ENHANCING THE CLIENT EXPERIENCE OF AN E-COMMERCE SITE USING EYE- TRACKING TECHNOLOGIES.

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Abstract

In 2015, France had more than 157,300 e-commerce sites. Competition is therefore becoming stronger. In addition to entailing a drastic change in household consumption (absence of physical contact during the purchase), the amount of credit card hacking has strongly increased since the arrival of e-commerce on the market. As a consequence, trust becomes relatively difficult to establish between the cyber-buyers and e-commerce sites.
In this paper, we want to report on our experience with a start-up that is selling its products through an e-commerce site, and that is facing the difficulty of both attracting the cyber-buyers and ensuring the purchase.
We worked on the definition of a methodology to evaluate the quality of the information delivered to the client. Thanks to a literature search, we found that eye-tracking technology can be very interesting in order to understand the behaviour of the cyber-buyer. By following in real time the eye-gaze of a user, we can analyse the gaze trajectory both during the readings and the search for information to better understand how the interface is used and if the ergonomics of the website or internet page are well done. We obtained several heat maps that illustrate the gaze trajectory made by a panel of cyber-buyers: the red clouds represent areas where users looked the most, whereas yellow clouds indicate fewer views, followed by the least-viewed blue areas. Grey areas didn't attract any fixations. Thanks to that kind of analysis, we can identify problems of understanding, ergonomics and the cognitive strategies of a user.
To achieve this objective, we decided to create a grid that combined the user's and the company's points of view and a literature search to highlight the most pertinent criteria to evaluate the quality of the information put on an e-commerce site. The methodology is called

ETGSCE or 'Eye-Tracking Grid for Search Engine Optimization (SEO) and Customer Experience'.
The deployment of the proposed methodology is illustrated through a panel of 41 participants. The participants were chosen because of the target market addressed by our start-up. We evaluated for different pages of the site (welcome page, product pages and category pages), the zones with a real interest for the cyber-buyer and also its behaviour when searching for information on the site. The finding of the eye-tracking survey and its analysis thanks to the grid are very important for the start-up. Indeed, we were able to verify if the web-marketing strategy selected by the start-up is pertinent regarding its targets and if the aspects that the start-up wanted to promote are really perceived by the average cyber-buyer. Finally, our work leads to concrete recommendations to promote greater use of the site and improve visitor experience using the client experience.

Keywords: eye tracking technology, Customer Experience, web marketing

Introduction

In 2015, France had more than 157,300 e-commerce sites. Competition is therefore becoming stronger. In addition to entailing a drastic change in household consumption (absence of physical contact during the purchase), the amount of credit card hacking has strongly increased since the arrival of e-commerce on the market. As a consequence, trust becomes relatively difficult to establish between the cyber-buyers and e-commerce sites.
Furthermore, another threat persists for e-commerce: the time constraint. Some shoppers wish to receive the product they purchased as soon as possible, as if they came to buy it in a store. But there is evidence that buying on the internet takes twice as much time as in the store. It is therefore necessary for e-commerce sites to be innovative to better capture the customer by facilitating his search for information and purchase. This aspect is commonly called 'Customer Experience Evaluation'. In this paper, we have conducted research that led us to use a particular technology, eye tracking, to better understand the user's behaviour on an e-commerce site.
To make our research reproducible, we created a grid that combined both the user's and the company's points of views and a literature search to highlight the most pertinent criteria to evaluate the quality of the information put on a e-commerce site. The methodology is called ETGSCE or 'Eye-Tracking Grid for Search Engine Optimization (SEO) and Customer Experience'. In order to validate our proposal, we realized a test thanks to a start-up that is selling its products on an e-commerce site. So, after a presentation of the eye-tracking technology, we will explain our methodology and we will present the results obtained in our industrial case. Finally, we will conclude with our perception of the interest of this experience and we will propose new potential research.

Literature review on the use of eye-tracking technology for enhancing client experience

This section is the result of several readings that the authors have used (Chalon et al., 2001) (Goldberg et al., 1995) (Andrienko et al., 2012).

