Studying Online Contents Navigation: A Comparison Between Eye-Tracking Technique and Self-Reported Investigation

Elena Marchiori and Lorenzo Cantoni

Abstract This study posits that an eye-tracking approach, together with a self-reported research design, represent valid alternatives to study tourism-related web browsing behavior. Users might form their idea about a future vacation and/or about a destination from the contents presented online, which are based on relatively impersonal textual resources provided by other users. Thus, the ability to evaluate what prospective customers are looking at in online contexts represents a new way to enhance the promotion of a destination. An eye-tracking technique was therefore compared with the results gathered from a previous study which considered a user test with self-declaration of which features on the pages capture users' attention the most. Results of this study assess the presence of a common recognition by untrained users of the dominant topic and sentiment expressed on tourism related social media pages. The results obtained from both user tests performed in different research settings revealed also potential biases in data interpretation if only one technique is used.

Keywords Eye-tracking • Topic recognition • Sentiment expressed recognition • Social media • eTourism • Tourism destinations • eWoM

1 Introduction

Success in online promotion and communication is a key factor for successful destination marketing. The way destination marketers project the image of their tourism destination in a digital context is reflected in message cues presented on web pages, such as sentences/words with positive or negative statements, title position on a page, choice of images and their position within pages, etc. However, also social media contents contribute to the destination image projected online and can be perceived as more credible than official sources, which may affect the decision to visit a destination (Go and Govers 2005, 2009; Xiang and Gretzel 2010).

In this context, while a significant amount of research has been done around the classification of online contents in the tourism domain (Marchiori and Cantoni 2012), little research has been done on the analysis of the appearance and

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recognition of contextual elements on tourism social media websites (Kim and Fesenmaier 2008; Dickinger et al. 2011; Gefen et al. 2008; Yoo and Gretzel 2008).

Research on the classification of online contents tend to use trained coders for content analysis and only little investigation has been done in order to understand if untrained coders recognize similar dominant topics within social media pages. A recent study conducted by the authors (Marchiori and Cantoni 2013) addressed this issue using a self-reported investigation on social media contents. The study revealed insights on which kinds of characteristics of pages are perceived as prominent by web users. However, self-reported design might not fully represent the actual browsing activities of users.

With the advent of technologies such as eye-tracking, it is possible to track contingent responses and pupil dilation, which might be useful for further investigation of the behavior of online users. This study posits that an eye-tracking approach, together with a self-reported research design, represent valid alternatives to study tourism-related web browsing behavior. Moreover, the ability to evaluate what prospective customers are looking at in online contexts represents a new way to enhance the promotion of a destination. The eye-tracking technique was therefore compared with the results gathered from the previous study, which considered a user test with self-declaration of which features on the pages capture users' attention the most. Both user tests consisted of a content evaluation of online pages gathered from popular websites about tourism destinations representing a variety of international tourism sites.

Thus, this study aims at evaluating users' agreements on recognizing the dominant topic, and the dominant feeling expressed on social media pages, responding also to the tourism industry need to better understand how to perform effective online communication between tourism players and prospective travelers. Indeed, Destination Management Organizations (DMOs) need to design online communication that can persuade travelers to visit their destinations, and to satisfy information needs. Moreover, the eye tracking technique allows to identify the message cues that particularly affect the attention among web users, comparing the results from an actual navigation to a self-reported perception on what features of the pages capture users' attention the most.

This study has also managerial implications as it might help destination managers to have a more comprehensive picture of how a destination is portrayed in the digital context, and which kind of technique can be used in order to identify web users' behaviors. This might enable DMOs to design more effective web strategies to attract prospective travelers and promote the value of a territory.

2 Literature Review

2.1 Online Content Analysis

In the online environment, users might form their idea about a future vacation and/or about a destination from the contents presented online, which are based on relatively impersonal textual resources provided by other users (Brown et al. 2007).

