of the general exhibition's information board. Yet, since it is unclear if the museum learners' eye attention would be different when taking the age into account, further analysis was carried out.

To investigate the effectiveness of various types of materials in the museum based on the museum learners' age difference, this study performed several one-way ANOVAs. First, with regards to the exhibits, the results suggest that there was no significant difference on the TFF, $F(2, 31) = 0.841$, $p = 0.441$, TDF, $F(2, 31) = 0.820$, $p = 0.450$ and ADF, $F(2, 31) = 0.263$, $p = 0.771$. Likewise, there was no significant difference for the exhibits case' information boards on the TFF, $F(2, 31) = 1.376$, $p = 0.268$, TDF, $F(2, 31) = 2.430$, $p = 0.105$ and ADF, $F(2, 31) = 0.881$, $p = 0.424$. Nonetheless, a significant result existed on the AFD of the general information boards of the exhibit, $F(2, 31) = 5.749$, $p = 0.008$; yet, not on the TFF, $F(2, 31) = 1.268$, $p = 0.296$ and TDF, $F(2, 31) = 0.694$, $p = 0.507$. Specifically, Tukey post hoc analysis revealed that the AFD was statistically significant between younger adults and older adults ($p = 0.008$) as well as between adults and older adults ($p = 0.043$), where older adults had the highest AFD, followed by adults and younger adults. Nevertheless, for the room's information boards, there was no statistically significant difference on the TFF, $F(2, 31) = 1.570$, $p = 0.224$, TDF, $F(2, 31) = 1.465$, $p = 0.247$ and ADF, $F(2, 31) = 2.523$, $p = 0.097$.

The analysis proceeded further to examine digital objects. In the case of digital materials, the results showed that there was a significant difference for the TFD of video screens, $F(2, 31) = 4.561$, $p = 0.018$ and the TFD of touchscreens, $F(2, 31) = 6.459$, $p = 0.005$. In particular, the TFD of video screens was statistically significant between younger adults and adults ($p = 0.030$), but no other group differences were significantly different. Overall, adults had the longest TFD on video screens, followed by older adults and younger adults. On the other hand, the TFD of touchscreens was statistically significant between younger adults and adults ($p = 0.005$) and between younger adults and older adults ($p = 0.049$). Similarly, adults had the longest TFD on touchscreen, followed by older adults and younger adults. Finally, there were no significant differences existed on the TTF, $F(2, 31) = 0.544$, $p = 0.586$ and ADF, $F(2, 31) = 0.950$, $p = 0.398$ of video screens, nor on the TTF $F(2, 31) = 1.707$, $p = 0.198$ and ADF $F(2, 31) = 0.516$, $p = 0.602$ of touchscreen.

5 Discussion

This study zoomed in on the physical context of a museum as a key element of the museum visitors' learning experience (Falk and Dierking 2004). The analysis first examined various museum elements, and compared visitor's engagement with the room's information boards, exhibition's information boards, exhibits case' information boards, exhibits, video screens, and touchscreens. The analysis of several AOIs and the exhibition's elements revealed that most visitors first notice and look at the exhibition's information boards. It is interesting that touchscreens had the shortest TFF (time to first fixation) and having the highest average TFF (total fixation time), which highlights the great visual attention attraction power of such digital elements within a museum exhibition. This suggests a critical difference in the exhibition's

elements being noticed and lure the attention of visitors when entering an exhibition space.

The analysis of the exhibition elements TFD (total fixation duration) revealed that visitors spent most time engaging with video screens, followed by exhibits and touchscreens, while information boards of different exhibits seem to have attracted the least attention. These findings confirm the central importance of integrating digital media in exhibition spaces. This is in line with previous studies arguing that digital materials can lead to higher interest and attention levels (Venkatraman et al. 2018). While digital media per se may not be the motivating factor for people to visit a museum, they are indeed the elements that receive the most attention during a visit (Falk and Dierking 2013).

A deeper comparison of the AFD (average fixation duration) of the exhibition's elements revealed that touchscreens and textual description (e.g. exhibits case' information boards) had the same AFD. This might imply that touchscreens do not attract additional attention but are rather perceived as a mere substitute to traditional media and reading materials offered. The correlation analysis of eye tracking measures further revealed insights into the relations of fixation times and the exhibition's elements. The findings show that a strong positive correlation exists between exhibits and exhibits case' information boards, sharing a high TFF and TFD. This means that when an exhibit catch the visitor's attention, the information board close by is likely to become of interest. Moreover, the relationship between exhibits and touchscreens has been analyzed, and a positive correlation of the TFF has been found. It can, therefore, be concluded that visitors who viewed the exhibits first are also likely to engage with the exhibits case' information boards and touchscreens, and also likely longer with the exhibits case' information boards (TFD). In addition, visitors who saw the exhibits case' information boards are also more likely to also notice the touchscreens and engage with it.

Furthermore, the findings have revealed several interesting negative correlations between the physical exhibition's elements (see Fig. 1). There is a negative correlation between the time spent on the exhibition's information boards to the first-time view on the room's information boards. This implies that visitors who engage right away at the entrance with the general room information board may think they have sufficient information, which causes them to engage less time with the exhibition's information boards. Moreover, those participants who spend a longer average fixation time on the exhibition's information boards seem to spend less total time engaging with video screens. This suggests that the more time visitors spend on average engaging with a physical information medium, the less likely they are to spend time watching a video. Finally, the study could reveal that visitors who notice the exhibition's information board first spent less time engaging with touchscreens. Overall, these insights show the importance of TFF, the time to first fixation, as an indicator of what medium is used subsequently for knowledge acquisition and learning (e.g. information board vs. video screens vs. touchscreen). From the total fixation duration, a key learning is that visitors are highly subjective in their behaviours, and show a preference of a type of medium throughout their visit,

e.g. visitors spending time on exhibition's information boards spend less time engaging with digital media, i.e. videos.

Finally, the study was interested in understanding museum visitor behaviours by age group. When it comes to the visitors' time spent on general information boards, the analysis could demonstrate statistically significant differences between the three compared age groups. It was found that the average fixation duration on the exhibition's information boards was highest within the group older adults, followed by adults and younger adults. This suggests that information boards are particularly valuable to older age groups, while younger visitors may spend less time interacting with this particular medium, or may have a preference for information acquisition through other displayed media relating to an artefact (e.g. touchscreens, video screens). In fact, the analysis of digital media, namely video screens and touchscreens, found a significant difference between the age groups. Adults had the longest total fixation duration on both video screens and touchscreens, followed by older adults and younger adults. This may suggest that adults and older adults generally spend longer time engaging with objects, compared to younger people. Overall, the comparison of visitors' age groups revealed that for many forms of exhibition elements engagement, no significant differences could be found, suggesting similar behaviours. At the same time, a few interesting nuances relating to TFD could be found, which suggests a difference in attention spans between age groups. This finally highlights the importance of carefully designed exhibitions by keeping in mind in what form, where, and for how long information is presented.

6 Conclusion

Physical contexts, space design, and the exhibition's elements play an important role in museum learning experiences (Falk and Dierking 2013). As the landscape of museum experiences is diversifying through the integration of digital technologies, it is of particular interest to design artefacts in a way that they blend physical and digital media for an optimal visitor flow and learning experience (Venkatraman et al. 2018; Rainoldi et al. 2018). This study used a mobile eye tracking research design with 34 participants to capture the visitors' experience in a real-life museum context. The findings suggest that the museum experience is a complex construct happening at the intersection of the visitor's personal context (e.g. age) and the physical design put into place by the museum (Falk and Dierking 2013). The data analysis of the visitors' eye fixations, from time to first fixation, average fixation, and total fixation duration, revealed which exhibition's elements particularly capture visitor attention and lead them to engage and spend time. A comparison of three age groups highlighted varying overall fixation times, e.g. with older people spending more time on information boards than younger people. Fixation time is a primary indicator for visual attention and cognitive processes, and thus a marker of learning taking place (Rainoldi et al. 2018). Therefore, a nuanced understanding of how much time visitors generally, and at different ages, spend on observing the exhibition's

elements offers valuable insights into designing effective museum learning experiences.

6.1 Theoretical and Practical Implications

By conducting a mobile eye tracking research, this study adds to the scarce body of literature using mobile eye trackers in real-life situations (Krogh-Jespersen et al. 2020; Mokatren et al. 2016; Rainoldi et al. 2018; Scott et al. 2019). Mobile eye tracking was critical to gather insights into real-life visitor behaviour and gaze movement (Filippini-Fantoni et al. 2013) that could not have been revealed otherwise. This study builds on recent studies, e.g. Rainoldi et al. (2018), in that it analyzed museums as experiential environments of interest to study visitor behaviour.

This study expanded our understanding of the relationship between the exhibition's elements and visitor interaction and put the analysis of the physical elements found in a museum design at the centre stage. One of the core tasks of museums is to design experiences in a way that they are engaging, invite visitors to interact with the artefacts, and foster learning (Falk and Dierking 2013; Rainoldi et al. 2018). For the practice of museum design, our study shows not only which exhibition's elements visitors interact with or not, but also highlight that there exists a relationship among exhibition elements, and the way (order, sequence, duration) visitors engage with them (e.g. exhibits, information boards, and videos). The closer analysis of physical versus digital media elements brought to light the insight that digital media could attract the highest attention and engagement levels.

On a more general level, the study emphasizes for experience design that there is no such thing as one experience for all. Instead, museum experience designers need to design with their target audience in mind. This means in a first step (1) getting to know the visitor target group and age structure, and (2) design the experience of exhibition rooms, visitor flows, and information presentation with different age groups in mind that maximizes the possibility of individual experiences that visitors can have. For example, one visitor type may want to get a fast general overview at the room entrance, and then quickly look at exhibits to get a feeling of the room, while a second visitor type may only want to learn about exhibits through digital media, and a third visitor type may want to spend extensive time on each exhibit and the surrounding descriptions and information boards.

6.2 Directions for Future Research

Mobile eye tracking research in tourism research is a method that has just started to gain traction. In line with recent studies (Krogh-Jespersen et al. 2020; Scott et al. 2019), we recommend further application of mobile eye tracking as a method that is

particularly suited to understand real-time visitor behaviours without intrusion in natural environments. Market research could use mobile eye tracking to offer answers to specific problem situations, e.g. design or redesign of retail stores, visitor attractions, public spaces of interest, where the goal is to (a) design new experience concepts, or (b) enhance existing experiences, flows, and customer journeys. Moreover, for scholars in the research field of tourism experiences, mobile eye tracking could be a particularly beneficial method to uncover cognitive and behavioural insights that often remain hidden in traditionally used methods that ask for the articulation of the lived experience in retrospect.