In early 1879, Louis Emile Javel conducted a study on eye movement and realized that, when reading, the eyes perform a series of short stops and quick jerks. Contrary to what he thought, it's not a fine scan.
From 1930, eye tracking is designed for medical and psychological applications.
Eye tracking is a technology that aims to track the gaze of an observer in real time.
In 1950 Yarbus established a link between thought and eye movement. He discovered that the determination of what catches the viewer's eye is related to his thoughts, their order and frequency.
But it was in 1970 that the eye-tracking system began to be improved, making measurements more accurate and easy to obtain. Indeed, it can analyse the path of the eyes when reading and looking up to find out how the interface is used by the user. Thanks to this technology, we can see if there is consistency between the audience and the ergonomics of the interface. Thus, we are able to identify the difficulties of understanding, usability issues and the cognitive strategies of the user. (Jacob et al., 2003).
Andrew Duchowski, Professor of Computer Science at Clemson University, is one of the most experienced current researchers on this topic. Indeed, he has written many articles on eye tracking which have become references. The main article (Andrew Duchowski, 2007) has been cited more than 1,840 times.
Eye-tracking technology can be employed in two types of use: passive or active use.
During passive use, we are just concerned with eye movement. That is the reason why this type is used for an ergonomic analysis of a site. With regard to active use, there is in this case a real human-machine interaction through the movement of the eyes. It is often used for medical purposes.
Similarly, the eye-tracking device can be in two forms: fixed and embedded.
The embedded form consists of a helmet or a pair of glasses with sensors. This has the advantage of not perceiving any disturbance due to the movements of the user in the study. This device can also be used in all types of environments since it is easy to move.
The fixed shape, meanwhile, has sensors present on the edges of the user's field of vision. The environment is therefore very limited because if you want to move from one environment to another, you must move it entirely, which represents a significant amount of work. Furthermore, it is very sensitive to movement, which does not allow it to provide accurate results.
There are four methods for a study of eye tracking: electro-oculography technology, galvanometer technique, the technique of corneal reflection and video-oculography.

(i) The electro-oculography technique, also called EOG, can measure differences in electrical potentials produced by the rotation of the eyes. These differences are captured using electrodes placed around the eyes of the participant. This method does not allow one to precisely know the position of the gaze.

(ii) Galvanometer technology relies on the fact of creating a magnetic field and identifying the variations of an electrical signal through a lens placed on the eye of the participant through sensors. The participant is placed inside a magnetic field created by three coils positioned horizontally, vertically or laterally. The position of the gaze is thus marked by these three dimensions. This technique makes it possible to know the precise position of the eye; it is very accurate but very expensive. It can be dangerous for the participant due to the lens and the field.

(iii) The technique of corneal reflection is based on sending an infrared beam to the eye pupil through an infrared diode. Of course this ray is harmless to the participant. It is reflected in contact with the eye pupil to a small camera, which detects this radius. The camera captures the contrast between the pupil and the retina; it then transmits the information to eye-tracking software that analyses the course of the gaze in space and in time.
This technique is very accurate and has the advantage of being very insensitive to external disturbances.

(iv) Video-oculography, also called VOG, consists of recording eye movements by means of ultrasensitive small cameras that are positioned on a mask. Several infrared beams illuminate the eye to enhance the brightness of the pupil, which allows the cameras to more easily identify the latter. Once the video image being captured by the cameras is processed by computer, the system can begin to locate the centre of the pupil. Thus, for each eye movement, the computer will calculate the gaze position by paralleling the calculated position of the centre of the pupil and the recorded image video. Finally, it seems to us interesting to present the latest evolutions in the areas of application.

