Practical Eye Tracking of the Ecommerce Website User Experience

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Abstract. Eye tracking is a productive tool in researching the user experience of ecommerce websites. Because information throughout the online path to purchase is communicated visually, gaze behavior is among the most effective and informative means of testing the extent to which a given ecommerce site facilitates a smooth transaction. The process of analysis typically involves examining the characteristics and patterns of visual attention during the online shopping process. Eye-tracking metrics are used in conjunction with data-based visualizations and traditional usability techniques to answer a variety of questions about the online shopping process. Principles of appropriate design, execution and analysis of an ecommerce eye-tracking study are discussed, along with relevant case examples.

Keywords: eye tracking, ecommerce, usability, user experience, visual behavior analysis, heat map.

1 The Challenge of Ecommerce

The advent of the internet has completely transformed the means by which products and services are bought and sold. Today's consumer has the ability to purchase virtually anything at any time from any place with only the click of a mouse or the tap of a finger. For businesses, this technological evolution has resulted in dramatic improvements in efficiency, communication, productivity, research and scalability. There is little doubt that as access continues to spread and bandwidth continues to grow, ecommerce will become an even more powerful force in the global economy [1].

However, for any business that hopes to realize the promise of ecommerce, a number of challenges exist. First and foremost, an ecommerce site must perform the complex task of convincing a user to execute a financial transaction without a human sales presence. That means there is no agent to promote the product, answer questions or help facilitate the purchase, and if the user does not respond to the site's "pitch," an entire internet worth of competition awaits. To further complicate this already daunting market scenario, an ecommerce website must address a number of technical considerations, including security, privacy, usability, navigation, logistics, multi-platform use and customer support [2]. The delicate practical balance between marketing, customer relations and computer science required to sell products online is a difficult one to achieve.

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The challenge of implementing and maintaining a successful ecommerce site is evident in the relevant literature. In a study of online shopping behavior, Loveday & Neihaus [3] found that 60% of intended online purchases are never completed. The Baymard Institute [4] aggregated ecommerce interaction data from a range of different industries and concluded that 68% of online shopping carts were abandoned before a transaction was made. Consumer attitudes research suggests that online shoppers experience frustration and dissatisfaction [5], [6]. And yet, ecommerce continues to expand as a proportion of the overall economy [7]. For this reason, it is more important than ever that businesses optimize their online sales capabilities and close the gap between shopping online and buying online.

The internet offers a wide array of web analytics for evaluating the performance of an ecommerce site, such as page views, unique visitors, active time, click paths and exit rate. These metrics are valuable as descriptors of online activity, but they reveal very little about the underlying drivers of site performance. Why is Product A selected for purchase more often than Product B? What causes the high exit rate on a particular page in the signup process? These questions are difficult to answer with web analytics alone. Understanding the complex interplay of cognitive, emotional and behavioral processes that defines the shopper journey requires a bottom-up research approach. To this end, eye tracking is a very effective tool.

2 Eye Tracking as an Ecommerce Research Methodology

In nearly all human-computer interactions, the most basic point of connection between an interface and its user is the eye [8]. In the context of online shopping, goods are presented, explained, promoted and processed almost entirely through information and imagery perceived by the shopper's visual systems. Products that are not seen will not be bought. Information that is not read will not inform the purchase decision. Steps in the transaction that are ignored may result in errors and, potentially, abandonment. Therein lies the essential motivation for including eye tracking in the study of ecommerce

By eye tracking shoppers' visual behavior – from that very first glance on the landing page to the instant they click on the "buy" button – UX researchers are able to uncover both barriers and affordances in the shopper journey. This may include discovering unintended patterns of attention, quantifying the attractive power of key interaction elements, identifying the attentional or cognitive mechanisms behind missed opportunities and differentiating the performance of design variants. In a domain that is so intensely visual, it makes eminent sense to include a methodology that naturally connects visual behavior to the outcomes that matter most in ecommerce: increased sales, satisfaction and loyalty [9].

An added benefit of the eye-tracking approach to ecommerce research is its universality. Because visual attention is so basic to online interactions, it can be applied to almost any shopping context – clothing, music, insurance, childcare, etc. There are essentially no limitations on the type of shopping experience that can be examined through eye tracking. This universality also applies to the shopping medium.