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Using Mobile Eye-Tracking to Inform the Development of Nature Tourism Destinations in Iceland

James Graham, Leslie A. North, and Edward H. Huijbens

Abstract Since the late twentieth century, ecotourism—an alternative to mass tourism with a focus on natural environments—has grown in popularity. Ecotourism destinations are platforms for informal education and exemplify environmental stewardship and conservation. Iceland, an island nation in the North Atlantic, is one area of the world that has seen dramatic growth in its tourism industry over the last several years. Between 2010 and 2015, inbound tourism grew from 488,600 to 1,289,140. The pressures of economic development have resulted in the continued promotion of Icelandic tourism, and, subsequently, the rapid development of various tourist destinations. This study used a mixed-methods approach that focused on the use of location-aware mobile eye-tracking as well as post-assessments and observational analysis to assess visitor experience and behavior in two popular Icelandic tourist destinations: Sólheimajökull and Þingvellir. With these methods, a greater understanding of visitor behavior in these areas has been developed. These findings will guide the future development of tourism destinations, to further engage visitors, while promoting education and conservation. Furthermore, the critical evaluation of the original methodology developed for this study will exist as a tool by which the development of other nature-based tourism destinations can be assessed.

Keywords Eye-tracking · Environments · Tourism · Destinations

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1 Introduction

In recent years the application of eye-tracking technology has gained increasing attention outside marketing and consumer applied research. This text highlights the applications of the technology within the tourism industry for both management and academic purposes. This particular installation documents the methodical application of mobile eye-tracking (MET) within nature-based tourism destinations in Iceland. This study's intent was to document the application of MET technology within a rapidly developing tourism destination, and in doing so, identify successes and failures in the management of tourist behavior in Iceland's natural, and sometimes vulnerable landscapes.

In recent decades, trends in tourism have become more diverse, ranging from standard mass tourism practices to more sustainable or alternative forms. "Alternative tourism," representing a wide range of divergent practices, is characterized by development that promotes sustainability and conservation of host environments and cultures (Hetzer 1965; Fennell 2003). Considered to be one subsection of alternative tourism, ecotourism is defined by travel to natural environments (Thompson 1995). Commonly stated principles of ecotourism are education, stewardship, and protection of natural areas (Fennell 2003). To promote education and discourage environmentally degrading behavior in natural environments, information is often disseminated to tourists at tourism sites through the use of interpretive signage (Orams 1996). Few studies attempt to assess the use of interpretive signs as an educational medium and management method in tourist areas (Kiefer et al. 2012). Studies conducted on the use of signs have largely focused on museum exhibits rather than open environments (Eghbal-Azar and Widlok 2012).

The environment, climate, geology, culture, and infrastructure of Iceland make the country an exceptional platform for informal environmental education and an interesting case study in the development of ecotourism destinations. The country is home to one of the most dramatic and diverse landscapes, despite its relatively small size of approximately 103,000 km^2 (CIA 2016). In Iceland, tourists can visit black sand beaches, volcanoes, and glaciers, often within minutes of each other; furthermore, the harsh environment, seclusion, and limited resources of the island have shaped a resilient and unique culture. All these things, which Iceland has to offer a visitor, may serve to foster both an appreciation and understanding for the natural environment if visitor interaction is guided through the use of interpretive signage and experiential learning.

The case study presented herein used location-aware mobile eye-tracking (LA-MET) technologies, coupled with post-assessments, and observational analysis, to determine the ways that tourists experience, learn, and interact within the natural outdoor environments of Icelandic nature destinations. The coupling of spatial data alongside mobile eye-tracking (MET) data has been limited in current literature (Kiefer et al. 2012); however, the collection of visitor location data allows for detailed analysis and visualization of visitor behavior. This study aimed to employ

them together, and in increasingly diverse environments with regards to the MET technology, to develop a more comprehensive analysis of human behavior.

1.1 Structure of Chapter

The chapter will proceed in five sections. The introduction will explain the background and rationale for the study and propose the aim of the study in relation to each subheading below. Section 2 will explain the methodology employed. Section 3 will explain how the data gathered was analyzed. Section 4 will outline the results and Sect. 5 will provide discussion and conclusion.

1.2 Mobile Eye-Tracking

Mobile eye-tracking is a developing technology that uses infrared sensors to track the movement of the retina in an attempt to study an individual's interpretive process. Eye-tracking data is used as a proxy for assessing attention and determining common areas of interest (AOI) in an environment or graphic (Duchowski 2007). More recently, the use of eye-tracking as a mobile technology has proven to be a useful tool in understanding human–environmental interaction (Kiefer et al. 2012); yet, a lack in the application of mobile eye-tracking (MET) technology in tourism exists in current literature.

In the past decade, many studies have utilized eye-tracking technology to identify ways to improve learning potential in both formal and informal environments. A study by Ozcelik et al. (2009) discussed the issue of split attention, where the learner is tasked with piecing together related topics across a series of graphics and text. In this study, Ozcelik et al. (2009) used eye-tracking techniques to show that the use of color-coding is an effective method for increasing user perception and efficiency. A similar study by Beymer et al. (2008) used eye-tracking to assess the influence of font size and type on reading, finding an advantage in reading speed with larger fonts.

Tsai et al. (2012) discussed significant implications for the study of informal learning through the use of eye-tracking technology. In this study, a group of students were tasked with answering multiple-choice problems using graphics as visual aids. The study found that those who unsuccessfully answered the problems often shifted their vision between relevant and irrelevant factors. While the study does not make any effort to determine how prior knowledge may have influenced the perception of the graphics, a suggestion is made that emphasizing relevant portions of educational graphics could in fact influence learning potential. This study is significant in that it attempts to quantify learning in addition to analyzing eye movement patterns. In a critical review of the literature on eye-tracking with respect to learning, Mayer (2010) suggested, in agreement with Tsai et al. (2012), that an

increase in fixation on relevant information leads to an increase in understanding. In the development of sustainable tourism destinations, understanding ways to divulge information through effective signage and infrastructure is important; however, given the free choice nature of informal learning, it is also important to understand visitor experience to help inform the development of interpretive programs. This study aims not only to assess the effectiveness of interpretive signs themselves but also the environment in which these signs exist and the ways in which visitors experience that environment.

1.3 Eye-Tracking in Ecotourism

More recent studies have begun to apply eye-tracking technology in increasingly diverse environments. Evans et al. (2012) used mobile eye-tracking technology (MET) in outdoor environments to assess the learning of both professional and amateur geologists. While the study focused on differences in eye movements between novice and expert geologists, the main contribution of the study to the present literature is the use of MET in outdoor environments. Studies like these, which have pushed the boundaries of this previously limited technology, have opened the door for its use in other consumer-oriented industries such as tourism.

Nature-based tourism destinations are the ideal study areas for the use of MET. The implementation of interpretive signs in these areas typifies the informal learning environment. In these situations, whether the tourist chooses to seek out available information is free choice. By understanding the ways in which tourists typically explore these natural areas, and what they pay attention to, education can be encouraged through adaptation of current interpretive practices such as sign reading. Kiefer et al. (2012) proposed location-aware mobile eye-tracking (LA-MET) as an emerging and valuable field. In their study, hot spots for map usage were determined through the joint use of GPS and MET technologies. This pilot study placed the issue of informal learning in a spatial perspective. Determination of the most common stopping points for tourists along paths could help determine the effective and ineffective placement of signs. Many issues, from the influence of proper tourist behavior to the development of effective learning environments, can be recognized and remedied with LA-MET, yet no readily available literature exists for its use in the ecotourism industry. This study suggests that LA-MET, coupled with post-assessments and observational data analysis, can maximize the potential and identify the shortfalls for learning and management in ecotourism destinations.

1.4 Effective Strategies for Managing Tourist Behavior

Interpretive signs are regularly used in nature-based tourism destinations to educate visitors and discourage environmentally degrading behaviors. The design and

integration of interpretive signs in any environment is a multifaceted process that requires the consideration of a multitude of factors. These factors range from the design and placement of signs to the intended audience.

The design of interpretive programs in nature-based tourism destinations should cater to the expectations held by the typical visitor in that area. In border surveys administered by the Icelandic Tourism Board (Óladóttir 2016), the number one motivator of tourists to Iceland is the pristine impression of the landscape. This impression lends itself to the more indirect approach of management such as the installation of interpretive signs. A study by van der Stoep and Gramann (1988) suggests that the indirect approaches to the management of tourism areas are favorable to both managers and tourists as they allow visitors to voluntarily alter their behavior through education and understanding.

A study by Martin (1987) compared the implementation of three separate signs, one requesting visitors not to remove pumice stone from a nature area, one asking visitors to report such behavior, and a third stating that those in violation would be subject to prosecution. Of the three signs, all were effective in reducing the amount of pumice removed from the area; however, the third sign was determined to be the most effective. Another study conducted by Johnson and Swearingen (1988) supports the findings of Martin. While it may be true that signs invoking consequences for visitor actions may be the most effective, signs must be designed with the consideration that the tourism industry succeeds when development meets the expectations of both managers and visitors alike. In contrast to these findings, a study by Ajzen and Fishbein (1980) suggests that humans form beliefs about an object based on whether that object is associated with positive or negative characteristics.

The literature on the effective design of interpretive signs is extensive and spans several decades. One way by which developers can develop effective interpretive material is through the creation of multisensory features to engage visitors (Bitgood 2000). In his study, Bitgood suggests that effectively engaging multiple senses may increase attention and in turn the perception of information within interpretive material. One way that this can be done is with hands-on flip-labels which reveal certain facts to visitors when a panel is turned over. A study by Arndt et al. (1993) determined this to be a notably effective strategy for peaking participant curiosity. Another effective tool commonly suggested to increase participant engagement with interpretive signs is the inclusion of 3D figures (Peart 1984). Other possible engaging techniques might include an auditory component that demonstrates sounds such as various bird calls or noises that might occur within an environment.

In terms of attracting visitors to interpretive signs, one common technique is the use of large type size (Thompson and Bitgood 1988). This concept relates to the perceived difficulty of reading and interpreting a sign. The more challenging a visitor perceives a sign to interpret, the less likely they are to approach the sign at all (Rand 1990). For this reason, signs should focus on chunking small segments of information, about 25–75 words, alongside visually appealing images and figures. This idea of simplifying text and thus making information more digestible for the observer can also be done through the creation of bulleted lists rather than long strings of text.

In addition to decreasing the perceived effort of interpretation, Rand (1990) suggests one additional way by which signs can entice a reader's interest is through the fostering of cognitive–emotional appeal. One of the most consistently discussed ways that signs can increase a viewer's emotional engagement is through posed questions (Hirschi and Screven 1988; Litwak 1996). Additional methods by which Rand (1990) suggests signs can entice a viewer's emotional appeal include confronting misconceptions, challenging the reader to solve a problem, drawing analogies, and the use of reader-relevant concepts.