Initially, eye tracking was used to solve arithmetic problems and for reading sheet music. This technology has also been used by researchers in marketing. They have done studies on advertisements for products (Colombi and Russo 2010), on posters, advertising inserts (Lotise, 1997) and on consumer behaviour at the supermarket. Today, this technology is primarily used in medicine, e-commerce and marketing.
In the medical field, it improves the quality of life for people with reduced physical and mental capacity. It can also be used to help with mobility and communication (Soonjin et al., 2010). Indeed, the blinking of the eyes combined with some communication software can give a voice to those who do not have one. This is an active use.
For e-commerce, it allows evaluation of the ergonomics of a website or a web page, among other things (Baccino et al., 2001) (Barrier, 2002). It provides heat maps that illustrate the habits of Internet users: red represents areas where there was a high persistence of the gaze while cool colours represent areas of low attention.

Figure 1: Example of a Heat map. Source: http://images.google.fr/imgres?imgurl=http://www.definitions-marketing.com

Also frequently used in marketing, this technique can confirm through heat maps if advertising messages on posters and brochures are correctly perceived by consumers. This

allows the company to adjust its marketing strategy. Also, this technology is increasingly used to optimize phone applications, to make them more ergonomic. In addition, it is now possible to objectively measure consumer behaviour at the grocery counter and analyse what they see through the eye-tracking glasses. Merchants can make better decisions in terms of shelving (Tellier, 2015).

Eye tracking is also used to evaluate and validate the aesthetics of a product.
Finally, we can find it in studies carried out by the Road Safety Board to analyse driver behaviour in various driving environments. It is a portable system that uses eye tracking to record optical measurements, to check the time during which the driver's eyes are closed.
Note that the outlooks for this technology are diverse. The rapid development of web optimization and recording systems will expand the potential use of eye tracking.

Indeed, this technology will be more and more precise and can be used on small screens such as mobile phones. It could thus accurately detect what the user application icon looks like. At present, Samsung is starting to launch a feature that tracks the gaze on GalaxyS4 phones: Smart Croll. This feature pauses a movie when the eye is no longer on the screen, and relaunches it when the gaze has returned to the screen. In a few years, this feature will run on many phones, and will be increasingly advanced.

With technological advances, eye tracking will quickly become usable by the general public. This mainly concerns the field of gaming: new ways to interact with screens and digital content are emerging through eye tracking. Currently, the University of Copenhagen is working on this point. Finally, it can also be used for adapting interfaces for the physically handicapped.

Some keywords regularly emerge when we talk about customer experience, particularly in the standards:

(i) Usability is the "degree to which extent a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (EN ISO 9241-11 Standard, 1998). Usability should not be mixed up with utility.
(ii) **Utility** is a concept related to a need, a demand. Visitors come to the site out of interest, because they need something. We can thus realize that it is very important to succeed in capturing the user so that he remains on the site and does not go to a competitor's site.
(iii) **Efficiency** is the "relationship between the resources spent and the precision and degree of completion according to which the user reaches the specified objectives" (NF EN ISO 9241-11, 1998).
(iv) According to Standard ISO 9241-11, **effectiveness** is the "accuracy and the degree of completion according to which the user reaches the specified objectives."
(v) Additionally, a good customer experience reflects user satisfaction. Satisfaction is the "absence of discomfort, and positive attitudes in the use of the product" (NF EN ISO 9241-11, 1998).
(vi) Optimizing the accessibility of a site is the fact of designing an interface that favours the access to the information for the greatest number, taking into account various point of view such as the visual, hearing, motor and cognitive.

There are two laws regularly used in order to enhance the customer experience: Fitts' law and the law of proximity of Gestalt. Fitts' law, created by psychologist Paul Fitts in 1954, predicts the time required for a person to point with the mouse to an area on a web page. Thus it can optimize the interfaces by moving one element closer to another and/or by enlarging one of them. Indeed, the farther the mouse is from an area, the more time it will take to reach it; and the larger an area is, the quicker the mouse will reach it. Regarding the law of proximity of Gestalt, it allows the brain to focus on an area as a whole and thus to gather the elements that belong together. Therefore, it is very important to gather elements that have the same function or a similar action.

