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ESP Students Processing Multimodal Websites Through the Eye-tracking Technique

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ABSTRACT
With the increasing importance of the Internet for teaching and learning, websites have become an interesting pedagogic resource as they entail interconnected modes of communication to convey meaning. When combined with multimodal website analysis, eye-tracking can provide valuable insights into how users engage with different modes of communication on a website. In this pilot experimental study, we analyze and compare how twenty-six Computer Science and Business and Law double degree students process two entrepreneurial websites to understand their meaning through eye-tracking (RealEye™ online tool, https://www.realeye.io/). On the one hand, we analyze to what extent the eye-tracking technique contributes to the ESP students' perception of the multimodality of websites. On the other hand, we tested the students' reactions to using an activity with an eye-tracker in ESP courses, and we compared the results between two academic backgrounds. Our results show more fixations on titles and body text than photos or graphics, and the overall reading pattern entails fast scanning with no significant differences between the two groups. This research proves that eye-tracking can be a valuable tool for understanding how people process multimodal texts. It can be used to improve the effectiveness of such texts for communication and learning.

KEYWORDS: Eye-tracking; Language Learning through Technology; Multimodal Website Analysis; Website Reading.

1. INTRODUCTION

English for Specific Purposes courses are standard in higher education bachelor's degrees today since they respond to students' English language needs and prepare them for their future careers (Paltridge & Starfield, 2013). However, meeting the students' future needs requires updated curricula, especially regarding introducing digital genres (Darvin, 2023). Several

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studies have already been published about implementing internet genres in the classroom. Girón-García and Fortanet-Gómez (2023), for instance, explore the criteria for selecting and utilizing multimodal digital resources in ESP teaching, thus enhancing the learning experience of language learners. However, it is still a challenge for ESP teachers to keep updated with these genres and their pedagogical affordances, mainly because most of these genres need a multimodal approach.

We understand multimodality following systemic functional linguistics and Kress and van Leeuwen (2001), who argue that language consists of a combination of semiotic modes. This becomes even more evident in digital genres (Prior, 2013). Lim (2011: 47) states that:

> Multimodal discourse analysis foregrounds the complexities inherent in the multimodal text, where meanings are made through a repertoire of modalities and semiotic resources. It invites investigation into the nature of these semiotic resources as well as the relationship between these resources [...] (47)

The present study aligns with this idea of the interconnection of modes to convey meaning focusing on websites and their multimodal structure.

O'Halloran (2011: 120) defines multimodal discourse analysis as "an emerging paradigm in discourse studies which extends the study of language per se to the study of language in combination with other resources, such as images, scientific symbolism, gesture, action, music, and sound". With this statement, she exposes this idea of meaning-making as a combination of distinct modes of communication.

However, there are two ways to look into the genre from a multimodal perspective: production and reception-oriented (Holsanova, 2014). Much multimodal research has been done from the point of view of production (Bernad-Mechó, 2021; Valeiras-Jurado, 2020), that is, it analyses "the sign-maker's choices of modes to achieve a certain effect" (Holsanova, 2014:9). Only a few studies focus on the reception of multimodality, that is, "the recipients' ability to select, attend to, and process information" (p.9). Some of the studies on internet genres have already followed this approach (Bucher & Niemann, 2012; Girón-García & Fortanet-Gómez, 2023; Ruiz-Madrid, 2021), although more research needs to be carried out in this respect.

Moreover, it is not only the research of these genres that is needed; it is also vital to integrate the use of new technologies in their analysis. Eye-tracking is one of those technologies used in recent years for various purposes, among them the multimodal analysis of digital genres (O'Rourke, 2012; Holsanova, 2014; Capellini & Hsu, 2022). This technology detects the viewer's eye movement while watching a video or reading from the screen (Capellini & Hsu, 2022).

Eye-tracking provides a record of how the viewer perceives the information and the cognitive processes that underlie it: how they have drawn the information, in which order, and for how long. The results of this kind of analysis are used, for instance, to improve the design of digital materials. They can also be used as pedagogical tools to discuss them with the students.

With our research, we aim to respond to the following research questions regarding websites:

(i) How can eye-tracking contribute to studying the perception of the multimodality of websites by ESP students?

(ii) What are the students' emotional reactions to using this type of activity in ESP courses?

(iii) What is the students' overall attention to entrepreneurship websites during an ESP class?

(iv) Is there any difference in the results of students belonging to two different academic disciplines?

The anticipated findings of this research are expected to contribute significantly to the literature by offering empirical evidence and valuable insights into the effectiveness of eye-tracking techniques in enhancing ESP students' perception of website multimodality and their reactions to utilizing such technology within educational settings. These findings may serve as a basis for refining teaching methodologies, designing more engaging learning activities, and advancing the integration of innovative technological tools into ESP courses, ultimately aiming to enhance students' learning experiences and outcomes in the digital age.