A final consideration that must be made in the development of effective educational signage is placement. In one study by Davis (2009), the most commonly stated reason respondents chose to read signs was the location. Determining the proper location for signs is equal parts understanding the behavior of visitors in the study area and identifying areas of interest within the environment. When placing signs, consideration must be given to where visitor attention is generally focused. If a sign is not located next to the particular feature or area it describes, it is likely to go unnoticed by the majority of visitors to an area (Bitgood et al. 1990). In addition to considering a sign's placement relative to points of interest, placement must also take into account a participant's relative gaze patterns. For example, a visitor in an area with a rocky and somewhat challenging trail will likely focus on the ground causing signs placed higher up to go unnoticed. An additional method by which placement influences a visitor's likelihood to interpret various signs is placement along a defined or perceived route. This factor is somewhat difficult to control in certain open environments, especially during peak flow where movement becomes more chaotic; however, if a pathway or trail is perceived to relate to the viewing order of interpretive signs the chances of visitor engagement increases (Bitgood 2000). This study suggests that LA-MET can contribute to the effective placement of signage in ecotourism destinations.

1.5 Selection of Study Area

Tourism in Iceland has increased exponentially in recent years. In the period between 2010 and 2015, inbound tourism grew by nearly 164% from 488,600 to 1,289,140 visitors (Óladóttir 2016). This trend has caused tourism to become the leading industry in Iceland. All Icelandic tourism operations, abroad and domestically represent 31% of the foreign income exchange and have created 21,600 jobs (Óladóttir 2015, 2016). In 2015 total inbound tourism consumption contributed 263,213.5 million ISK to Iceland's economy (Þorsteinsson 2017). Following the recent collapse of Iceland's banking sector, the success of the tourism industry has been voiced in policy and governance as an option for development in Iceland (Jóhannesson and Huijbens 2010).

In the 2016 annual border survey of the Icelandic Tourist Board (ITB) respondents were queried for suggestions in the development of the tourism industry. Of those surveyed, 26.2% suggested environmental issues/behavior must be a focus

moving forward (Óladóttir 2016). The same survey showed for the first time that 75.7% of respondents believed that tourism pressure on Icelandic nature is too high. The conclusion by the ITB is that to properly manage tourism in Iceland state involvement, monitoring, education, and management of tourist numbers would be beneficial (Óladóttir 2016). These reports suggest that development has not mirrored the rapid growth in Iceland's tourism industry. As a result, the pressures placed on Icelandic natural areas have begun to have negative impacts. This study will address these pressures through identifying some of the common oversights in development which may lead to undesirable behavior by tourists.

1.5.1 Areas of Interest Within Iceland

This study focused on the use of MET technology to understand visitor learning and behavior in two popular nature-based tourism destinations in Iceland. The study areas, depicted in Fig. 1—Þingvellir and Sólheimajökull—were chosen in order to incorporate areas of varying stages of development, as well as differences in cultural and environmental significance.

1.5.2 Þingvellir

Þingvellir National Park is considered the most historically significant site in Iceland (Hlöðum 2015). Given its proximity to Reykjavík, it is also one of the most visited

Fig. 1 Study area locations

and one of Iceland's most popular tourist destinations, with approximately 674,000 visitors each year (Centre n.d.; Óladóttir 2016). The UNESCO designated national park is home to the Almannagjá rift zone between the Eurasian and North American tectonic plates. With visible fissures and astounding scenery, including lake Þingvallavatn, Iceland's largest natural lake, the Þingvellir area is also of great cultural significance. Þingvellir became the meeting place for the Alþingi, what is often considered the first democratic parliament established in 930 AD. Due to the destinations high rate of visitation and proximity to Reykjavík, Þingvellir is one of the more developed tourist destinations in Iceland. A visitor center at the entrance to the park presents guests with a multimedia exhibit that includes relevant information about the area. From here visitors are guided along paved trails through the park and surrounding area. Given that Þingvellir is a national park and has UNESCO designation as a site of global heritage worth, it must adhere to mandates put in place by the division of nature conservation that require the development of trails and interpretive material to educate visitors on the cultural and natural heritage of the region (Umhverfisstofnun 2017). Signage and trails have thus vastly expanded and have a strict management protocol to guide their development. As one of the most developed nature tourism sites of Iceland, it is of value to the study, juxtaposed with the second site, Sólheimajökull.

1.5.3 Sólheimajökull

Sólheimajökull is one of many outlet glaciers in Iceland. The glacier itself is 15 km long and extends from the Mýrdalsjökull ice cap in southern Iceland (Friis 2011). Recent climatic change has caused the glacier to retreat nearly 800 m in the last two decades (Friis 2011). Sólheimajökull represents only a small portion of the glaciers in Iceland; however, it is a well-studied and documented glacier that shows what has become a seemingly global trend in glacial retreat (Staines et al. 2015). The Sólheimajökull glacier was chosen for this study for several reasons, including its significance with respect to recent climatic changes. The glacier was recently featured in a documentary that followed National Geographic photographer James Balog in his attempt to document the glacier's rapid retreat (Orlowski 2012). The retreat documented in the film may contribute to Sólheimajökull's and other glaciers popularity among tourists as they attempt to see these impressive landforms before they disappear. The area has an established parking area and café, both relatively make-shift and developed by entrepreneurs wanting to service arriving visitors. Visitor-made trails, which traverse the somewhat unstable surface of the glaciers lateral moraine, lead to the glacier face and lagoon in front. Glacier tours are offered here with trained guides, but visitors are free to walk around the area. Signs are present to discourage guests from walking onto the glacier unsupervised; however, their effectiveness is not documented. The potentially dangerous environment at Sólheimajökull exists as an ideal location to assess the effectiveness of interpretive signage as a means to alter visitor behavior in nature tourism destinations.

2 Methodology

This study was conducted using a mixed-method approach to assess visitor experience and behavior at two popular nature-based tourism destinations in Iceland. The methods used in this study included LA-MET, post-assessments, and observational analysis. As is shown in Fig. 2, the results of each method utilized underpin subsequent methods and their cumulative findings feed directly into the results of the study.

2.1 Participant Recruitment

At both of the selected study areas—Þingvellir and Sólheimajökull—15 participants were recruited to participate in the LA-MET trial, which was the quote aimed for in light of the time available in the field. Recruitment occurred from the same designated location each day that trials were run. This location also served as the start and end point for each individual trial. From this position, each individual or group of individuals entering the area were asked if they would like to participate in the study, so everyone coming that day could be included in the trial. This spatially clustered non-probability sampling aimed to maintain a normal distribution and keep a diverse

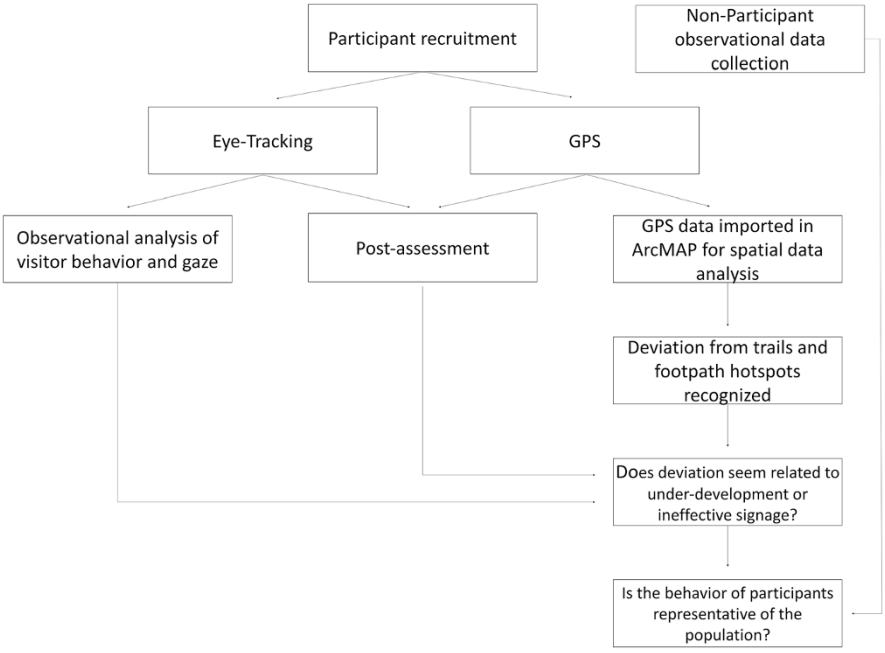

Fig. 2 Flowchart of data collection and analysis

and representative sample, through considering demographics such as age and gender when screening potential participants. After recruitment, each participant was asked to review an informed consent document prior to being outfitted with the mobile eye-tracking (MET) unit and GPS device. In addition to the 15 LA-MET participants at each site, 35 post-surveys were collected from visitors leaving the park. The time allotment for an individual LA-MET trial included the following time ranges:

- Review informed consent doc (5 min)
- Nature walk/eye-tracking trial (8–105 min)
- Post-test (5 min)

The time needed between each eye-tracking trial furthermore helped increase the likelihood of a more diverse and representative sample. Provided that nearness is related to both space and time (Miller 2004), it can be assumed that increasing the time between samples should decrease the potential of recruiting members who might, for example, be part of the same tourist group.

2.2 *Mobile Eye-Tracking Trial*

This study utilized the Tobii Pro Glasses 2 mobile eye-tracking glasses as the primary means for interpreting visitor experience and behavior. For this portion of the study, the participant was outfitted with the MET unit and a Garmin Montana 680 compact GPS data logger in an attempt to assess visitor experience and behavior within the destination. The Tobii MET unit (Fig. 3) consists of a compact glasses

Fig. 3 Tobii Pro Glasses 2 mobile eye-tracking unit setup

frame and recording unit. The glasses themselves are equipped with four infrared eye cameras capable of tracking pupil and gaze patters with high resolution at 50–100 Hz. On the front of the glasses frame is a full HD scene camera with 52° of vertical and 82° of horizontal view (Tobii 2016). Using the Tobii Pro Glasses 2, patterns among visitor behavior and perception were visually observed.

As mentioned, each participant was outfitted with a backpack equipped with a Garmin Montana 680 GPS data logger. For each participant, the device was set to record coordinates at a 2 s interval. Prior to conducting the mobile eye-tracking trials, trails and interpretive signs were recorded using the GPS device's Waypoint and track functions. This data was collected to provide a reference with which visitor footpaths could be compared. Prior to the participants' departure, a new track log was started on the Garmin device and placed in the pack's side pocket.

2.3 Post-survey

The post-assessments used in this study consisted of a mixture of six Likert scale statements (Fig. 11), three open-ended questions, and a demographic survey. The questions used in the post-survey were validated using standard validation techniques prior to beginning data collection. Questions in the survey were designed to gain insight into the participants' experience at the destination and do not constitute the basis for statistical inference to a larger population. Specific questions focused on various management strategies implemented within the area while others were designed to solicit feedback and suggestions for future development.

2.4 Observational Data Collection

The final component of the methodology is the collection of observational data. During the data collection period, one member of the research team walked through the study area at a defined interval to take notes regarding nonparticipant visitor behavior. These observations were then transcribed and coded using standard coding techniques to identify common behavioral trends among visitors. This data was then compared with the observations made during LA-MET to support the assumption that the glasses would not alter visitor behavior.