Whether the ecommerce site is accessed via tablet, smartphone, laptop, desktop or other system, the primary and oftentimes sole modality for communicating information, value, and relevance is screen-based. In today's UX research, eye tracking is used to collect data on a multitude of consumer device formats and a wide range of different types of ecommerce sites.

3 Developing an Eye-Tracking Study for Ecommerce

3.1 Logistical Considerations

Ecommerce user experience studies including eye tracking have many of the same considerations as non-ecommerce studies. These include the number of tasks that can be reasonably executed during the session, order of presentation of stimuli, whether the study will be between-subjects or within-subjects and what types of people should be recruited to take part in the research. There are, however, additional questions specific to ecommerce studies. Participant privacy is an important consideration, as most eye-tracking software automatically captures hardware-generated events such as loading of website URLs, mouse clicks, and keystrokes as a non-modifiable part of its normal operation. Thus, researchers who engage in studies that require actual user logins should establish a protocol or policy regarding data access, storage, and retention similar to those in use at academic research institutions that engage human subjects.

Another important decision for the researcher is how to facilitate a 'purchase' in the testing environment. Options include (1) allowing the participant to complete real transactions during the session, (2) halting the task immediately before a transaction is completed and (3) setting up a 'trapdoor' scenario in which simulated transactions are immediately nullified. Each of these options has benefits and drawbacks that must be weighed on a case-by-case basis. The appropriate logistical approach for a given study is the one that replicates as closely as possible an authentic shopping process, while ensuring that accurate eye-tracking data can be captured and meaningfully applied to research objectives.

3.2 Asking Appropriate Research Questions

A sound methodological framework is a useful first step in designing a study, but the real challenge is in developing appropriate research objectives. Ecommerce websites are often dynamic and intricate, with the capacity for highly variable user behavior, compared with other types of consumer research materials (e.g., packages, advertisements, signage). Added to that is the challenge of realistically simulating the online shopping process with participants who may not be willing or able to make an actual purchase during the testing situation. To put it simply, the test stimuli are complex, the behavior of the user is unpredictable and the testing scenario is not entirely naturalistic. For these and other reasons, it is essential that suitable research objectives are developed before the start of data collection.

Examples of unsuitable research objectives include, "I want to know where people look," "I'd like to add eye tracking to my study," and "I need a heat map."

Such statements are not uncommon in our experience. However, studies based on such requests tend to fail for three reasons:

A. They are not specific with respect to the research insight sought. The desire to "know *where people look"* is an incredibly broad starting point. It is instead preferable to focus on specific visual activities.
B. The requests do not relate to measurable behaviors (e.g., order of looking, duration of looking, context in which looking occurs).
C. It is unclear how these statements relate to business priorities. Without an understanding of the relationship between performance metrics and relevant indicators, it is exceptionally challenging to broach the issue of return on investment of the research.

The most fruitful eye-tracking research objectives are the ones that focus on specific questions about the user experience. For example, "are product imagery, special offers, and reviews salient and in a visible location?" "How readily are calls to action seen and processed?" "What elements of the checkout tend to be ignored?" Because websites are primarily visual media, the questions that can be addressed through eye tracking are myriad. Defining and prioritizing these questions is the key to developing a successful study with actionable results.

3.3 A Practical Example of Appropriate Research Objectives

A simple illustration of the aforementioned approach to eye-tracking ecommerce is now provided. It begins not with the general question of "where do people look on the site," but rather by examining a specific component of the transactional process and associated visual behaviors. Figures 1 and 2 on the following page illustrate the gaze behavior of two groups of participants as they consider the purchase of headphones on the target.com website (simulated data). Group A (fig. 1) viewed the product on a product display page and was more likely to purchase the product. Group B (fig. 2) viewed the product in a quick look product display window and most often chose not to purchase the product.

In this example, standard web and sales analytics would offer a wealth of information about these user experiences, including when pages were visited, how long the pages were visited, where the user subsequently navigated and whether or not the product was purchased. Obviously, these data are valuable in describing the behavior of online shoppers, but eye tracking adds the potential for several further layers of analysis: Do shoppers see the image right away? Where is attention most heavily concentrated? Which product details tend to be ignored? As highlighted in the figures, one potentially important distinction between these two heat maps is that shoppers who tended to purchase the product also tended to view the 5-star customer rating. In contrast, the shoppers who did not purchase generally failed to see the ratings. Is this conclusive evidence that inattention to star-ratings causes shopper abandonment? Of course not, and yet it does provide a concrete jumping off point to explore this aspect of the shopper experience in detail.