In addition, the evaluation of the customer experience is done in most cases with a grid of non-weighted criteria and furthermore is not specialized to evaluate the interface of an e-commerce site. That is why we found it interesting to create a grid with hierarchical criteria that will evaluate the quality of information of an interface by combining the perspective of the user and that of the company. Indeed, to have the weighted criteria is very important and very useful as they will allow us to evaluate the interface according to different aspects. In fact, this grid will permit quick detection of what is not going on the site, in order to provide relevant recommendations.

Methodology to evaluate the quality of the information delivers on e-commerce site

Methodology to evaluate the quality of information delivered on an e-commerce site

In the previous section, we highlighted the importance of having a specific evaluation for enhancing the customer experience on an e-commerce site. Consequently, we propose the following approach:

STEP 1- Creation of a grid of weighted criteria

1.1) Identification of different criteria
The identified criteria were classified in three categories: navigation menu, content and graphics.

1.2) Prioritization of criteria
The criteria were weighted according to their importance for the user and for the company regarding its values and needs. Therefore, each criterion is assigned a score from 0-2. This note represents its index of weighting, called 'level of importance' in the grid.

Table 1: Weighted criteria

Navigation menu			
	Level of importance User	Level of importance	Total
Short loading time of the page	1	1	2
Presence of a search engine	1	1	2

Search engine visible by	1	0.5	1.5
Navigation bar visible and	1	0.5	1.5
Detailed navigation bar	1	0.75	1.75
Limited number of topics	0.75	0.5	1.25

Furthermore, the person that will perform the evaluation of the quality of information of an interface will also be asked to attribute a number of points, ranging from 0 to 3, for each criterion: 0 point represents the absence of the criteria whereas 3 points represent the excellence of the latter on the analysed interface. So every analysed web page will have a quality level that takes both the SEO and the user into account.

Table 2: Eye-Tracking Grid for Seo and Customer Experience

Navigation menu	No 0 point	A little 1 point	Enough 2 points	Yes, expected 3 points	Level of importance
Short loading time of the page: (Note from 1 to 3)					2
Presence of a search engine: (Note from 1 to 3)					2
Search engine visible by internet user: (Note from 1 to 3)					1.5
Navigation bar visible and identifiable: No (< 25%), Little (26% - 50%), Enough (51% - 75%), Yes (>76%)					1.5
Detailed navigation bar (Note from 1 to 3)					1.75
Limited number of topics : >15, No ; within 10 and 15 : a little ; within 7 and 10 : Enough ; <7 : Yes.					1.25

Total	/ 30

This grid has the advantage of having several possible applications. Firstly, it can be used to evaluate the information contained on an e-commerce site, or to help with the analysis of different maps obtained following an analysis of eye tracking. We decided to call it: 'Eye-Tracking Grid for SEO and Customer Experience'.

Step 2- Creation of the experimental protocol of the ETGSCE with the eye-tracking tool

a. Preparation of the study

Before performing the test with the eye tracking, it is important to dwell on three main stages of preparation.

Stage 1: Define the personae to target the panel of the study

To conduct a study of eye tracking effectively and relevantly, one should develop a panel in advance. The panel must be representative of the target audience, for which it is best to use the personae of the company. A persona is a fictional character that represents a target person or target group. It has characteristics such as age, leisure activities, job, …