3 Data Analysis

Prior to analyzing the results, individual data was analyzed for each component of the methodology. Footpath data recorded with the Garmin GPS unit was imported into a GIS to conduct spatial analysis. Eye-tracking data was imported into the

provided firmware, but the added feature of audio recording with the eye-tracking and observational data were more qualitative in nature. These were analyzed using content analysis coding methods and summarized into trends. The same method was used for the analysis of nonparticipant observations.

3.1 Footpath Analysis

Prior to conducting any analysis on visitor footpath data, the .GPX files were first imported from the Garmin handheld unit into ArcMAP, an application of ArcGIS for desktop, using the *.GPX to feature tool*. After importing the data, it was the projected appropriately using the *project tool*. Footpaths for each participant were then joined into a single shapefile using the *merge tool*. The choice to use GIS was made for its ability to visualize and create meaning from spatial data. Using the newly created shapefile, kernel density analysis was performed using ArcGIS' spatial analyst extension. This analysis was conducted to show the common areas of interest where visitors spent the most time. The results are represented in a three-dimensional graphic in Fig. 4 in which peaks in the graphic represent areas where visitors commonly spent larger amounts of time.

Footpath data also provides insights into the areas where visitors commonly deviate from defined trails. This study used a buffer analysis to highlight these occurrences. At each destination, trail locations were documented using the Garmin handheld's track feature. The trail was recorded as a line feature at the center of the trail. The Garmin Montana 680 was able to maintain a horizontal accuracy of 3 m throughout each of the two selected study areas. Provided the handheld's reported accuracy of 3 m, and the possibility that a visitor may fall within several meters of

Fig. 4 Sólheimar Glacier footpath coverage and duration. Inset visual is a three-dimensional representation of kernel density analysis performed on the combined visitor footpath data. Larger peaks represent hot spots of visitation

the center line and remain on the trail, a buffer of 5 m was created to the left or right of the trail shapefile. Using a spatial selection footpath points falling within the buffer area were selected. Selected features were then reversed to select those which would be considered deviations.

3.2 Eye-Tracking Analysis

MET technologies are still in the early years of development when compared to static devices; however, the increasing potential of these devices has allowed for both quantitative and qualitative data collection in a myriad of environments. Brône et al. (2011) argue the development of object recognition algorithms can increase the quantitative capabilities of MET data analysis. Today, Tobii has worked these algorithms into their Pro Analyzer software allowing multiple participant's gaze to be compared through the creation of heat maps and gaze plots overtop of snapshot images.

Given variable weather conditions gaze samples collected ranged from 10 to 88% at the Sólheimajökull with a mean value of 38.6%. Trials run earlier in the morning often had larger gaze samples than those that occurred during the middle of the day. This was in large part due to incoming UV interference from the sun. However, those trials which occurred on overcast days also allowed for improved gaze sample collection. During the period of data collection for this study, Tobii was in the development stages of a firmware update which would allow the glasses' infrared sensors to adapt to changes in incoming UV light. The update was not however made available in time for this data collection period.

For this study, MET trials were played back and observations regarding the participants' behavior were transcribed. An added feature of the Tobii Pro Glasses 2 is the ability to record audio. With this capability, any dialog by the participant pertaining to the study area was also transcribed. After reviewing the transcriptions from each eye-tracking trial common themes and behaviors were identified and coded using standard coding techniques. After the identification of common themes in dialog and behavior, transcriptions were color-coded. Occurrence of defined themes were then documented in excel.

3.3 Nonparticipant Observational Data

Similar to the observational data collected for the MET trials, observations made about nonparticipant behavior was analyzed using standard coding techniques. This content analysis was deployed to identify emergent themes. No prior template for those themes or expected themes was deployed. Common themes identified through these observations were then compared with those of the MET trial participants. This was done to provide alternate arguments for the MET technology as a valid tool in

the study of visitor behavior in nature-based tourism destinations. If observations among nonparticipants were similar in nature to those of MET participants, this suggests that the glasses did not alter the participant's behavior. Due to the small sample size, this cannot be validated at this stage.

4 Results

The study employed location-aware mobile eye-tracking together in two nature tourism destinations in Iceland in order to develop a more comprehensive analysis of human behavior when it comes to the effectiveness of interpretive signs, but also the environment in which these signs exist and the ways in which visitors experience that environment.

4.1 Identified Learning and Management Issues in Ecotourism Destinations

Upon initial analysis of the footpath data from the Sólheimajökull and Þingvellir study areas, obvious differences were observed in visitor behavior. While both sites have defined trails and signs to prevent certain visitor behavior, the data from the Sólheimajökull area suggested a considerably greater deviation from the trail. As displayed in Fig. 4, considerable deviation occurs past the second sign (Fig. 9).

Using the buffer method (see Sect. 3.2), it was determined that between the 15 LA-MET participants on site, 45.81% of their collective time was spent off trail. Based on the findings from the MET trials 13 of the 15 participants were observed walking off trail. These deviations occur despite the presence of the signs in Fig. 9, as well as those in Fig. 5, which occur at the trailhead and at the edge of the glacial tongue. Based on the 3D representation of the kernel density analysis shown

Fig. 5 Signs at the Sólheimajökull area

in the top left corner of Fig. 4, not only did deviation toward the base of the glacier occur, the area possessed the second-highest density for visitor footpath coverage.

Four common issues can be identified through the study leading to the undesirable behavior occurring at Sólheimajökull. These include site development, congestion, and the overall failure to observe certain interpretive material. First is the issue of trail development. A distinct difference exists between Sólheimajökull's gravel and somewhat unstable trail, and the paved network of trails present at Þingvellir. Observations of the MET trials indicated that visitors to the Sólheimar glacier area spent a greater deal of time fixated on the trail ahead of them than their surroundings. In addition to the extra attention needed to traverse the terrain is the trails resemblance to the landscape around it, which has the potential to blur the lines between where a visitor believes they are or are not allowed to go. The second contribution to the improper management of visitor behavior at Sólheimajökull is the issue of underdevelopment and lack of management. Considering the majority of Iceland is rural land, populations do not exist to support the nations rapidly developing tourism industry. With that said certain destinations, such as Sólheimajökull, lack development and desirable employment opportunities. Third, upon review of the MET data, temporal variation in behavior can be observed throughout the day. Of those participants who chose not to deviate, or only slightly deviate from the trails, many were arriving at earlier hours when visitor numbers were lower. Throughout the day as tourist numbers increased and guided tours began to operate, so seems to increase the issue of deviation. Fourth, is the issue of poorly defined and developed interpretive material. As is depicted in Fig. 6, signs, even when acknowledged, are ineffective when the majority of visitors disregard or fail to see them. In this example one participant stops to look at the sign; however, after observing how many fellow trail users simply pass the sign the participant decides to continue forward.

Fig. 6 Participant contemplates disregarding sign as a result of herd mentality

Fig. 7 Point of deviation at the Sólheimar glacier trail

Overall, observing the dialog of MET participants indicated a general sense of confusion regarding the second sign in Fig. 7. Multiple visitors questioned whether the sign was properly placed, one suggesting that it may have been placed during a time of greater glacial extent. Contributing to the sign's inability to prevent tourists from passing its location was the installment of an additional sign at the base of the glacier tongue. Visible from the second sign, one visitor suggests that it is in fact the third and final sign that they are not supposed to proceed beyond. Despite this assumption, the same participant later goes on to pass the final sign and walk onto the glacier without proper gear. Here, the MET unit demonstrates its effectiveness as a tool for assessing visitor attention and perception. Through the use of the MET glasses, one can conclude that the issue is, in this case, not an issue of the sign being read, but instead, an issue in the visitor's perception of the sign. Referring to examples such as that in Fig. 6 one can observe the interpretive process of an individual without in-depth quantitative analysis.

4.2 Effective Strategies for Managing Tourist Behavior

Overall, the development at Þingvellir resulted in far less deviation than at Sólheimajökull. Of the 15 LA-MET participants there only one clearly deviated from the path as denoted by the arrow in Fig. 8. The park has a well-developed network of trails that navigate between fissures, waterfalls, and historical landmarks. As opposed to Sólheimajökull, trails at Þingvellir are lined with ropes and 59 documented signs signaling visitors not to walk off trail. Using GPS data this area of deviation was easily identified. After identifying which participant deviated and where, MET data was reviewed to determine what led the visitors to deviate. The sequence in Fig. 8 shows the participant pointing to the trail that leads in the direction in which they intend to go; however, her partner can be seen pointing toward a shorter walk over a grassy area.

The explanation for what likely encouraged the deviation is visible in Fig. 9. The visitors traversed the area from the bottom left corner toward the sign in the top right of the grassy area. Figure 9 shows the area where the participants would have returned to the defined trail. Had they approached the same area from the opposite

Fig. 8 Footpath coverage and duration density

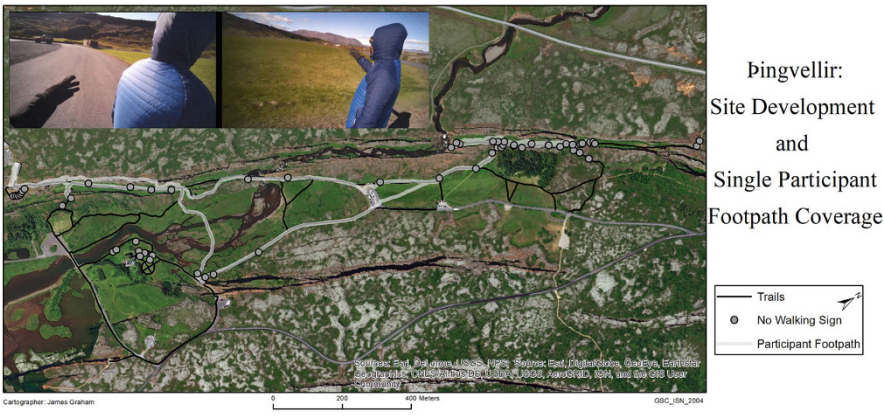

Fig. 9 Inactive trail taken during deviation

sign, the participants would have likely noticed the sign, preventing them from deviating into what may be a reclamation area; however, seeing as a past trail exists through the area it is easy to understand why they might have deviated. If the intention of the park is to protect this particular area, additional signs will likely be required at the alternative end to the restricted trail.

Interestingly enough, visitor experience in both study areas elicited similar findings in the post-survey results (Fig. 10). As is indicated by the responses to the survey statements most visitors strongly disagree that the designation of restricted

Fig. 10 Post-survey Likert results

areas negatively impacted their experience within the study areas. What this seems to indicate, given that the vast majority of participants and visitors at the Sólheimar glacier did in fact deviate from the trail, is that visitors were unaware or simply misinterpreted certain boundaries at Sólheimajökull. Feedback on site development was elicited through open-ended questions in the post-survey. In many cases, visitors indicated that the experience had met their expectations and suggested no areas for improvement. However, during a review of MET trials, participants at Þingvellir can be heard expressing frustrations with the number of visitors and the inability to efficiently locate or even know what features exist within the park. What MET allows the researcher to do is develop a firsthand account of visitor experience through observation of their actions, attention, and dialog. Many of the transcriptions from MET trials provide additional and more accurate insight into visitor experience and perception than a more traditional method of surveying.