2. THEORETICAL BACKGROUND

2.1. Eye-tracking applied to multimodal materials

The observation of eye movements in reading dates back to the 18th Century with the studies of Louise Émile Javal and his colleagues (Roper-Hall, 2007). Javal discovered for the first time that readers' eyes make fast movements (called saccades) while reading, alternating with brief pauses (called fixations). In the lack of more sophisticated technology, this research was based on observations made with the naked eye. Since then, researchers have continued to design methods, protocols, and tools of various kinds to study eye movements systematically (Delabarre, 1898; Lamare, 1892). Eye-tracking research flourished in the 1970s and 1980s (Anliker, 1976; Just & Carpenter, 1976; Rayner, McConkie & Zola, 1980; Scinto & Barnette, 1986). Eye trackers improved accuracy, decreased intrusiveness, and the ability to distinguish between head and eye motions throughout the 1970s. At the same time, psychological theories began to look at the relationship between the data collected from eye tracking and cognitive functions. When computers were powerful enough to perform real-time eye tracking in the 1980s, video-based eye trackers could be used in human-computer interaction. With the advances in artificial intelligence, numerous available tools can be used online to trace the ocular movements of participants and even their facial expressions. We could describe eye tracking as measuring visual attention by observing eye location and movement in an area of focus using an optical tracking system that detects corneal reflections (iMotions, 2018). As

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introduced above, eye-tracking techniques consider two types of eye movements (Land & Tatler, 2009; Rayner, 2009): fixations are the most frequent and can be used to draw conclusions about cognitive functions and attention. Eyes stop sweeping the scene during fixation and fixate on the foveal[i] region of our field of vision. This enables the visual system to process in-depth information about the viewed object. Even though our eyes appear to be fixed during a fixation, there are constant, tiny eye movements. Nonetheless, these are regarded as part of the same fixation because they do not divert our attention from the object of our focus. The fixation length measures how hard it is to interpret the observed information but also detects the participants' interest in what they are processing. This is one of the reasons why follow-up surveys are an excellent option to check a correlation among the results obtained. Saccades are also measured with eye trackers; they are quick movements of the eye's fovea between different points of interest. Sequences of fixations and saccades control how we perceive the world (or the materials under analysis). Information intake occurs primarily during the fixation period of a saccade because the image on the retina has poor quality due to rapid movements.

Another kind of analysis that can be done through web-based eye trackers is facial analysis, which is based on a technique created by Carl-Herman Hjortsjö (1970) to decipher emotional states from facial muscle movements (FACS[ii]). We can now evaluate people's emotions online thanks to computer vision and artificial intelligence technologies.

Attention can also be measured with web-based online eye trackers. After numerous failed attempts to develop a dynamic visual attention indicator, a team of researchers (Krejtz et al., 2016) from Clemson University (US) and SWPS University (Poland) ultimately developed a K-coefficient. This measure describes the dynamic path of attention of a person being observed using eye movement metrics (fixation duration and saccade amplitude). Two main categories of visual attention can be distinguished in eye-tracking studies: ambient and focal. Ambient attention suggests a scanning pattern over stimuli, characterized by brief fixations followed by lengthy saccades (typical for the initial phases of visual perception). On the other hand, longer fixations followed by shorter saccades are a sign of concentrated attention. The deeper attention is given, which can indicate that an individual is paying close attention to the information, the more focally processed the stimulus. The results of eye-tracking experiments can be used for a wide variety of purposes, such as marketing and branding (Wedel & Pieters, 2008; Zamani, Abas & Amin, 2016), user experience (of websites, but also physical places, Cao et al., 2021; Cutrell & Guan, 2007), or even linguistics (Capellini & Hsu, 2022; Conklin & Pellicer-Sánchez,2016; Hansen-Schirra & Grucza, 2016).

Bisson et al. (2015) found out how much attention is given to different types of stimuli when learning unintentionally and how it affects future explicit learning. Participants were exposed to auditory words in a foreign language (FL) on their own, together with written translations in their native language (NL), or along with both written NL translations and

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pictures. Results showed the importance of visual information in incidental vocabulary learning and the effect of exposure to multimodal stimuli on subsequent explicit learning. Another research (Montero et al., 2015) analyzes, through video with L2 subtitles or captions, the impact of two attention-enhancing techniques on L2 students' acquisition of new French words and processing of those words (i.e., target words). An interesting discussion about the relationship between attention and word learning through video can be found in their paper. The actual reception of the messages by real users in a specific context invites research that demands empirical studies. The composition of multimodal documents and their potential for meaning-making have been discussed in the social semiotic tradition (Kress & van Leeuwen, 1996) and the rhetorical tradition (Bateman, 2008; Schriver, 1997). Multimodal analyses using eye trackers will spread light on how text design affects and interacts with users, how they read complex texts, what catches and does not catch their attention, and how they integrate language, images, sounds, and animations.