Online pages evaluation measures have been proposed in various contexts and fields as they are crucial for the understanding of the performance of online communication (Fogg 2003). This is particularly relevant in the hospitality and tourism field, where the massive use of internet by prospective travelers who need to search for information, inspiration and purchase for their next holidays, has open to research the communication spread via web and the perceptions by users. Park and Gretzel (2007) analyzed the main critical factors for the development of successful tourism websites. Nine factors are actually the main research topics in this field: (1) information quality; (2) ease of use; (3) responsiveness; (4) security/privacy; (5) visual appearance; (6) trust; (7) interactivity; (8) personalization; and (9) fulfillment. Scholars argue that website evaluation (hence their quality) can provide benefits such as customer retention, positive return on investment, and leadership within the competition (Park and Gretzel 2007). Even if the main focus of these studies is the content of the websites, and the overall evaluation of the browsing experience (Gretzel 2006; Kim and Fesenmaier 2008), an increasing attention is devoted to the contextual elements present in tourism websites. Studies on destination websites' persuasiveness (Loda et al. 2009) underline the importance of message credibility, which can impact on the decision to visit a destination. Scholars underline how the first impression that a user has about a webpage is crucial in order to proceed or not with the reading of the contents (Li et al. 2009). As in Kim and Fesenmaier (2008, p. 1), the perception of credibility of contextual elements can influence the decision to continue (or not) to visit a website, and "this decision is based primarily on visitors' overall impression toward the website, and on their perception of the site inspirational value, and these factors are closely followed in importance by involvement, and by destination knowledge".

2.2 Eye-Tracking Technique

Eye-tracking is a technique that allows to measure where a person is looking or the motion of an eye relative to the head (gaze plot) (Nielsen and Pernice 2010). Eye-tracking is used in research, particularly in psychology and marketing, as it provides powerful insights for interpreting users' behaviours (Gidlöf et al. 2013; Venkatraman et al. 2014). As in Glockner and Herbold (2011) fixation (when the eye is resting on something) durations techniques revealed that shorter fixations are typically associated with implicit and automatic processing while longer fixations are associated with deeper processing. Wan Adilah Wan et al. (2013) have recently investigated the use of eye tracking analysis of users' behavior in online social networks, revealing the dynamics of fixations on social media. In the digital context, eye-tracking is used also to evaluate website's usability (Nielsen and Pernice 2010; Katsanos et al. 2010). Research from technology persuasion studies tend also to apply this technique in order to investigate the prominent signals on the web pages, and users' online dynamics (Nielsen and Pernice 2010). Eye-tracking

has been used in the tourism research, particularly in the hospitality sector (Russo and Leclerc 1994; Lorigo et al. 2008; Pan and Zhang 2010) in order to investigate mainly hotel guests decision-making. However, a clear understanding of the potentiality of this technique in the tourism research is still under-researched.

3 Research Design

The comparison between the two different techniques for user testing consisted of a content evaluation of 13 online pages gathered from popular websites about 13 US destinations representing a variety of tourism sites (Baltimore, Boston, Cape May, Charleston, Chicago, Everglades, Lancaster, New Orleans, New York, Philadelphia, Pittsburgh, Virginia Beach, and Washington). The eye tracking technique was therefore compared with the results gathered from a previous study (Marchiori and Cantoni 2013) which considered a user test with a self-declaration of which pages' features captured users' attention the most.

Therefore, both tests were performed within the following parameters:

(1) selection of the social media pages as *stimuli* materials: four pages from Facebook.com, five pages from TripAdvisor.com, and four blog pages (mainly from TravBuddy.com) were selected, as those websites represented the main social media platforms used in the tourism online domain (Xiang and Gretzel 2010).
(2) Original comments about destinations were left on each page.
(3) Users were asked to indicate the dominant opinion expressed on each presented page, classifying the dominant topic according to destinations' categories (Marchiori et al. 2011), and were:

- Products and services at the destination
- Society: culture, residents and traditions of the place
- Governance: tourism industry, institutions, and organizations
- Environment: weather, safety
- Overall image of the destination

(4) Users were asked to indicate the dominant judgments rendered about the destination on each page. The scale used was a 5-point Likert scale (1 = positive value judgments expressed; 5 = negative value judgments expressed; with the additional point 6 = the contents do not express any value judgment). Users were not given specific guidelines for their content analysis, leaving them free to evaluate all the cues presented on the pages.