The dialog from the LA-MET trials along with the responses to the open-ended response questions in the post-survey do point to one issue in the development of nature-based tourism destinations. When compared to Þingvellir a greater

percentage of visitors to the Sólheimajökull glacier suggested that their visit had met their expectations with few or no suggestions for future development. Analysis of GPS data suggests that deviations at Sólheimajökull were around 45.81%, while deviations at Þingvellir were only determined to be around 17.40%. Again, a report by Óladóttir (2016) suggests that the unspoiled impression of Iceland's landscape is a common motivation that encourages tourists to travel to Iceland. The issue now becomes, how development can occur without drastically altering the natural landscapes which have driven the rapid increase in Iceland's booming tourism industry. While many visitors report that their expectations had been met while visiting Þingvellir, considerably more suggestions were made for future development. Additionally, dialog between participants suggests that, when compared to other Icelandic tourism destinations, Þingvellir was considered to be somewhat underwhelming. In multiple cases, visitors to the site were entirely unaware of the environmental and geological significance of the area.

The obvious confusion which exists among visitors to the Þingvellir region occurs despite a higher percentage of tourists that stop to read educational signs. In fact, of all 15 participants at Sólheimajökull not one was observed reading the informational signs present at the trailhead. In contrast, nearly every participant at Þingvellir was observed at least approaching educational signs. This failure in implementation relates back to the spatial and design principles of effective signs. At Sólheimajökull, educational signs were clustered at the trailhead; this placement disagrees with findings by Davis (2009) who suggests that the placement of signs along natural stopping points can increase visitor attention. Additionally, signs at Þingvellir were often text-heavy, utilizing few of the previously mentioned design principles. Reviewing eye-tracking trials suggests that visitors to the Þingvellir area seldom fully read interpretive signs.

These examples show the importance of utilizing spatial analysis of destination features and footpath coverage alongside MET observations in assessing the development of tourism destinations. Identification of hot spots such as those in Fig. 8 helps to show where signs may be placed to increase interaction. Additionally, the lack of interest in educational signs at Þingvellir suggests that previously mentioned design principles may assist in fostering the attention of tourists. When interpretive programs consider spatial and design principle in the design of educational and management campaigns, the overall effectiveness of these programs can be increased.

5 Discussion and Conclusions

With the increasing presence of tourists in Iceland, educational programs and infrastructure must be developed, not only to protect visitors to Iceland's many natural attractions but to protect the environment as well. The issue of deviation at the Sólheimar glacier area is worth noting for two obvious reasons: the safety of visitors themselves and the protection of vulnerable biota. First, pointing to the

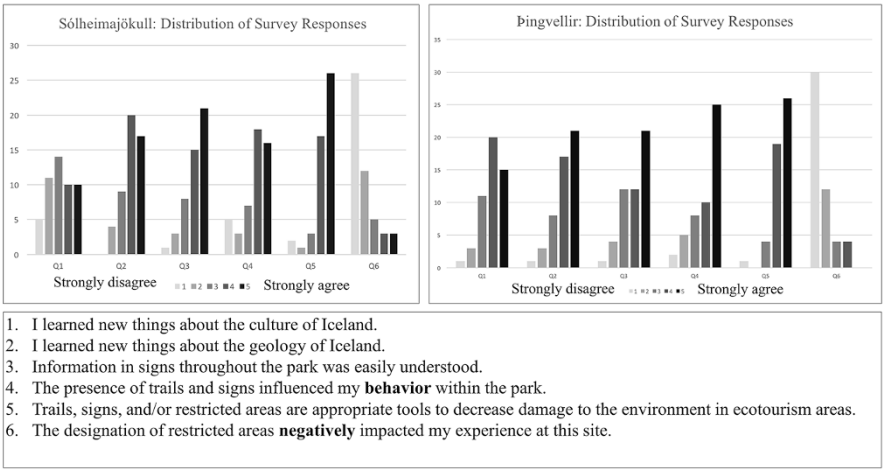

Fig. 11 LA-MET participant interacting with delicate vegetation

information provided on all three signs present in the area, the glacier is actively calving and can be very dangerous to unsuspecting tourists. One report by Hafstað (2016b) *describes one instance where a local voluntary search and rescue team was dispatched to rescue tourists who had disregarded road closure signs. Another report by* Hafstað (2016c)*, discusses one man who was seriously injured after a fall down a hill at the* Sólheimajökull glacier. In 2016, four tourists lost their lives in just a 2-month period in Iceland (Hafstað 2016a).

Figure 11 shows one participant, who reached to brush some moss growing off the side of the trail. An article by Elliott (2015) *reports one account where tourists, attempting to insulate their tent, ripped up large patches of moss. This moss is one example of Iceland's vulnerable biota, one which will take many years and possibly decades to reach its former state. With respect to the glaciers themselves, it is important still to educate tourists and locals on the vulnerable biota even on what may appear to be an ice mass entirely void of life. Glaciers are often home to* surprisingly complex ecosystems. These ecosystems include species of invertebrates that live in cryoconite holes. A study by Coulson and Midgley (2012) points to moss-covered rocks, affectionately referred to as "glacier mice," which provide ecosystems for similar species.

5.1 LA-MET and Mixed Methods

The study serves to validate MET technology as a useful tool for the effective management of nature tourism sites. The use of MET technology has provided insight into the behavior and experience of tourists to Iceland; however, the findings of this study were further validated through the mixed-method approach, combining LA-MET, post-surveys, and observation data collection. The usefulness of this

mixed-method approach can be demonstrated through post-surveys which disagreed with behavior observed in MET trials. When asked, visitors agree that trails, signs, and/or restricted areas are appropriate tools to decrease damage to the environment in nature destinations (Fig. 10); however, many of these same participants were observed deviating from the established trail at Sólheimajökull. This does not suggest that participants were not truthful in their responses. With the assumption that unprompted dialog from eye-tracking trials is a more honest representation of visitor experience, this disagreement suggests that MET allows for greater accuracy in assessing visitor experience than traditional survey methods. This is especially apparent when the behavior of visitors to Sólheimajökull is compared to that of visitors to Þingvellir. The collection of spatial data along with the MET data allowed for increased visualization in behavioral trends among tourists. Post-surveys prompted the input of participants so that findings were not solely based on assumptions of the researcher. Finally, the collection of nonparticipant observational data suggests that the use of MET glasses did not noticeably alter the behavior of the participant.

5.2 Study Limitations

The qualitative insights complementing this study were unintentional in some respects. The originally proposed methodology projected additional quantitative analysis of MET data; however, certain technological errors limited these capabilities. First and foremost, the UV interference from the sun in the outdoor environments significantly impacted the gaze samples collected. UV interference also contributed to calibration issues; however, this issue was resolved using UV-protective cover-up sunglasses. It is uncertain whether this method of calibration affected the gaze sample accuracy once the UV glasses were removed. Future firmware updates for the Tobii Pro Glasses 2 should provide solutions for this particular limitation.

Another limitation exists when considering comparative quantitative analysis of MET data. When using static eye-tracking devices comparisons between participants are simplified due to the two-dimensional environment within which the participant is generally engaged. In these instances, a participant is generally interpreting a single static object such as a computer monitor or graphic; however, the three-dimensional realm in which MET participants exist means a certain point of interest can be observed from multiple vantages thus altering the foreground and background of the snapshot.

One potential limitation which did not drastically affect this study was the battery life for the Tobii Pro Glasses 2. Each battery is capable of recording one and a half hours of video and gaze data. While the majority of participants returned well before this time, on two occasions participants had to be tracked down to retrieve the MET device.

One concern prior to beginning the data collection period was that the participants would alter their behavior knowing that their behavior is being recorded; however,

when compared with the nonparticipant observational data and given the large number of deviations that occurred at Sólheimajökull, this does not seem to be the case.

5.3 MET as an Effective Tool in Managing Nature Tourism

Overall, this study provides beneficial information that can be utilized in the future development of Icelandic nature-based tourism destinations. As put forth by Óladóttir (2016), state involvement, monitoring, education, and management of tourist numbers have become a concern moving forward as government policy aspirations stipulate (ITB 2011; PKF 2013). The MET glasses have shown that visitors to these areas are more aware of their surroundings when trails are well developed and easily traversed. However, it seems that while a certain level of development is mandatory to increase the effectiveness of interpretive and management programs, a certain level of "wilderness" must be preserved to promote a positive experience for the average tourist to Iceland. One of the main challenges moving forward, for Iceland in particular, is managing the number of tourists present at popular destinations. Controlling tourist numbers was mentioned as a suggestion in both study areas. This issue is largely influenced by mass tourist groups that arrive at these destinations by bus at common hours.

When tasked with the management of mass tourism numbers the use of interpretive signage and infrastructural development must be developed appropriately. This is especially true in rural areas and countries such as Iceland where the annual number of tourists nearly exceeds the local population five times over which in effect reduces the physical monitoring of sites. Through this study, LA-MET methods have proven to be a useful tool in understanding influences on visitor behavior and experience within such destinations. These findings can be used to identify areas of improvement so that future development can promote principles of ecotourism which include both education and conservation of the natural and, in many cases, vulnerable landscapes of nature-based tourism destinations.

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Viewing Behaviour and Task Performance on Austrian Destination Websites: Comparing Generation Y and the Baby Boomers

Vanessa Knogler

Abstract Nowadays, the Internet is the most important travel planning tool across all generations. Considering the high purchasing power of people aged 50 years or older, understanding how Baby Boomers perceive destination websites and how this differs to Generation Y might be particularly important. In this study, participants from both cohorts were browsing three destination homepage screenshots and completed realistic tasks on Tyrol's destination website. Viewing behaviour, usability perception, and task performance were analyzed by means of eye tracking, retrospective think-aloud (RTA), and a questionnaire. Baby Boomers had a stronger focus on central page elements compared to the younger cohort during the first impression; peripheral elements such as the logo were looked at less frequently. Moreover, Baby Boomers were less efficient in their task performance and had lower subjective usability ratings. Issues with cluttered page layout, website navigation, and input elements were frequently encountered by this cohort. The study suggests that destination websites should be designed with the end user in mind and should address the specific needs of the targeted user group.

Keywords Eye tracking · Viewing behaviour · Usability testing · Generation Y · Baby Boomer

1 Introduction

'On the Web, usability is a necessary condition for survival'. Nielsen (2012)

Maintaining a website is crucial in the information-intense tourism industry (Law et al. 2010). Tools such as official destination websites are vital for Destination Management Organisations (DMOs) and serve as information hubs for potential travellers (Choi et al. 2007). Moreover, these websites convey images, operate as a point of sale, and provide ways of interacting with users (Del Vasto-Terrientes et al.