Stage 2: Apprenticeship of the device available

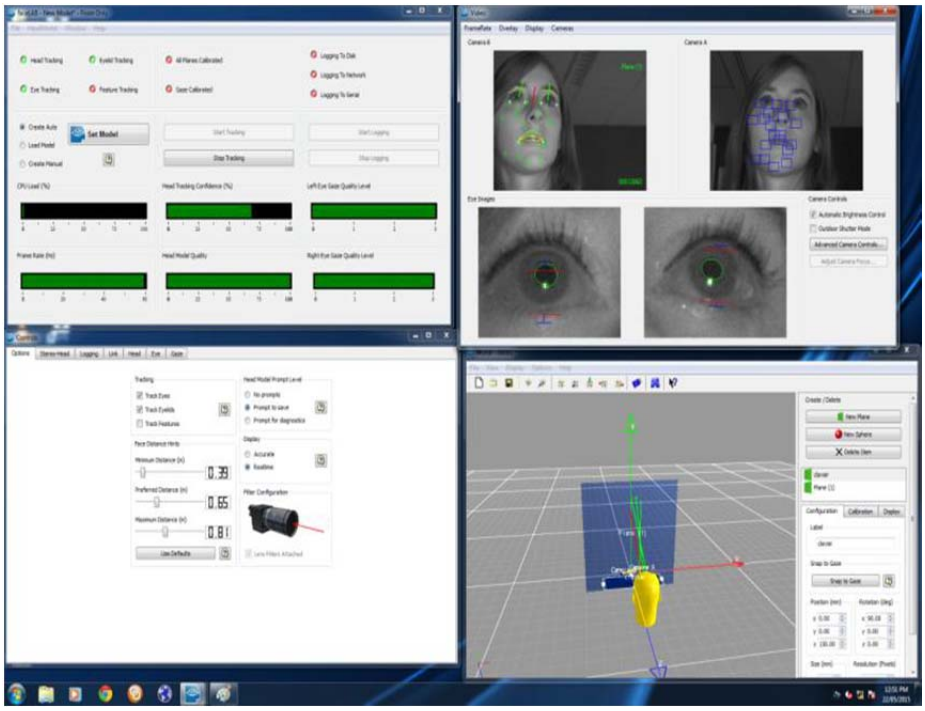

Figure 2: The different Eye Works Analyzers

Figure 3: The Eye-tracking device used

Stage 3: Creation of a protocol to facilitate the consistency of results

In order to best achieve this study, a study protocol should be created, which is to be followed by participants when they are equipped with the eye-tracking tool.

Table 3: Participant protocol

N°	Activities
1	Free discovery of the company's home page
2	Selection of a category
3	Selection of a product
4	Free discovery of the product sheet
5	Fill the grids
6	Validation of the observation test: draw the homepage

Stage 4: Creation of a questionnaire to gather the participants' initial reactions

It is interesting to submit a short questionnaire about what they saw. The technique of evocation is a frequently used practice that is very interesting. It involves asking participants to draw some pages to see what they have kept in their memory and how they kept it. This may be indicative of problems.

Stage 5: Result analysis

The analysis of the results is done thanks to a synthesis of questionnaires, drawings, the eye-tracking heat maps and also the monitoring and real-time recording of the eyes' pathway. This leads to recommendations in order to help the company improve its marketing strategy.

Case study and findings

The case study focused on the analysis of the home page, the category and product pages of a start-up that is selling its products through an e-commerce site. As the objective is to test a

site, we selected the passive use mode. For each type of page (home page, category page and product page), we determined the most viewed and least viewed areas and the behaviour of the user, which is closely linked to his customer experience.
For confidentiality reasons, we can neither give the name of the start-up nor present the full results. We chose for this article to present only the analysis and findings on the home page.

41 participants took the test, between 19 and 51 years of age. This panel is consistent with the targets of the company since 73.2% of them are in the age group of 21-30 years (which is the core target of the company).

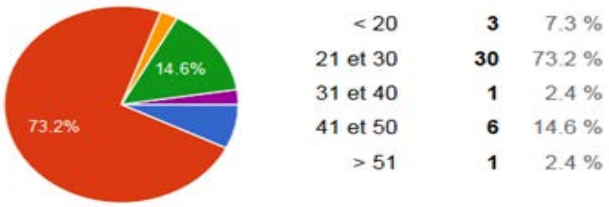

Figure 4: Profile of the panel

The heat map summarizing the 41 tests realized on the homepage gives the following results.

Figure 5: Tested homepage

A quick analysis of the eyes' pathway leads us to a comprehensive understanding of the user's behaviour: he first looks at the great advertising image, then flies over the categories located just below. Then he goes down the page and looks at the bottom of the page.