Research Settings The previous user test (Marchiori and Cantoni 2013) involved a self-declaration of which pages' features capture users' attention the most, and it was used Qualtrics (www.qualtrics.com), a professional online survey tool, for the development of the online questionnaire used during the user test. The Qualtrics online survey platform allowed for a heat map analysis, asking respondents to pick

a spot on the page, which helped to underline how pages' features captured the respondents' attention. Users were asked to select the area of the page that communicated the most dominant opinion about the destination (i.e. main topic with positive or negative opinions presented within the page) by moving the cursor on the most interesting area and clicking on it. If users saw many topics within the page, they were asked to indicate the one that captured their attention the most. Heat maps were generated by summing the data points taken from all respondents.

The second user test was performed with an eye-tracking technique, using the Tobii *X*2-60 Eye Tracker and the Tobii Studio Professional edition (www.tobii.com), which allowed to record eye tracking data during the navigation of users between different visual stimuli. After an eye tracking calibration procedure for each participant, they were left free to explore the pages thanks to a great freedom of head movement. Heat maps were generated by summing the eye tracking data taken from all respondents.

Sample For the first user test: 28 international graduate students (female: 16; male: 12; age range: from 22 to 46) from an European university were selected to participate in the user test, which was conducted in May, 2012. A room equipped with PCs was used, and the researcher was present in the room during the user test in order to ensure that the instructions were clearly understood by all participants. Participants received an account to login to a given PC and were asked to browse 13 pre-selected online pages from tourism websites, and to provide their opinions using an online questionnaire. The test took around 30 min to complete.

For the second user test: 12 international graduate students (female: 7; male: 5; age range: from 22 to 34) from an European university were selected to participate in a user test, which was conducted in August, 2014. A room equipped with a PC with the hardware installed was used; the researcher was present in the room during the user test in order to ensure that the instructions were clearly understood by all participants. The user test was performed individually, each user was asked to browse the same 13 pre-selected online pages used in the previous test, and to provide their opinions using a questionnaire. For each participant the test took around 30 min to complete. Data were then analyzed at the aggregate level.

4 Results

A comparison of the results of the self-reported investigation and the eye-tracking technique on online contents navigation shows that in an untrained coding context, a majority of users agreed on the recognition of a prominent feeling expressed. Participants in both research setting were exposed to the same stimuli, so that the specific question from the self-reported investigation to identify the area of the page that capture their attention the most, and the free navigation in the eye-tracking setting have not interfered with the identification of the main sentiment expressed in the pages. In particular, TripAdvisor pages resulted in generation of more

agreement; then came blogs, and, lastly, Facebook pages. This result suggests that Facebook and blog pages are characterized by a wide variety of comment types, as divergent posts and comments are allowed on these pages. Conversely, TripAdvisor tends to have more consistent comments on each page, as it allows users to create specific topic discussions. Regarding the coding results for the topic recognition task, the tendency reported from the previous study (Marchiori and Cantoni 2013) was confirmed also in the eye-tracking test. Seven out of thirteen pages clearly communicated an identical message (>50 %) regarding a specific topic. In particular, pages from TripAdvisor seemed to generate more consistent perceptions of a common topic recognition.

Results from the secondary investigation revealed interesting insights on the actual navigation of participants (reading of the page), which has proved to be quite different if compared with the self-declaration of which pages features captured their attention the most. Figures 1, 2, and 3 show the graphical representations of the respondents' attention on the pages, which are represented as bright spots in the map. The brightest areas in Figs. 1, 2, and 3 indicate the most visually interesting areas on the social media pages. The screenshots with grey background show the areas of the page where the majority of users selected that area. The screenshots with white background show the areas of the page where the majority of users gazed at the most (the time spent on each page by participants was on average 1.76 min). As the figures show, there is (apparently) an inconsistency among the areas within the pages that capture users' attention the most. In the results from the previous user test, titles, pictures, and presences of ranks and ratings were indicated by users as being those that captured their attention the most. On the contrary, eye-tracking results show that users quite neglected those areas while looking at those pages.