Fig. 1. Group A: Heat map of fixations for users viewing headphones on a target.com product display page. This user group most often chose to purchase (simulated data).

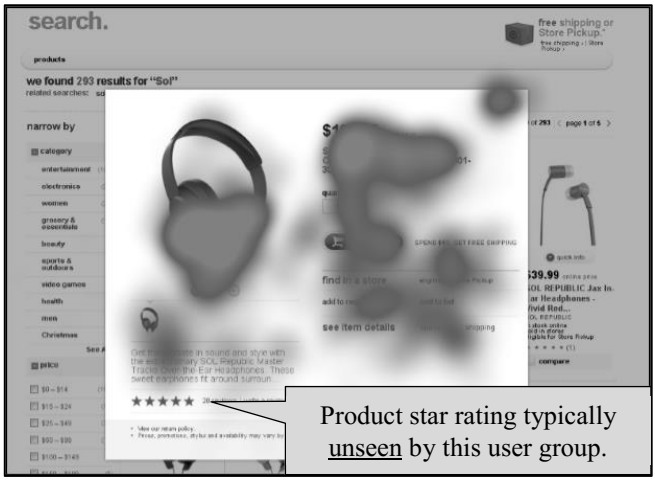

Fig. 2. Group B: Heat map of fixations for users viewing headphones on a target.com *Quick View* window. This user group most often chose *not* to purchase (simulated data).

The next step is to determine whether or not the anecdotal evidence in these figures is representative of the population at large. The researcher might prepare a follow-up study, comparing attention to star ratings among a large sample of purchasers and non-purchasers on a comprehensive list of different product types. Additionally, it might be of interest to examine the impact of attention to high vs. low star ratings on purchase intent. And of course there is the visual salience of the star rating itself,

which may be examined to elucidate overall visibility differences between the standard product display page (rating provided on the right) and the quick look page (rating provided at the bottom). Analyses such as these have the potential to inform site design decisions and create a more effective medium for communicating product value.

The basic question underlying this hypothetical eye-tracking study is, "how does attention to star ratings on the product display page impact purchase intent?" Notice that this question meets the three criteria described above. It is (A) specific to a particular visual behavior, (B) measureable in terms of both the eye data and the sales data and (C) directly related to the business objective of promoting products more persuasively through presentation of star ratings.

4 The Tools of Visual Behavior Analysis in Ecommerce

4.1 Analyzing Eye-Tracking Data

At its core, eye-tracking data consists of a time-ordered sequence of pixel coordinates. The primary task of the analyst is to extract meaningful behaviors, trends, and tendencies from this fundamental information stream. Recent advances in eye-tracking software have automated much of the process, to the extent that most kinds of results can be calculated almost instantaneously. Thus, the test of today's adept eye- tracking researcher is not in generating results, but rather understanding how to interpret and apply them. There are a number of approaches used in eye-tracking analysis, three of which are explained below in the context of ecommerce.

Attention Distribution refers to the percentage of time visually allocated to each feature of a webpage during a given task. Understanding the distribution of attention can be useful in answering a variety of research questions, such as: Which homepage features are most useful and interesting to shoppers? Which products on a category page are most heavily considered? Which information on a product display page factors most heavily into the purchase decision?

Element Viewing provides the percentage of participants who viewed a given element during a given task, for any length of time. There is an important distinction between this approach and attention distribution. Element viewing accounts for the fact that not all elements of a page require the same level of visual engagement. For example, if a shopper spent 10% of their time viewing a product image and the other 90% viewing product description, does that mean that the text was nine times more important to shoppers? The more probable explanation is that an image can be processed very quickly, whereas a block of text requires more detailed perceptual and cognitive processing. An analysis of the percentage of the total sample that fixated the image and text at least one time would be a better assessment of the level of interest in these elements.

Perceptual Flow is the typical order in which page elements are first seen? Understanding the shopper journey is not just a matter of *where* attention lands; it is also a matter of *when* attention lands. By analyzing the time to first viewing of elements, it is possible to map the perceptual flow of the page. Is the price of an expensive item

seen after the selling points? Is the upsell for a product seen in time to convince someone to take advantage before adding to cart? To answer such questions it is important to understand the typical sequence of visual behavior.