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2015). A major factor in the success of a DMO website is its usability: it should be as easy as possible for potential travellers to navigate the website and to learn how to use it with a minimum of mental effort (Fernández-Cavia et al. 2014; Kim and Fesenmaier 2008; Qi et al. 2008).

In tourism, the Internet has become the most important tool for travel planning across all generations, as previously existing gaps in Internet adoption have become blurred (Xiang et al. 2015). However, Generation Y (born from 1981 to 2000) and Baby Boomers (born from 1946 to 1964) have been found to look at retail web pages differently. Whether this is the case also for other types of websites—such as destination websites—must yet be investigated (Djamasbi et al. 2011). Prior studies suggest that Generation Y's preferences in destination websites might differ from other cohorts, as this generation is known to be highly demanding due to their strong technological know-how (Wahler et al. 2016). However, to the author's knowledge, how Baby Boomers perceive DMO websites has not been subject of previous eye tracking studies. This may be especially important as the high purchasing power of people aged 50 years or older leads to opportunities for the tourism industry (Wirtschaftskammer Österreich 2015). Nevertheless, only few studies have investigated the relationship between web performance and age, and even fewer studies have used eye tracking as part of their methodology (Romano Bergstrom et al. 2016; Sonderegger et al. 2016).

Websites should always be designed with the end user in mind (Djamasbi et al. 2011). Therefore, it can be argued that understanding usability issues and viewing behaviour of Generation Y and Baby Boomers can help DMOs improve user experience and, consequently, convert users into destination visitors. As Austria ranks among the top 10 destinations in Europe, with 26.7 million international tourists arriving in 2015 (UNWTO 2016), the official destination websites of Austrian regional destination management organisations (RTOs) are considered relevant for this research. The following research questions (RQs) have been defined:

- *RQ1*: What are the differences and similarities between Generation Y and Baby Boomers regarding web page viewing behaviour on a destination website?
- *RQ2*: What are the differences and similarities between Generation Y and Baby Boomers in perceived usability and task performance on a destination website?

This research adds to the body of literature by using Austrian RTO websites as stimuli for an eye tracking experiment and putting the results regarding viewing behaviour in context with existing literature. Moreover, the research provides novelty by focusing on differences and similarities between these two cohorts in subjective usability ratings, quantitative performance metrics, experienced usability issues, as well typical user behaviour during task performance on Austrian RTO websites.

2 Theoretical Background

2.1 Fundamentals of Web Page Viewing Behaviour

Capturing ocular movements by means of eye tracking makes it possible to see where people have looked on a web page without having to rely on self-reported data (Nielsen and Pernice 2010). A human's focus of attention is usually linked to the foveal vision—the only area of the visual field which allows us to see clearly and in detail. When a user is stabilizing the eye movement on a website element for a period of 200–300 ms, this is referred to as a fixation (Duchowski 2007). Fixation-based eye tracking metrics are commonly used to evaluate viewing behaviour, since they show which areas of the stimulus the user pays attention to and thus are presumably either interesting or confusing to them (Djamasbi 2014).

Visual Attention There are two models of visual attention: bottom-up and top-down. In the bottom-up model, the selection is defined by the stimulus (stimulus-driven), whereas in the top-down model the selection is driven by the goals of the viewer (goal-driven) (Van Zoest and Donk 2004). The bottom-up visual attention is defined by the salience of the stimuli. This means that if the stimulus is sufficiently different from its surrounding, it automatically attracts our attention. On the other hand, the top-down model of visual attention suggests that we voluntarily move our gaze towards elements which are of importance for a task goal. Viewing behaviour is simultaneously driven by a stimulus as well as goal oriented; both models of visual attention can work in parallel (Itti and Koch 2001).

Visual Hierarchy When searching for information on a web page, a user goes through two phases: a search phase and a scanning phase. In the search phase, the user is looking for a point of entry to the page, which is driven by the saliency of the elements. In the scanning phase, the user has found the point of entry and is now looking for information around this point. Both phases are influenced by the characteristics of website elements. Therefore, by manipulating them, the visual behaviour of the user can be guided (see Table 1). In this scanning phase, the Gestalt laws—especially of proximity and similarity—play an important role in guiding the user's viewing behaviour (Djamasbi and Hall-Phillips 2014; Faraday 2000).

Table 1 Factors affecting visual hierarchy

1. Motion	Animated elements draw user attention before any other elements.
2. Size	Larger objects attract more attention.
3. Images	Images attract more attention than text.
4. Colour	Elements with brighter colours attract more attention than those with darker colours.
5. Text style	Typographical variations serve as effective nonverbal cueing systems for attracting attention.
6. Position	Top elements attract more attention than those located on the bottom.

Source: Djamasbi et al. (2010, p. 308)

Typical Viewing Patterns Users tend to scan web page content in an F-shaped pattern, looking first in a horizontal movement from the top left area of the page across the page's upper area. Afterwards, the user moves his or her gaze down the page and reads another part horizontally before moving on and scanning the left side of the content in a vertical movement (Buscher et al. 2009; Pernice 2017). However, structuring the page content into different sections or using images on the web page may discourage users from this viewing behaviour ensuring that the user is not missing important information (Djamasbi and Hall-Phillips 2014). Nevertheless, the left area of the page seems to be more important than the right area, which is consistent with a left-to-right reading order of, for instance, the English and German languages. Users were found to have 80% of the total fixations on the left half of the web page, and they spent only 20% of the viewing time looking at the right half of the screen (Fessenden 2017).

2.2 Eye Tracking as a Usability Evaluation Method

The term usability can be defined as the 'extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO 1998, Sect. 3.1). The concept considers the hedonic as well as utilitarian system dimensions: hedonic dimensions concern enjoyment, fun, and entertainment and are measured through perceived scales. Utilitarian dimensions can be measured through objective measures, such as task timing, or perceived assessments of the website, such as perceived usefulness (Wagner et al. 2014). The ISO's definition includes both dimensions by considering the user's satisfaction and task performance (efficiency and effectiveness).

The goal of conducting usability studies is to discover issues related to usability that, if addressed, can consequently create a website that is more user-centric (Fernandez et al. 2011). Traditional Usability Evaluation Methods (UEMs) can be combined with eye tracking in order to obtain a deeper understanding of the user's experience with the website (Olmsted-Hawala et al. 2014). By dividing a web page into areas of interest (AOIs), which are '[. . .] areas that contain objects of potential interest to the experimenter', it is possible to report fixation data for different zones of the web page and to compare these areas quantitatively (Goldberg et al. 2002). Common ways for visualizing eye movement data are heat maps and gaze plots: heat maps represent the aggregated fixations of many users on a website. Gaze plots, on the other hand, show a single participant's behaviour on a website (Pernice and Nielsen 2009).

Pernice and Nielsen (2009) argue that the most valuable way to analyze eye tracking data from a usability test is to watch the gaze replays of the users, which can give insights into how users are interacting with the website. The evaluation of eye tracking data regarding usability problems is often based on the subjective interpretation of the evaluator as there is a lack of validated correlation schemes between eye tracking data and usability issues (Ehmke and Wilson 2007). For this reason, eye

tracking is often combined with think-aloud methods to be able to make proper decisions (Elbabour et al. 2017). Duchowski (2007) supports the view that eye tracking metrics are process metrics which should complement traditional usability measures like users' subjective satisfaction and the performance metrics of efficiency (time to task completion) and effectiveness (task completion rate).

2.3 Literature Review of Generational and Age-Related Differences

Generation Y grew up in a fast-paced world with immediate access to technology, whereas Baby Boomers were not raised in such an environment. Consequently, the web page viewing behaviour of the two cohorts may be considerably different. Comparing the viewing behaviour of Generation Y and Baby Boomers on retail web pages revealed that on cluttered sites, Baby Boomers had more fixations throughout the entire page than the younger cohort indicating that they were examining the website more carefully (Djamasbi et al. 2011). Research shows that Generation Y might be drawn to the top left corner and upper area of the page because they expect to find the logo and the navigation bar in this position (Djamasbi et al. 2010; Romano 2010). In the case of destination websites, Generation Y was found to have high fixation counts on website elements containing images of random people; website elements embedded in lower parts of websites, by contrast, as well as social media, are not seen as important elements at the first impression (Wahler et al. 2016).

Romano Bergstrom et al. (2013) found that older participants in some eye tracking usability studies had higher task-completion times or lower accuracy than younger participants. Age-related physical changes that affect usability task performance are declines in vision, motor functions, and hearing (Loos and Romano Bergstrom 2014). Moreover, there is a relationship between age and cognitive changes such as memory decline, reduced attention span, and changes in spatial ability (the ability to recognize how objects are related to each other). Due to these factors, older adults can feel lost or disoriented on websites, especially if the website is cluttered (Finn and Johnson 2013; Wagner et al. 2014).

Placing navigational elements at the peripheral edge of a page may result in poorer website task performance for older adults, since the part of their field of vision that can be used with accuracy and without effort—their useful field of view (UFOV)—may have decreased (Romano Bergstrom et al. 2013). Romano Bergstrom et al. (2016) confirm that information in the website periphery may be difficult for older adults (age 62–72) to access, as they fixate the left navigation area significantly less often ($p = 0.03$) than young adults (age 20–25).

3 Experimental Research Design

The proposed research questions are answered through a mixed-method approach. Eye tracking is combined with retrospective think-aloud and a traditional questionnaire survey. This triangulation helps to enhance the understanding of the cognitive processes of the website users (Wang et al. 2014). The experiment was conducted in the German language in a laboratory setting at the IMC University of Applied Sciences Krems using a Gazepoint GP3 HD eye tracker (60 Hz sampling rate). This allowed normal head movement of the users since it was mounted on the desktop.

3.1 Definition of the Sample

Convenience sampling is a frequently used sampling technique in eye tracking studies (e.g. Djamasbi et al. 2010, 2011; Wahler et al. 2016) and was also applied for this research. Following Djamasbi et al. (2011), 20 total participants were recruited, split evenly between Generation Y members (between 17 and 36 years old) and Baby Boomers (between 53 and 71 years old); five female and five male participants were recruited from each cohort. A screening question asked whether potential participants had already purchased a tourism-related service or product online.

3.2 Method of Data Collection

To answer RQ1, participant's eye movements while browsing the destination homepages of Lower Austria (www.niederoesterreich.at), Styria (www.steiermark.com/de), and Vienna (www.wien.info/de) were tracked and analyzed. Screenshots of the homepages of the desktop-version of the page (taken on 11 January 2018) were shown in a randomized order for 5 s each, which is enough time to understand viewing behaviour during the first impression (Djamasbi et al. 2010). The users were not given any goal-oriented task; instead, they were told to familiarize themselves with the web pages. Therefore, in this browsing task, the participants' behaviour was expected to be driven by the salience of the stimuli (bottom-up model of visual attention). Following previous research by Wahler et al. (2016), areas of interest (AOIs) were drawn around page elements which are relevant for answering the RQ. For each AOI, the average number of fixations, and the average time viewed were compared among the two cohorts. Moreover, the most likely scan path on the page was compared for each user group.