2.2. Eye-tracking in second language learning and bilingualism

In recent years, there has been a growing interest in the use of eye-tracking in applied linguistics, second language acquisition, and bilingualism, as proven by the special issue on eye-tracking in the journal *Second Language Research* in 2020 (Godfroid, Winke & Conklin, 2020). Before that, in 2016, the volume *Eye-tracking and Applied Linguistics* (Hansen-Schirra & Gruzca, 2016) included several chapters on the use of this technique to analyze the relationship established by viewers between images and text in subtitled TV films (Fox, 2016), in impact captions (O'Hagan & Sasamoto, 2016), or TV documentaries (Läng, 2016). Eye-tracking has also been used for language learning to analyze the reading process when the learner may have difficulties in the vocabulary used (Wolfer, 2016) and to infer what attracts the user's attention and what does not to design multimedia and multimodal materials that can be used in education. Eye-tracking provides information about the visual attention toward the elements such as letters, words, and images the viewer fixes, for how long, in what order, and how often (Holsanova, 2014). Conklin and Pellicer-Sánchez (2016) highlight the advantages of eye-tracking to investigate the processing of individual words, idioms, or morphosyntax in language acquisition. However, they warn against the uncontrolled stimuli that may affect the results, such as the position of ROIs (Regions of Attention) (left is predominant if the language system requires reading from left to right) or the size and salience of images. These two researchers, together with Carrol (Conklin, Pellicer-Sánchez & Carrol, 2018), produced a volume in which they explain how to use eye-tracking in a wide range of applied linguistics contexts such as reading, listening, and multimodal output, writing, testing, corpus linguistics, translation, stylistics, and computer-mediated communication.

In addition to discerning fixations and saccades, eye-tracking is also used to detect emotions, as also done by other devices such as the Emotive EPOC, which was used by

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Palmer-Silveira and Ruiz-Garrido (forthcoming) to complement multimodal discourse analysis of an EMI class. This study combined emotional analysis with multimodal research and the teacher's contributions through an interview. Triangulation is a common recommendation by most researchers (Holsanova, 2014, Hanse-Schirra & Guzca, 2016), as many uncontrolled variables and stimuli interpret data difficult to analyze without contrasting it with the producers or receivers.

2.3. The use of websites to foster learning in ESP and EMI courses

There are several studies on websites for English language teaching and learning. For example, Kong (2009) analyzed the differences in the instructional discourse used in 20 websites for teaching English grammar and five textbooks. The results show that websites tend to simulate the traditional methodology and language in textbooks. Some parts of this appropriation may seem suitable, for example, websites can integrate more interactional elements. On the other hand, while websites show fewer sentences in each paragraph, the resulting discourse may unintentionally increase the processing difficulty by including more content in each sentence.

Other studies analyze the use of online materials for business courses. For example, Barneva et al. (2019) describe the types of Open Educational Resources (OERs) used in business courses taught in English. OERs can be classified according to their level of structuring. Therefore, some materials are designed exclusively for teaching a particular course. They are narrowly structured and organized, and they form a whole group together. That is why, often, they are compiled as a book, a MOOC, etc. In addition, they can also be structured by content with the following categories: textbooks, courses, journals, software, digital tutorials, data, video clips, images and photographs, and presentations. Barneva et al. (2019) also provide a list of sources of OER for business courses, among which the most salient is the MIT OCW (OpenCourseWare). Other providers of ERs are the Indian River State College Online Library, Saylor Academy, or Lumen Learning platform, which offer a "Business Writing" course to help students in their communication skills, especially thinking about their future professional careers. The materials are multimedia, including streaming videos. The GlobalEdge Online Course Modules of Michigan State University are interactive educational tools and podcasts that are also recommended for business courses.

About half of the business teachers need to learn how to use OERs or the Creative Common Licenses (Barneva et al., 2019) and need some training to select the best materials. Shank (2014) published a complete guide to help higher education practitioners select the best educational digital resources available online. However, many teachers prefer authentic materials to already-designed educational digital resources, especially at a university level. Authentic materials are those that are prepared for native speakers and not designed to be used for teaching purposes (Martínez, 2002). When dealing with English for Specific Purposes, the definition of authentic materials applies to any kind of resource that is likely to be used in

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concrete professional situations (Rus, 2020). In addition, by working with these materials, as in the case of those used in the current study, students are invited to put into practice what they have studied in other subjects.

In this regard, websites are considered ideal materials for classroom use. Not only are they authentic but also *multimodal* and *multi-sequential* (Holsanova, 2014). Websites are considered multimodal material because they entail a combination of delimited parts of text, images, videos, graphics, and even auditive content such as music or sound. Websites are considered multi-sequential as they have various entry points and reading paths.

With this respect, we propose a pilot experimental study designed to explore the possibilities of the web-based eye tracker RealEye™ applied to the web page reading processes of students in two ESP (English for Specific Purposes) courses.

3. METHOD

3.1. Participants

The participants of this experimental study are degree students from two different higher education institutions:

(i) 26 students from the English and Law Degree at the Universitat Jaume I (Castellón, Spain) enrolled in the *English for Business* course, which is in their fifth year. Their ages range from 21 to 23 years, and their levels in the English language are from B1 to C1.

(ii) 7 students from the Computer Engineering Degree at Universitat Politècnica de València (Valencia, Spain). These students were enrolled in the *English for Computer Engineering* course, in which the experiment occurred. They were from 19 to 21 years old and all Spanish, thus having English as a foreign language with a B1-B2 level.

Both English courses are part of the two degrees, and they are meant to develop language skills at a B2 level, even though the students enter the course with different proficiency levels in the language.

The reason why these two groups of students were selected was to answer the fourth research question, that is, to compare if there were any differences in the results obtained due to their academic discipline.