The eye-tracking technique allowed also for a Gaze Plot analysis, displaying the movement sequence, order, and duration of gaze fixation. According to a recent report from Nielsen (2011), users often leave web pages in 10–20 s. Moreover, literature on persuasive technology (Fogg 2003) confirms that users tend to evaluate a page in the first seconds. Thus, the first two and ten seconds of navigation have

Self-reported test on Everglades page | Eye-tracking test on Everglades page | Self-reported test on Lancaster page | Eye-tracking test on Lancaster page

Fig. 1 Two pairs of examples of heat maps for Facebook pages from the self-reported test (*grey background*) and eye-tracking test (*white background*)

Self-reported test on New Orleans page | Eye-tracking test on New Orleans page | Self-reported test on Baltimore page | Eye-tracking test on Baltimore page

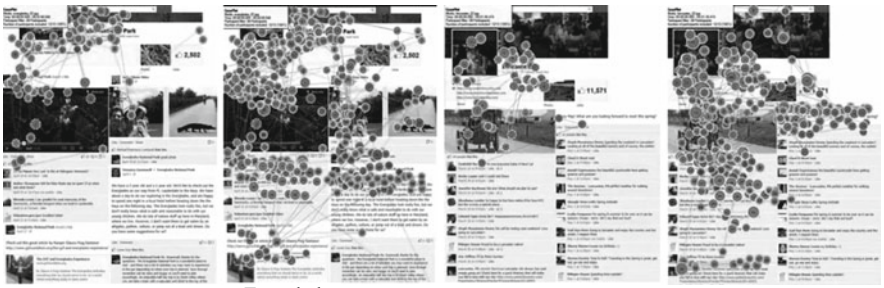
Fig. 2 Two pairs of examples of heat maps for TripAdvisor pages from the self-reported test (*grey background*) and eye-tracking test (*white background*)

Self-reported test on Boston page | Eye-tracking test on Boston page | Self-reported test on Cape May page | Eye-tracking test on Cape May page

Fig. 3 Two pairs of examples of heat maps for blog pages from the self-reported test (*grey background*) and eye-tracking test (*white background*)

been considered for a further investigation. Figures 4, 5, and 6 show the graphical representations of the respondents' gaze plot on the pages for the first 2 and 10 s of navigation. The gaze plots are represented as numerical dots in the maps. A closer look at the gaze plot data shows that users had a quick look at the pictures, titles, and ranks and ratings during the first seconds of their navigation, but for no more than 1 s, and therefore only little or not at all represented in the heat maps presented earlier.

These results suggest that the eye-tracking technique is a powerful tool for understanding which elements of the pages are seen. In particular the movement sequence, order, and duration of gaze fixation generate the identification of the dominant topic and sentiment expressed. However, a combination with a self-reported identification of the features of the pages that capture the attention the most is advised. When participants are asked to verbally identify the elements that capture their attention the most, they tend to identify elements that in a real-life navigation they quickly look at. Therefore, if researchers investigated only the real-life navigation they might encounter biases in data interpretation of this emerging technique and vice versa.

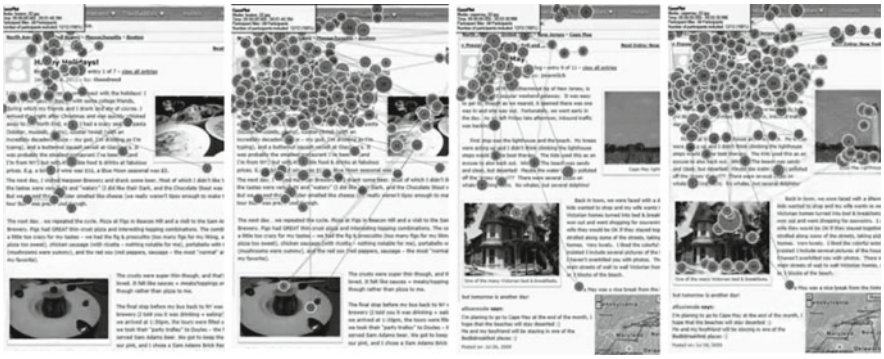


Everglades page: gaze plot at 2 sec. | Everglades page: gaze plot at 10 sec. | Lancaster page: gaze plot at 2 sec. | Lancaster page: gaze plot at 10 sec.