The second part of the experiment is designed to answer RQ2. Participants were given realistic tasks to conduct on the destination website of Tyrol (www.tirol.at):

(1) finding a cross-country trail which is suitable for beginners, (2) booking a 4-star hotel room in Innsbruck, and (3) signing up for the destination newsletter. In this part of the experiment, the users are expected to show goal-oriented search behaviour (top-down model of visual attention). After completing the tasks, users were asked to comment on their actions and thoughts retrospectively, which is referred to as retrospective think-aloud (RTA). This method is often combined with eye tracking to better understand participants' eye movements (Elbabour et al. 2017). To conclude the experiment, users were given a questionnaire which contains the system usability scale (SUS), a reliable scale (Cronbach's alpha of 0.911) to evaluate users' perceived website usability (Bangor et al. 2009). Moreover, questions regarding Internet experience and demographic data are incorporated in order to strengthen the reliability of the results.

Following Romano Bergstrom et al. (2013), performance data (task-completion rate and the average time for task completion) was evaluated. Moreover, the SUS score was calculated and compared between the tested user groups. The RTA interviews were transcribed, and a qualitative content analysis was performed using a coding scheme developed deductively from existing literature (Fraiss et al. 2017). The recorded eye movements of the users during task completion were evaluated qualitatively and should support the traditional usability metrics to better understand user behaviour (Duchowski 2007). Specifically, the gaze replays for each user were watched and a list of user behaviour and usability issues was compiled. The outcome of the content analysis and the analysis of the gaze replays was used to extract findings regarding usability issues experienced and patterns of typical user behaviour.

4 Research Results

The following sections contain the key findings of the research structured according to the proposed research questions. The age of Generation Y members included in the sample ranged from 21 to 30 years, with an average age of 25 years (SD = 2.8). The Baby Boomers' age ranged from 53 to 69 years with an average age of 61 years (SD = 6.0). When asked to rate their level of comfort navigating the Internet on a scale from one (very uncomfortable) to five (very comfortable), Generation Y members had an average score of 4.6 (SD = 0.5) and Baby Boomers had an average score of 4.4 (SD = 0.8) indicating that both cohorts feel rather comfortable navigating the Internet.

Differences can be found in the frequency of Internet usage (see Fig. 1): whereas most Generation Y members (nine participants) use the Internet several times per day, only seven participants of the older cohort use the Internet this frequently.

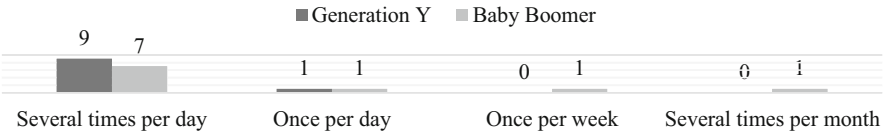

Fig. 1 Frequency of Internet usage

Table 2 AOI statistics (SD) for the tested screenshots for Generation Y (GY) and Baby Boomers (BB)

	Vienna		Styria		Lower Austria	
	GY	BB	GY	BB	GY	BB
Mean fixations						
Logo	1.20 (1.75)	0.20 (0.42)	0.70 (0.82)	0.60 (1.07)	2.20 (2.04)	1.00 (1.56)
Main menu	3.90 (3.14)	2.00 (2.79)	1.80 (2.20)	2.00 (1.94)	1.40 (1.35)	1.60 (1.65)
Central element	4.10 (1.73)	4.90 (2.85)	6.50 (1.96)	9.00 (3.65)	4.30 (2.16)	6.20 (3.65)
Mean sec viewed						
Logo	0.32 (0.47)	0.06 (0.18)	0.20 (0.23)	0.10 (0.20)	0.70 (0.8)	0.34 (0.52)
Main menu	0.91 (0.90)	0.49 (0.71)	0.53 (0.68)	0.37 (0.40)	0.35 (0.37)	0.35 (0.46)
Central element	1.10 (0.57)	1.19 (0.62)	1.66 (0.60)	2.33 (1.07)	1.08 (0.53)	1.32 (0.84)
Viewers (#)						
Logo	4	2	5	3	8	5
Main menu	8	4	5	7	6	7
Central element	10	10	10	10	10	10

4.1 Differences and Similarities in Viewing Behaviour

In this section, the viewing behaviour of the two user groups on the static homepage screenshots is considered.

Baby Boomers Have a Strong Focus on the Central Page Area As can be seen in Table 2, the older cohort had a higher number of average fixations on the central website element on all three homepages. Moreover, the stronger central focus is evidenced by the higher average dwell times compared to Generation Y. Interestingly, on Lower Austria's homepage, a top navigation menu in the upper-right peripheral area of the page was present: six users of the Generation Y cohort looked at this element, whereas it attracted no viewers from the Baby Boomer cohort. Similarly, the top navigation menu in the upper-right peripheral area of

Table 3 Mean fixations (SD) and mean dwell time (SD) throughout all three stimuli

		Generation Y	Baby Boomer	
Mean fixations	Logo[a]	1.37 (1.69)	0.6 (1.13)	$p = 0.044$
	Main navigation[b]	2.37 (2.53)	1.87 (2.11)	$p = 0.409$
	Central element[a]	4.97 (2.19)	6.7 (3.72)	$p = 0.033$
Mean sec viewed	Logo[b]	0.41 (0.58)	0.17 (0.35)	$p = 0.055$
	Main navigation[b]	0.60 (0.70)	0.40 (0.52)	$p = 0.231$
	Central element[b]	1.28 (0.61)	1.61 (0.98)	$p = 0.117$

[a]Significant group difference, Generation Y versus Baby Boomer; $p < 0.05$
[b]No significant group difference, Generation Y versus Baby Boomer; $p > 0.05$

Styria's homepage attracted just one viewer from the Baby Boomer cohort compared to four users from the younger cohort.

Generation Y Is Strongly Attracted by the Logo On all three pages, the logo consistently attracts more Generation Y viewers than Baby Boomers (see Table 2). Moreover, on all three tested sites, the younger cohort had higher fixations numbers and longer dwell times compared to the Boomer cohort. Indicated by longer average dwell times, the main navigation menu appears to be particularly attracting to the Generation Y cohort. This is especially true for Vienna's homepage, where more users from the younger cohort looked at this element compared to the older cohort (8 compared to 4, respectively).

To test whether these differences are statistically significant, the mean fixations and mean view times for the logo, the main menu, and the central element across all three pages were compared among the two cohorts (see Table 3). Generation Y ($M = 1.37$, SD $= 1.69$, $n = 30$) has significantly higher fixations on the logo compared to the Baby Boomers ($M = 0.60$, SD $= 1.13$, $n = 30$), $t(51) = -2.063$, $p = 0.044$. Regarding the central webpage element, the Baby Boomers ($M = 6.7$, SD $= 3.72$, $n = 30$) compared to Generation Y ($M = 4.97$, SD $= 2.19$, $n = 30$) have significantly more fixations on the central element, $t(47) = 2.202$, $p = 0.033$.

Both Cohorts Have Similar Scan Paths Throughout all three stimuli, the main image acts as an entry point to the page for participants from both cohorts. Users continue their scan path by looking at upper page elements before focusing on lower page elements. This viewing behaviour strongly supports the theory of visual hierarchy, stating that larger elements, pictures, and top elements attract visual attention before text or elements at the bottom of the page (Faraday 2000). If objects were located on the upper left as well as the upper right area of the page (Styria; Lower Austria), both cohorts looked first at the upper left area of the screen. This viewing pattern is consistent with the idea that users' scan path mirrors the left-to-right reading order of the German language (Fessenden 2017).

4.2 *Differences and Similarities in Perceived Usability and Task Performance*

In this section, the results of the usability test conducted on Tyrol's destination website (the participants conducted three realistic tasks on the live website) are evaluated. Typical user behaviour is derived from the gaze replays and content analysis of the RTA.

Baby Boomers Have Lower Perceived Usability Ratings and Longer Task-Completion Times Users from the older cohort were less efficient in using the site, with longer task-completion times across all three tasks (see Table 4). Regarding the perceived usability, the SUS questionnaire shows an average score among all participants of 63.4 (SD = 23.2, $n = 20$), which is below average and means that the website would receive the grade D for the overall perceived usability (Bangor et al. 2009). Considering the SUS scores for the two cohorts individually, the average score for Generation Y was 76.5 (SD = 11.6) whereas the average score for the Baby Boomers was 50.3 (SD = 24.8); the difference in averages is statistically significant ($p = 0.007$). Using the grading scheme from Bangor et al. (2009) perceived usability would receive the grade C from Generation Y and the grade F from Baby Boomers. Putting this into context with the ISO's (1998, Sect. 3.1) definition of the usability concept, it is more difficult for users from the older cohort to perform tasks on the website efficiently (longer task-completion times); moreover, their perceived satisfaction with the website after using it is lower compared to the younger cohort.

Baby Boomers Are Drawn to the Central Button For the information search task, most users from the older cohort (6 out of 10) clicked on the central button on the homepage before clicking on any other link. As suggested by the users' comments, the reason for this might be that cross-country skiing trails were expected to be found at the skiing page (the link's landing page). However, users from the older cohort also used the central button as an entry point to the website during the booking task (4 out of 10) and newsletter subscription task (3 out of 10). In contrast, none of the users from the younger cohort used the central homepage button throughout all three tasks. The screenshots below (Fig. 2) show BB2's fixations and GY9's fixations at the first impression (5 s) of the homepage. It is revealed that the Baby Boomer's

Table 4 Task-completion rate and task efficiency (SD) for Generation Y (GY) and Baby Boomers (BB)

	Information search task		Booking task		Newsletter subscription task	
	GY	BB	GY	BB	GY	BB
Completion rate	80%	50%	70%	70%	100%	100%
Task efficiency	1:19 (0:46)	2:36 (1:16)	2:33 (0:53)	5:29 (3:09)	0:59 (1:26)	1:19 (0:75)

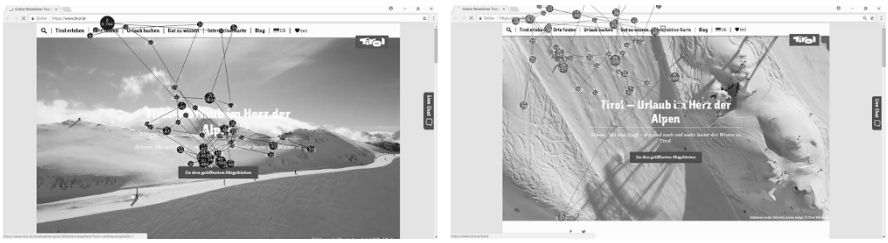

Fig. 2 Gaze plot for the time of first impression (comparison of exemplary users). Source: Screenshot of www.tirol.at; created with Gazepoint Analysis Software

fixations focused on the central homepage area before clicking on the central button. By contrast, the user from the Generation Y cohort immediately looked through the different drop-down menus.