3.2. Materials and tools

3.2.1. The websites

To carry out the activity in class, two websites were selected. Both deal with the topic of how to start up a new company. The selection of these websites was based on the interest their content could have for business administration and computer engineering students. We will hereby briefly describe the home pages of these websites from a multimodal perspective,

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considering the content, the font types and sizes, the images, and the hyperlinks. The websites were Google for Startups and Jumpstart.

Google for Startups has 7 different content blocks[iii], the reader can scroll up with short texts in various bright colors, fonts, and sizes. Regarding content and text, it starts with a concise text, inviting the reader to navigate the page: "Connect with the right people, products, and best practices to help your startup grow." It goes on with a banner the reader can scroll to the right to click on. The first-choice frame shows a colorful form and a short text that adds imperative sentences inviting the reader to click and find more information. The rest of the choice frames introduce several programs offered by this organization using very short descriptive texts, illustrative photos of happy women and men of different ages and races, and links to more information. The following content block invites readers to use the website's products and resources practically. The fourth content block is an introduction to "Google for Startups" (About us), with a short descriptive text and a link to learn more. The following content block invites readers to find a "Google for Startups Community" near them on a world map. The last content block introduces several embedded videos with success stories, showing happy people again in illustrative photos, short descriptive texts, and hyperlinks. The footer includes the social media logos and a list of the website pages in four columns, followed by the legal privacy terms and the choice of language.

In 3 of the 7 content blocks, it is possible to go deeper into the topic by scrolling to the right on one of the content blocks by clicking on an arrow or clicking on several specific links in the shape of "meta-text buttons" (Askehave & Nielsen, 2005). These buttons can be short texts ("Get started!" or "Found out more!") (see Figure 1).

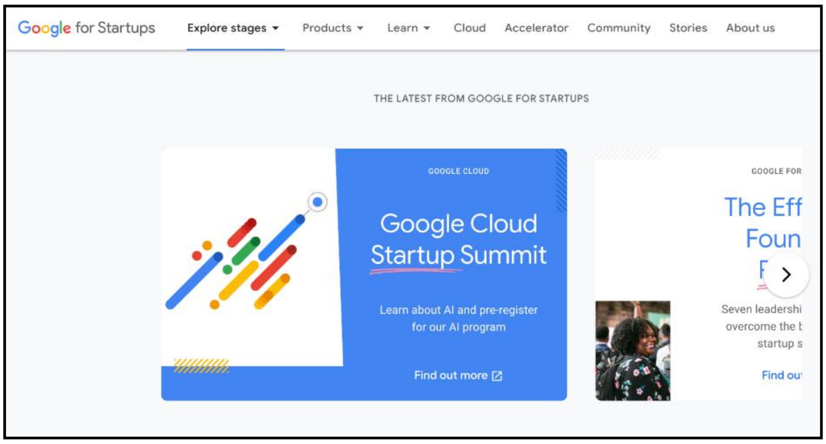

Figure 1. Example of the use of colors, fonts, and hyperlinks as well as scrolling to the left using arrows in "Google for Startups".

Images are illustrative and complementary to the text (Pérez Llantada & Luzón, 2022) and represent medium shots of adult people of several ages and races with happy faces (see

Figure 1). On page 5, there is an interactive world map in which the reader can select a region and a type of partner (see Figure 2).

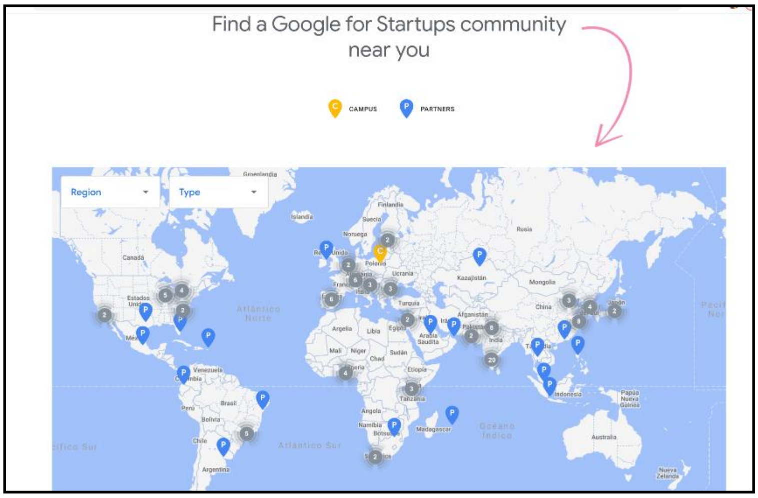

Figure 2. Example of the interactive image in *Google for Startups* website.

Jumpstart has 5 content blocks also combining short texts in different font types and colors, in this case, a dark red being predominant, combined with a distinctive blue, both cooperative colors. The first content block has a menu and a banner with images and inserted text that constantly changes, offering 5 updated pieces of news. The second content block shows their services classified into three groups: Tech Startups, Small Businesses, and Corporations & Researchers. Each has its own frame with a photo, illustrative and complementary to the text, of happy people at work, a short descriptive photo, and a meta-text button. The following content block is devoted to upcoming events. The meta-text buttons on this block are internally realized; that is, they are activated when the cursor or mouse is placed on them (see Figure 3).