The list of other eye-tracking approaches commonly applied to research includes length of scan path, number of fixations/visits and duration of fixations/visits to name a few. The experimental design and objectives of the study should be taken into account when determining which approaches to data analysis will be most fruitful.

4.2 Visualizing Eye-Tracking Data

The numerical results described above are very useful in demonstrating trends in shopper visual behavior, although in many cases images can be more impactful than numbers. For example, it may be difficult for some clients to conceptualize the following hypothetical research finding: "Users take an average of 17.5 seconds to notice the hotel offers on the lower part of an car rental homepage (based on time to first fixation)." The eye-tracking metric proffered in this case is quite clear, but what does it actually mean in the context of web interaction? To provide perspective, one might include a gaze video example of a user demonstrating this behavior alongside the metric. The combination of data results and visual illustration can be singularly effective in presenting the findings of an ecommerce study. Three of the most commonly used eye-tracking visualizations and relevant ecommerce examples are provided below.

- **Heat maps** are, for better or worse, eye tracking's signature visualization. This graphical representation of visual behavior data renders gaze or fixation points of one or more participants in a color-coded intensity plot of visual behavior (see Figures 1 & 2 above). As a snapshot of aggregated visual attention, this graphic is efficient and useful. However, it is important to keep in mind two limitations: (A) attention to page elements that require little time to process will be deemphasized in a heat map, and (B) a heat map does not take into account the time-course of the visual interaction.

- **Gaze plots** present the position and sequence of fixations/gaze points of a given participant viewing a given page (see Figures 3 and 4 below). While these visualizations are not as clear or intelligible as heat maps when multiple participants' data are aggregated, they are useful in illustrating noteworthy individual gaze behaviors.

- **Gaze replay videos** consist of screen recordings from the eye-tracking sessions with the participant's point of gaze overlaid on the video. These visualizations can be used to illustrate the visual behavior on dynamic content (drop downs, video, etc.) or across multiple pages (category page → PDP → shopping cart). For example, one might present a video clip of a user watching a promotional product video.

The visualizations described above are not unique to ecommerce. They are employed in virtually every commercial and scientific field of eye tracking. Nonetheless, we submit that evaluation of ecommerce extracts greater utility from such visualizations than most other applications. This is because the UX researchers who typically

conduct eye-tracking studies rarely have the authority or know-how to make unilateral changes to the site. Recommendations from eye tracking must be approved or at least communicated across multiple departments, a list that may include sales, marketing, creative, support, consumer insights and technology, among others. Subsequently, recommended changes must be clearly expressed to developers or software engineers. Thus, the UX researcher is faced with the difficult task of conveying study results and suggested revisions to a large number of colleagues from many different backgrounds, most of whom have no experience with eye-tracking research. In this scenario, visual results (heat maps, gaze plots, gaze replays, etc.) can be far more intuitive and compelling in communicating the gist of a complex finding than charts and tables alone.

4.3 A Comprehensive Approach to Analysis

Eye tracking is rarely, if ever, the sole methodology included in a study of ecommerce sites or apps. As previously discussed, these sites are often complex and dynamic, and shopper behavior can be highly variable. In order to fully evaluate and characterize the user experience, it is important to include additional data streams, such as clicks, key presses, page visits and task time. Most eye-tracking software captures this information automatically, so there is no impact on the technical or methodological setup. In terms of analysis, this additional data pairs nicely with the eye data, which often anchors the spatial context from which an analysis of these events can be carried out. The visual and navigational components of user interaction are inextricably linked. It, therefore, makes sense to evaluate these related processes in parallel.

The other data stream that is typically incorporated into eye-tracking ecommerce research is direct user feedback. While the thoughts, perceptions and expectations of users are difficult to probe during the online shopping experience, post-testing interviews and questionnaires are able to explore the cognitive and emotional experience of the user in ways that visual and navigational data cannot. This is especially true when using the Retrospective Think-Aloud (RTA) technique, in which a screen recording with gaze and click data is replayed for the participant as the moderator conducts the interview. The video serves as a useful memory aid for the interviewee, as he or she attempts to recall the experience of interacting with each page in the shopping process.