Both Cohorts Experience Issues Regarding the Website Navigation Baby Boomers commented that the website navigation is 'complicated' (BB5) and 'not meant for my age group' (BB7). BB5 said, 'I could not book a holiday on such a website because I cannot get where I want to go'. Especially during the booking task, both cohorts had difficulties finding a suitable hotel on the website. The destination website offers a hotel booking engine; however, none of the participants were able to locate the engine on the site. Especially Generation Y members commented seven times on the missing booking engine. GY5 said, 'I could not choose the travel date [. . .] this travel search function cannot be found anywhere'. GY3 comments, 'it would be cool if I could search for hotels specifically in Innsbruck. I had to look at each hotel individually [. . .]. That stressed me out a bit'.

Baby Boomers Perceive the Website as Cluttered Baby Boomers commented nine times that the web pages were too cluttered, and two users from the older cohort would not use the website due to this issue. The cluttered layout led one Baby Boomer to say that he or she would 'book in a totally different way' (BB5), while another user preferred 'typing in something in Google as there is not so much written' (BB3). The live chat window which appears in regular intervals might have contributed to the perception of a cluttered page layout. Generation Y members felt that the live chat window was rather annoying, 'just like every commercial' (GY9), and they would use it only if they were 'really desperate' (GY3). However, five Baby Boomers expressed strong dislike towards this object. BB7 said, 'And again this stupid chat page taking up my space. I hate such things'.

Another problem which might have been caused by cluttered page layout was Baby Boomers' overlooking the booking widget located on the web page for Innsbruck. The RTA protocols indicate that Baby Boomers who experienced this issue were too focused on the list of hotels and therefore did not see the booking widget. Figure 3 illustrates how BB3 focused on the list of hotels on the left side of the page and did not see the booking mask located on the right side. In total, 3 out of 10 Baby Boomers encountered this problem, whereas no members of Generation Y experienced this issue.

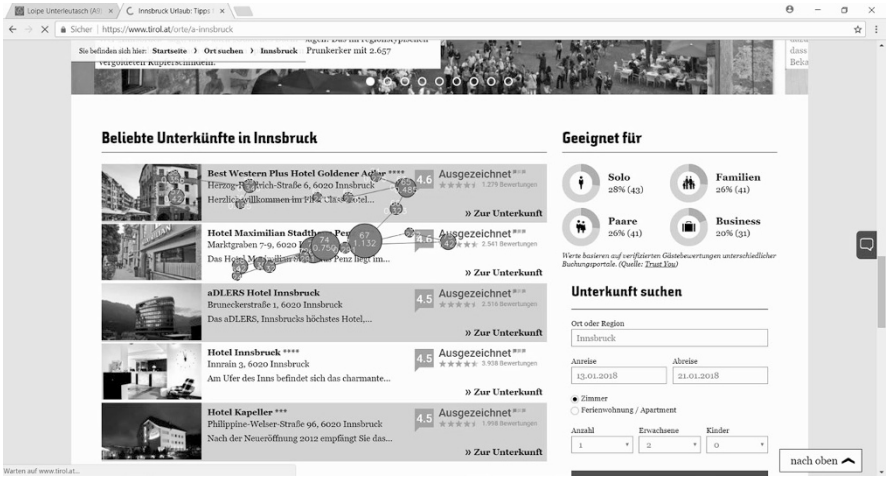

Fig. 3 Search box on the right side is overlooked by Baby Boomers (BB3). Source: Screenshot of www.tirol.at; created with Gazepoint Analysis Software

Baby Boomers Experience Problems with Input Elements The older cohort had difficulties choosing the date in the booking form (four participants) and using sliders (three participants). Moreover, three Baby Boomers unintentionally clicked on a link, two users tried to click on a link unsuccessfully (e.g. because the clickable area was too small), and two users had issues with clicking on non-links (e.g. one boomer tried to click on the central slogan on the homepage which is not a link). The drop-down menu displayed on mouseover caused difficulties for both cohorts alike. Nevertheless, it seems to be a greater issue for the older cohort: five Baby Boomers compared to two Generation Y members had issues with the drop-down menu closing unintentionally; four Baby Boomers compared to two Generation Y members were overlooking menu points due to the two-column layout.

Figure 4 demonstrates the second issue: the user focuses only on the left column of the drop-down menu; in the second sublevel is the link to Innsbruck, which could be used to find a hotel in the city and complete the booking task. However, the second column was clearly overlooked.

Generation Y Has Different Expectations Regarding the Newsletter Link When asked to sign up for the newsletter, six out of ten users from the Generation Y cohort immediately scrolled down on the homepage and searched for the newsletter subscription link in the footer. GY4 said, 'Usually this is all the way down on websites. For this reason, I immediately scrolled down'. By contrast, only one Baby Boomer searched for the newsletter link in the footer, and most users from the older cohort (6 out of 10) found the newsletter link through the drop-down menu. This finding suggests that Generation Y has different expectations regarding the location of common website elements compared to the older cohort.

Fig. 4 Users overlook links in the second column (BB2). Source: Screenshot of www.tirol.at; created with Gazepoint Analysis Software

5 Discussion

The findings of the current study suggest that Baby Boomers (age 53–71) focus most of their visual attention on the central page area. Therefore, the results of the browsing task (users were looking at destination homepage screenshots) confirm Romano Bergstorm et al.'s (2016) research stating that older adults (age 62–72) have difficulties to access information in the website periphery. This may be due to the declining UFOV of this cohort (Romano Bergstrom et al. 2013). Baby Boomers conducting real-life website tasks on Tyrol's destination website appeared to be using the central button as an entry point to the website, implying that the central focus is evident also during the performance of real-life tasks. Therefore, the poor efficiency of the older users in completing the website task may, in some part, be due to missing information in the website periphery.

The results of the browsing task show that Generation Y members (age 17–36) are more visually attracted by the top left page area. This suggests that they anticipate seeing the logo in the top left corner of the webpages and confirms research stating that Generation Y might be drawn to the top left corner of the page, as they expect to find the logo or other important elements such as the navigation bar in this position (Djamasbi et al. 2010; Romano 2010). Furthermore, during the performance of the newsletter subscription as part of the usability test on Tyrol's destination website, Generation Y expected to find the subscription link in the website footer whereas this behaviour was not shown by the Boomer cohort. These findings indicate that the younger cohort might have expectations regarding the location of common website elements which may be due to their advanced Internet experience.

Regarding the task-conduction on Tyrol's destination website, Baby Boomers were less efficient and had lower perceived usability ratings compared to the younger cohort. The older cohort explicitly stated that they feel that the website navigation is not made for older users and that they would be unable to book a hotel on the site. In a real-life scenario, this may lead to frustration and to Baby Boomers not using the site, even though they might be an important target group. Moreover, some Baby Boomers experienced difficulties using input elements on the website such as the booking form; literature suggests that these issues could be due to declining cognitive abilities (such as memory, attention span, and spatial ability) of the older cohort (Wagner et al. 2014). A crucial finding of the current research is that Baby Boomers have issues with cluttered page layout during task performance. Thus, the results of the current study disagree with Djamasbi et al.'s (2011) finding that Generation Y members have less tolerance for more web components. This study found the opposite: Baby Boomers have less tolerance than Generation Y members for more information on web pages.

6 Conclusion

The Internet is used as a tool for travel planning not only by young people but also by users from older cohorts. To the author's knowledge, this is the first eye tracking study aiming to investigate differences and similarities of Generation Y (age 17–36) and the Baby Boomers (age 53–71) in task performance, perceived usability and viewing behaviour on Austrian destination websites. Ten members from each cohort were exposed to destination homepage screenshots and completed realistic tasks on a destination website. Consistent with previous research, the findings of the current study indicate that Baby Boomers' visual attention during the first impression (5 s) of a webpage concentrates on the central area of the page. In contrast, members of Generation Y are more attracted to the upper left area of the page, where the logo is frequently located.

The results of this research provide new insights into common behaviour patterns and frequently encountered usability issues of the two generational cohorts. The older cohort experienced the page layout at cluttered and encountered problems in navigating the website as desired. Difficulties with input forms and clicking on links were frequent issues for users from the Baby Boomer generation. Findings demonstrate that Baby Boomers rated the subjective usability significantly lower and had longer task-completion times compared to the younger cohort. This suggests that destination websites are harder to use for Baby Boomers than for Generation Y members. Therefore, destination website providers targeting older users should consider addressing Baby Boomers' specific needs in their website design.

6.1 Implications and Recommendations

Since older people are a growing user group, a future challenge for DMOs is to address their specifics needs in the design of destination websites. Based on the research findings, DMOs targeting Baby Boomers should be cautious about placing important elements in the web page periphery, since they may not be noticed by older users. Moreover, it is recommended that designers be mindful of the placement of central buttons on the homepage, which can strongly draw the gaze of this user group. When designing a website for older target groups, it may be particularly important to have a clearly structured page layout with enough white space in order to aid these users in navigating the site without effort and to reduce the perception of clutter. Pop-up elements such as live chat windows should be avoided as they might further distract older users from their task accomplishment. It can also be recommended that destination websites targeting Baby Boomers should indicate links clearly and ensure that the clickable area is sufficiently large. Furthermore, input features such as forms and sliders should not require fine motor skills.

6.2 Limitations and Further Research

There are limitations that impact the generalisability of the results. The convenience sampling and the small sample size constrain the applicability of the research results to a larger population. Moreover, the differences which were found between the two groups might be explained by different practices of use or the current age group of the participants and may not necessarily be linked to the generational cohort of the users; further research is needed to test these assumptions.

Eye tracking can be a valuable tool in researching tourism, enabling insights into user behaviour which may not be obtained through traditional research methods. However, quantitative evaluation of the gaze data for the usability test was not possible, since analyzing large amount of dynamic content poses great challenges: for instance, analyzing the video content frame by frame is a time-consuming process and requires solid data quality of the available gaze recordings. Also, the available features of the eye tracking software for analyzing dynamic content must be considered. Future research could concentrate on user tasks with limited scope and focus on quantitative evaluation of the data. A further limitation relates to the fact that for analyzing users' viewing behaviour, participants were shown static images. Exposing users to destination websites for a longer amount of time and allowing them to scroll naturally should lead to insightful results and could be analyzed in future research.

This study has revealed that Baby Boomers are not strongly attracted by peripheral elements but are strongly attracted by the central area of a page. Future studies could aim to explore whether the placement of navigational elements in the peripheral areas of a web page reduces the task performance of Baby Boomers on tourism

sites. Moreover, by manipulating the amount of information displayed on the tested web pages, future research could focus on how cluttered page layout impacts perceived usability and task performance of Baby Boomers.

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