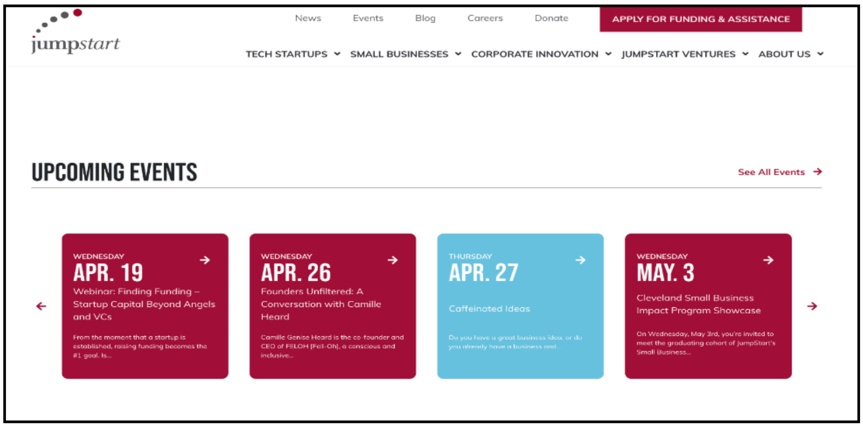

Figure 3. Example of external links with “meta-text buttons” on *Jumpstart* website.

The next block is devoted to the collaborating companies; there is a list of the names of companies with internally realized links that show a description of those companies when the mouse is placed on top of them. The final content block (also called the footer) contains Highlights, the social media logos, the company's contact data, and the Terms of Use, all in white text on a dark red background.

This brief multimodal analysis corresponds solely to the homepage of the website. As websites are complex materials with much information, it was decided that participants focused only on the home pages to facilitate our preliminary eye-tracking analysis. This means that the participants were asked only to scroll up and down or to the right.

3.2.2. The eye-tracker

Web-based eye-tracking platforms have several advantages: (i) they allow for sampling of larger populations, (ii) the experiments can be done in more naturalistic settings, (iii) the platforms are cheaper compared to specialized equipment that can only be used in a lab, and (iv) the any-place-any-time possibility is a plus for research teams. The tool that was selected for our study is RealEye^{TM}. RealEye runs AI (Deep neural network) that analyzes camera images using the processing capacity of a standard PC/laptop. With an accuracy of about 110px, the AI can identify the panelist's facial pupils and anticipate their gaze points. RealEye Dashboard (see Figure 4) is organized into three key elements essential for conducting any type of research: setting up the study, using the data to conduct the study, and performing data analysis. This tool allows researchers to see individual and aggregated heatmaps, create AOIs (Areas of Interest) and get statistics, do facial coding analyses, get attention measures, or download the heatmaps and recordings, among many other features (see Figure 4). An interesting part is that analysts can combine eye-tracking tests with follow-up surveys, as in the case of the present research.

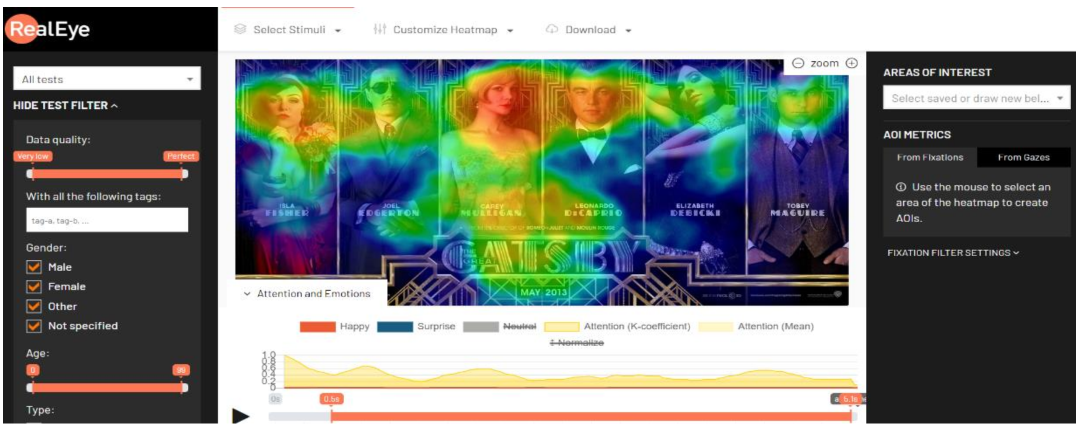

Figure 4. RealEye Analysis Dashboard. Source: RealEye website.

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3.2.3. The surveys

Two surveys (one per website) were designed for the participants to respond to after the eye tracking test to provide significant correlation and consistency between the eye tracker results and the participants' particular thoughts on the websites (Loyola et al. 2015; Low & Aryadoust, 2023). Each survey included the following two questions:
(i) What part of the website did you like best or caught your attention?
(ii) Was any part of the website difficult to understand?
As the fixation length can measure both difficulties in the participants' information processing and participants' interest in the perceived information, these two questions were intended to corroborate whether a fixation was mainly due to the participant's complex processing or, on the contrary, to a particular interest.