4.4 A Practical Example of a Multi-Dimensional Eye-Tracking Study

A recent case study involving research conducted by Valsplat illustrates the use of eye tracking alongside other data streams to diagnose usability issues and recommend changes to an ecommerce website. KLM airlines was the subject of this study, specifically the online booking tool. In 2009, KLM launched a redesign of this feature, and utilized eye tracking, click/navigation and qualitative results to inform design decisions. The study consisted of multiple rounds of iterative testing. A Tobii T120 eye tracker was used to collect visual behavior data from participants as they booked a flight for an upcoming trip. In post-testing interviews, the RTA technique was employed.

Among other elements of the booking tool, the study sought to understand the user experience on the Select Flights page. Figure 3 below demonstrates the visual behavior of a user attempting to choose a flight. Notice that there are two separate areas of concentrated attention (on the far left and on the far right). In this version of the booking tool, the price and flight times were placed on opposite sides of the page. This resulted in a somewhat unwieldy visual experience, as users were forced to constantly look from one side of the screen to the other to find a suitably priced and scheduled flight. This finding was supported by the navigational and qualitative data (i.e., users often abandoned the purchase and expressed frustration).

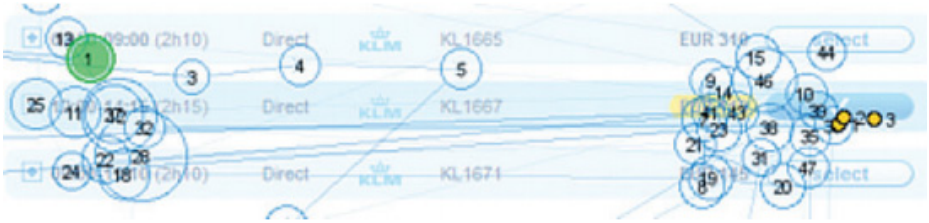

Fig. 3. Initial design of *Select Flights* page. Flight times and pricing are on opposite sides of the page, which results in a suboptimal pattern of visual attention.

These results were taken into account in the redesign of the Select Flights page. Figure 4 illustrates the visual behavior of a user interacting with an updated version of the Select Flights page. Since the pricing and schedule for each flight have been moved closer together on the new page, the data suggest that users enjoy a less taxing visual interaction. Without the eye-tracking data, it may have been difficult to pinpoint this minor flaw. When the new booking tool was launched with this change implemented, sales data demonstrated a 30% increase in conversion rate. KLM offered much of the credit for this success to the use of eye tracking in prelaunch testing.

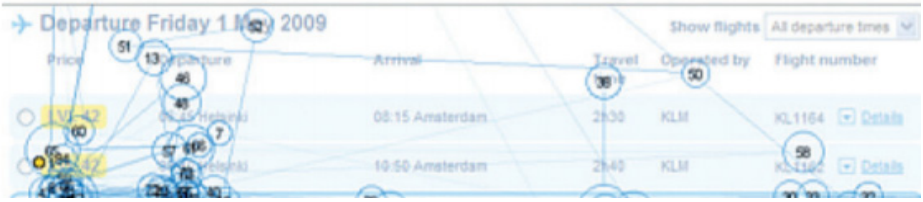

Fig. 4. Redesign of *Select Flights* page. In this version, flight times and pricing appear side-by-side, which results in a more efficient, less effortful pattern of visual behavior.

The case above encapsulates many of the best practices described in this paper. The KLM ecommerce study approached a complex online shopping process in an intelligent way. The methodology was naturalistic and yet carefully controlled, while also integrating other data streams. The research objectives were focused, straightforward,

measurable and relevant to business objectives. Finally, the analysis provided actionable conclusions in support of specific site modifications.

5 Summary

Online transactions or ecommerce is becoming an ever more prominent subject of study in user experience research. Because the primary channel of communication at the interface is visual, an investigative technique based on characterizing and interpreting visual behavior can be a powerful tool in understanding and optimizing the user experience. Eye tracking is a method that is useful and unique in the insights it provides regarding the processes of buying and selling online. When deployed in a structured methodology – including a suitable research question, appropriate metrics and visualizations, and framing of actionable insights in the context of articulated business goals – eye tracking is capable of returning tangible and substantial value.

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