Fig. 4 Two pairs of examples of gaze plot for Facebook pages after 2 and 10 s of navigation

New Orleans page: gaze plot at 2 sec. | New Orleans page: gaze plot at 10 sec. | Baltimore page: gaze plot at 2 sec. | Baltimore page: gaze plot at 10 sec.

Fig. 5 Two pairs of examples of gaze plot for TripAdvisor pages after 2 and 10 s of navigation



Boston page: gaze plot at 2 sec. | Boston page: gaze plot at 10 sec. | Cape May page: gaze plot at 2 sec. | Cape May page: gaze plot at 10 sec.

Fig. 6 Two pairs of examples of gaze plot for blog pages after 2 and 10 s of navigation

5 Conclusion

Results of this user test assess the presence of a common recognition of the dominant topic and sentiment on a web page, and provide different strategies for information processing across individuals in the eTourism domain. The results obtained from both user tests performed in different research settings revealed potential biases in data interpretation if only one technique is used. For example: the presence of text on a page can lead to a longer gaze fixation of that area of the page. However, the same user may not be interested or affected by this specific area of the page even if he/she fixated it longer compared to the time spent in viewing a photo in the same page. Indeed, a user could indicate that the most significant area of the page is the photo instead of the text. This potentially contradictory result should be considered from a different perspective: if we are asked to identify the main feature/content that most captures our attention on a page, we may be influenced by the desire to choose the most prominent element, such as ranking, photo, and stronger statement as it has been revealed by this study. Therefore, as this study is still at the stage of exploratory research, this research, and overall those results, require an interdisciplinary frame for their interpretation including a cognitive perspective. Indeed, the two tests tackle different stages in the visual process where eye-tracking tend to focus in the early stage of perception, and self-reported is generally closed related with cognition. In this direction, one of the main challenges in visual perception theories has been to determine the very moment where perception finishes and cognition process begins in the whole visual process. Thus, future research should reflect and answer to this question in order to provide useful insights for a managerial perspective.

Moreover, results from the gaze plot analysis confirmed principles from technology persuasion studies, for example, the tendency of users to look at prominent signals on the page like titles, ranks, and to start their navigation from the top corner of the screen. However, the predefined stimuli might have biased the users navigation, thus a real navigation is suggested in order to further test the validity of this study. Additionally, as suggested also from the studies on web usability (Nielsen and Pernice 2010), further studies on the foveal vision (in human vision is the central area with high resolution), and the peripheral vision (vast majority of the visual field with less resolution) are recommended in order to further investigate human vision during a web browsing. Other limitations need also to be addressed: the subjects used are not the same across the tests; moreover, there is a lag of nearly 2 years, and the groups are not balanced in number and those aspects might have led to bias the results even if data have been treated at aggregate level. Thus, future research should replicate the same tests with the same subjects, and extend the theoretical foundation to a cognitive sciences perspective, such as from Gidlöf et al. (2013).

Finally, this study aimed at contributing to current tourism literature on cues/features from social media pages, which might affect the perceived dominant topic and feeling expressed within a page, which in turn might affect the decision making towards a destination. Indeed, the ability to evaluate what prospective customers are looking at in the online context represents a new way to enhance the promotion of a destination, and glimpse practical implications for designers and managers who want to better design online messages. For example, destination managers might benefit from this study as the proposed framework for a user test which comprises self-reported and eye-tracking technique could be used for testing the effectiveness of an online marketing campaign, or a website interface, or a new mobile application.

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