3.3. Procedure

3.3.1. The class activity

To introduce the experiment with an educational aim within our ESP courses, a class activity was designed in which students were told to (i) get familiar with what eye-tracking is by exploring the RealEye website, (ii) look individually at each webpage (only looking at each home page) using the RealEye links of the experiments that were shared with them, and (iii) write a collaborative business report in groups between 1000 and 1500 words long (the description of the situation of the activity and the instructions to accomplish it that was given to the students can be read in Annex 1). Each experiment was created in the RealEye tool with a duration of 60 seconds[iv] each, which means that participants had 60 seconds to look at each home page. For the third part of the activity, they were allowed more time to navigate the whole website.

3.3.2. Data collection and analysis

Data were collected in class during the first week of December 2022. Students had to open the links of the experiments that were sent to them during that class at both institutions. All recordings and measurements were downloaded during that same month. All students attending the proposed class participated in the experiment (7 in the Computer Engineering Degree and 26 in the Business and Law degree). Each result was anonymized, labeling each participant with a numeric ID. We considered and downloaded each participant's results: data quality statistics, fixations table, heatmap recording, fixations recording, and facial analysis. Finally, the results from participants that, according to the data quality statistics, were classified by the tool as poor were not considered for the analysis. Thus, from website 1, only ten participants were considered from the *Business and Legal English* course, and three from the *English for Computer Engineering* course. From website 2, only eleven participants were

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considered from the *Business and Legal English* course, and seven participants from the *English for Computer Engineering* course. Regarding the responses to the surveys, only the responses from the considered participants were considered for the analysis.

To analyze the eye-tracking data, a spreadsheet was designed to annotate the participants' reading patterns, the number of fixations, the attention measurements, and the facial emotions detected by the software. Two more pages were added to the spreadsheet: the survey responses from each website. As live webpage processing cannot mix results across participants with the RealEye tool, the authors had to analyze each measure for each individual result manually in the following steps:

(i) divide each homepage into the different parts of its layout (content blocks)

(ii) specify the elements that appear in each part (menu, logo, icons, titles, body text, photos, buttons, links)

(iii) with each fixation recording, manually identify each fixation in each part of the layout and annotate them in the spreadsheet accordingly.

(iv) with each facial analysis graph given by the software for each participant, annotate the emotion peaks (if any) in the spreadsheet accordingly.

(v) with each participant, count the number of attention peaks below and above 0 and indicate the mean value.

To analyze the survey results, all responses were added to a spreadsheet, and then each response was classified under a category. Eleven categories were identified for question 1, and five categories for question 2 (see Table 1 below). Analysts then annotated the responses according to the categories.

Table 1. Categories to choose from for the survey analysis.

QUESTION 1 (catchy parts of the website)	QUESTION 2 (complex parts to be understood)
Logo	Nothing
Colors	Content Blocks
Icons	Text
Content Block	Overall information
Photos	
Titles	
Text	
Interactive content (map)	

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Overall design	
Menu	
None	

4. RESULTS

4.1. Eye-tracking contribution to studying the perception of the multimodality of websites by ESP students

In the qualitative analysis of the participants' fixation recordings towards each block of the two websites, several drawbacks were identified:

(i) The software classified many recordings as invalid because of low-quality stats: 16 out of 27 in the experiment of website one and 7 out of 27 in the experiment of website two.

(ii) Out-of-page fixations were identified in several recordings.

(iii) Some participants did not follow the instructions of just viewing the websites' home pages; they clicked on some buttons and menu hyperlinks.

(iv) The analysts realized that, at some moments, it becomes difficult to distinguish the exact gaze point of a given fixation.

Our eye-tracking analysis delved into the following findings:

(i) More fixations were identified on titles and body text rather than on photos.

(ii) The general reading path of the participants in the two websites entails a fast-scanning process. Only two participants showed mouse movements and fixations while reading word by word.

The results from the surveys that were asked of the students with a written form embedded in the eye-tracker tool are as follows:

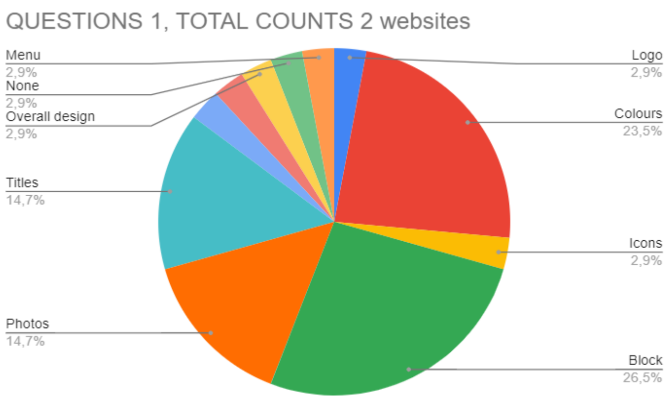

Figure 5. percentage results from Question 1 (identifying catchy or interesting content).

As it can be observed, the catchiest elements of both websites are first the content blocks (content divided into blocks that contain full information by using a combination of headings, text, and photos or graphics/icons) with 26.5%; second, the colors with 23.5%, and then titles and photos with 14,7% respectively. The least interesting elements are the logo, the icons, the menu, and the overall design of the websites. No participants mentioned the text.