Then, the participants were asked to fill the ETGSCE grid. On average, the result is around 21.5/30 with the following repartition:

Table 3: Results using the eye-tracking grid for SEO and customer experience for the navigation menu

Navigation menu	No 0 point	A little 1 point	Enough 2 points	Yes, expected 3 points	Level of importance
Short loading time of the page: (Note from 1 to 3)				3	2
Presence of a search engine: (Note from 1 to 3)				3	2
Search engine visible by internet user: (Note from 1 to 3)			2		1.5
Navigation bar visible and identifiable: No (< 25%), Little (26% - 50%), Enough (51% - 75%), Yes (>76%)	0				1.5
Detailed navigation bar (Note from 1 to 3)				3	1.75
Limited number of topics : >15, No; within 10 and 15 : a little ; within 7 and 10 : Enough ; <7 : Yes.	1				1.25

Total	21.5 / 30

A joint analysis of the results of the eye-tracking study and the ETGSCE has allowed us to entirely analyse the content of the company's website. Thus, the evaluation of the quality of the information posted on each page leads to the following results:
- Homepage: 64.01%
- Categories page: 65.2%
- Products page: 79.9%

Overall quality of the website: 69.5%

The home page is a very important page since, most of the time, it is the first page that users see. This page leads to the first impression they have of the internet site. Therefore, it is crucial to pay particular attention to it. Looking at the results above, we can see that the home page has the lowest quality rate. So the company must give priority to working on it. In order to do that, the company has a list of remarks and some recommendations.

Number of sections: there are 11 sections. It is recommended for a website not to have more than eight if we don't want to lose the user.
Text posted right under the images of the categories: it is not read and only serves to weigh down the page in information
Categories on the top: they are not detected quickly. This is due to the strong presence of the promotional image that sits just below. It catches the eye, to the detriment of the categories. Participants detect these categories only when they have read the page in its entirety. They do not see them at first glance.
Guides and advice: this area is briefly reviewed. The text fails to catch the eye.
Blog: no participant saw that there was the presence of a blog on the home page. We can conclude that it is not sufficiently developed.
Categories on the bottom: they are easily accessible and clickable.
Promotional image: This is the most viewed area so the first impression the user will have of the quality of the site is directly linked to it.

Overall, the participants of the study did not know what to remember (64.3%) and they took some time to know where to go (59.9%). In fact, the average time spent on the home page is around 34.38 seconds with a maximum of 73 seconds.
Furthermore, we did a special evaluation of the logo of the company. The result is clear:
Among the 41 persons of the panel, 23 people viewed the company logo (56%), yet only four people (10%) were able to give the exact name and five (12%) retained half of the name.
Therefore, it was recommended that the company modify the logo with two objectives: to be more attractive and easily memorable.
Moreover, it would be interesting not to do this work in-house but to take it to a communications agency.

Conclusion

Eye tracking offers multiple possibilities of use with both devices and its four different techniques. It thus attracts the curiosity of many researchers.
We have seen that, since the early 1900s, eye tracking has been constantly evolving to be optimized and perfected. Already in frequent use today in various fields, it will be even more so in the near future. Indeed, research on human-machine interaction is more than ever at the heart of society and could really change the lives of persons with reduced capacity. The active use of eye tracking is a real opportunity. In addition, this technology will become more affordable for the general public, which will be a sign of great progress.
To conclude, this research contributes to an important aspect in the MOT field: the integration of the client experience in order to help the company better understand its needs and behaviours.
A limitation of this work is that we have only done one experiment to date, but we are preparing some extensions of our work in two directions: 1) Repeat the eye-tracking survey after our recommendations are made. We would be able to evaluate the impact of our research on the improvement of the information search. 2) Realize the survey on the site of direct competitors in order to better understand why some cyber-buyers prefer them and thus develop an action plan to improve the client experience of our customers as well as less experienced shoppers.

We have shown the advantage of being able to track the opinions of clients on a site and its interface. This has had the effect of checking whether the web marketing strategy implemented by the company was relevant in view of its different targets and if the information it wished to highlight can be understood by its clients or potential clients.
Through this study we were able to highlight both the relevant issues and inconsistencies on the site tested to help the company improve its commercial offer thanks to the customer experience.

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