Regarding question 2 (see Figure 6), in which participants had to identify which part of the website was difficult to understand, 71% of them understood everything without any difficulty, 19.4% said that some content blocks were difficult to understand, 6.5% mentioned the overall information of the websites, and 3.2% identified the text as complex.

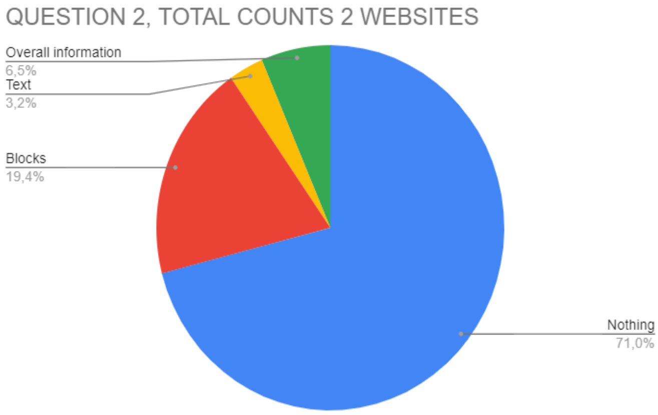

Figure 6. percentage results from Question 2 (difficult parts of websites).

4.2. The students' emotional reactions

The software employed in our study demonstrated the capability to identify and categorize emotions such as happiness and surprise; however, due to the contextual characteristics inherent in our experimental setup, it became apparent that the classroom setting presented a dynamic environment. Participants were seated alongside their peers, fostering an atmosphere conducive to conversation and the exchange of task-non-related comments among themselves.

Given this scenario, the authors made a deliberate decision not to consider the emotional results of the study. We considered that the natural interactivity among participants, wherein they engaged in conversations or shared unrelated comments, could have influenced the recorded emotional responses detected by the software.

4.3. The students' attention to entrepreneurship websites

In exploring the attention peaks within our study (Figure 7), we observed a difference in the mean values between the two websites. Notably, website one offered a mean attention peak value of 0.225, while website two offered a higher mean value of 0.3.

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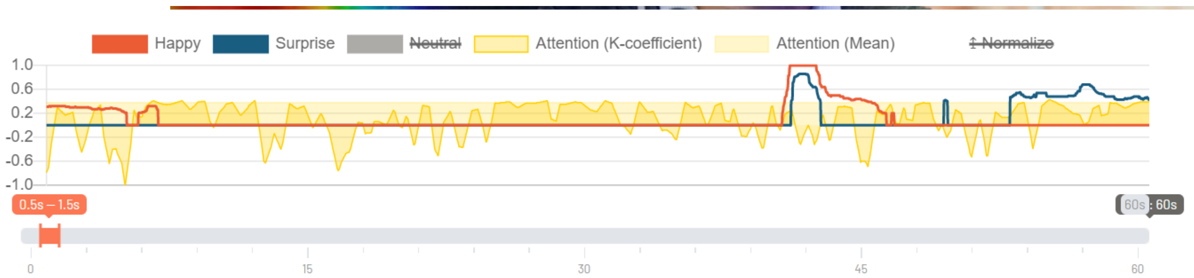

Figure 7. Example of a participant's facial and attention analysis.

4.4. Comparison between two academic disciplines

The comparative analysis revealed no statistically significant disparities between the two distinct academic disciplines represented within our study. Despite the diverse disciplinary backgrounds of the participants, both the observations drawn from the eye-tracking data and the survey results indicated a consistent pattern across both groups.

5. DISCUSSION

The study's findings provide valuable insights into how readers engage with multimodal texts. The catchiest elements of the websites were the content blocks, followed by colors, titles, and photos, respectively. This information can be useful for designers and creators of multimodal texts, as it can help them to prioritize and emphasize the most attention-grabbing elements of their texts. In the case of photos, most of them are illustrative and do not convey additional meaning; only those photos with an internal link draw the viewers' attention. This might be another reason why texts were the most viewed website key objects by the participants.

Regarding the use of the tool, we consider that the low-quality stats given by the software show a need for previous training offered to the participants with a previous task or even a need for another more controlled setting during the experiments. Many issues influence good results: light, gaze calibration, or head movements, for instance (iMotions, 2018). All these variables, which might also cause the identified out-of-page fixations, were not considered when performing the experiments inside the classroom. Another point to consider is that several participants did not follow the task instruction of only viewing the homepage of each website. They clicked on several icons, buttons, and hyperlinks, which might be caused by the participants' curiosity about the content, lack of attention to the instructions, or any other kind of distraction. More training for the analysts with the software is also needed.

Furthermore, the study's result that there were no significant differences in the overall reading pattern between the two groups of students suggests that the multimodal structure of the websites was effective in engaging both groups of students. This finding is consistent with the argument that multimodal texts can effectively engage readers from diverse backgrounds

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and with different levels of literacy (Girón-García & Fortanet-Gómez, 2023). However, our results also highlight the need for further research to explore the factors that influence what elements of multimodal texts are the most attention-grabbing for readers. For example, we found that the participants' profiles (as second language learners who were performing a task in class to write a report later) might have influenced their fixation patterns. Therefore, future research could explore how factors such as language proficiency, task demands, and cultural background influence readers' engagement with multimodal texts.

Regarding emotional arousal, the software identified more surprise than happiness, and there was no neutral emotion identified. However, as commented in the previous section, these results were not considered relevant, as students could talk to each other, and their conversations could bias the results from the emotional analysis. Nonetheless, the research possibilities of this tool might be of great interest for analyzing online learning environments and materials and the students' reactions towards them, for instance.

The attention mean of each experiment remains above 0, which may indicate that the participants were interested in the content they were processing. Again, this value might have been influenced by the participants' profiles, as they were students in charge of writing a report after the experiment, meaning they had to pay attention to the websites. The difference in the mean of attention peak values might denote varying levels of user engagement or focal points that could be attributed to differing visual cues, content arrangements, or navigational structures embedded within the websites. This finding highlights the significance of attentional variations and underscores the potential impact of website design nuances on users' attentional distribution, demanding further investigation into the specific elements contributing to these observed disparities (Cutrell & Guan, 2007: Cao et al., 2021).

Going back to the survey results, the participants' responses confirm the results obtained by the fixation recordings, that is, content blocks (the multimodal ensemble) and titles are the most interesting content for the participants. This aligns with the need to correlate eye-tracking results with the direct participants' opinions to validate the statistics given by the tools (Loyola et al. 2015; Low & Aryadoust, 2023). Almost all the participants considered that nothing was difficult to understand on the websites. Thus, we can conclude that, in our case, long fixations might be caused by participants' particular interest in an element or by their effort to understand the content because of the report they were asked to write after the experiments.

In general, we could state that the study's results provide valuable empirical evidence to support the claims made about the usefulness of eye-tracking and multimodal discourse analysis for understanding how people process multimodal texts. However, the study also highlights the need for further research to explore the complex interplay of factors that influence readers' engagement with these types of texts.

6. CONCLUSIONS

This research has shown the potential of the eye-tracking tool to unveil the attraction and difficulties an authentic website can have for ESP students, but also other research areas. A deeper focus on reading patterns with more materials and more participants, for instance, could lead to a better understanding of our reading models of multimodal materials such as websites.

No significant differences were found between the reactions of business and computer science groups, which proves that this type of material can be used for different specializations. Students do not seem to have difficulties understanding websites' homepages or navigating them, and they seem to show more interest in the text than in the visual materials. However, this research has focused only on two websites' homepages and two groups with a reduced number of students. Further research, including more websites and more students, would be necessary to draw more general conclusions.

On the other hand, as this was the students' and the teachers' first experience with an eye-tracker, many of the measurements were invalid. In the future, previous training on using the software is necessary to guarantee a higher success rate in the tests.

Finally, we believe tools such as the eye-tracker can be very useful in future research. It could be interesting to compare the results obtained by males and females, by participants from different academic backgrounds, cultures, and languages, or to compare the viewers' reactions when using digital and printed learning materials.

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NOTES

[i] The macula lutea is a tiny, flat patch situated precisely in the middle of the posterior region of the retina, which contains the fovea centralis (Yamada, 1969).
[ii] A technique that was adopted by Paul Ekman and Wallace V. Friesen in 1972
[iii] Different sorts of content blocks display various forms of content, including text, resource links, full-width images, buttons, and so on.
[iv] 60 seconds was the maximum length of an experiment with the subscription plan that the authors had at the time of the experiments.

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APPENDIX

SITUATION

You are Jaime/Julia Agost from AERG Consulting (Calle Sorní 20,4, Valencia). One of your international customers, George Stern (Wener Zuid 130, Rotterdam), has proposed a revolutionary product and would like to contact a consulting company to create a Start-Up business. Working with your group partners, explore the home page of these two websites (https://startup.google.com/, https://www.jumpstartinc.org/for-entrepreneurs/) and write a short report (1-2 pages) explaining the main advantages and disadvantages of each of them and recommending the one you find the most suitable. Please remember that all of you need to watch the homepages of both websites only once in class or on your own, if you have not come to class, using the Eye-tracker tool. You will then have to write a report following the guidelines given in this unit and the template provided.

INSTRUCTIONS UJI and UPV

THE EYE-TRACKER TOOL

Go to the Eye-tracker tool and find out what an Eye-tracker is. Please remember that you need to access it ONLY with the Chrome server. Please download it if you do not have it. Do the Demo. You will have to use it for the activity in this unit.

You will apply the Eye-tracker to 2 websites on Start-ups to find helpful information for a client of your Consultant Company who wants to start a new product. Please look freely at the homepage of each website for 60 seconds, and do not click on any of the links. You can only do it once. Later on, you will have more time to inspect it.

YOUR REPORTS

For this written activity, you will have to work in groups, and it will preferably be done in class. You need to write a business report following the guidelines in the unit. It should be a collaborative document (Google Doc) between 1000 and 1500 words long, and all the members of the group must write one part (preferably one section), with a balanced number of words with the rest (about 300 words). The text must be coherent (following a logical order and guidelines) and cohesive (forming a single unit).

The topic of the text is the situation presented in the Virtual Classroom. Once finished and reviewed by all members, it must be uploaded to this Drive folder (you will also find a template to guide your report writing here) on the 12th of December. The file must have the name of the group. The members of the group must appear as authors of the report. If there is a member who does not want to collaborate, his/her name should not appear.

