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E-COMMERCE AND SPORTS FASHION: NEUROSCIENTIFIC ANALYSIS OF USER EXPERIENCE

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1. ABSTRACT

Introduction: Global e-commerce sales reached revenues of approximately 5.8 trillion USD in 2023, an increase of more than 400 billion over the previous year's turnover. This trend is expected to continue to exceed USD 8 trillion by 2027. These new online platforms enable users to purchase products/services with greater ease and accessibility. In this context, websites are one of the main communication and interaction environments between users and companies. Therefore, ensuring their usability is a key factor in their design in order to favor the processes related to commercial transactions. Most studies assessing the impact of e-commerce apply a mix of qualitative and quantitative research methods based on declarative measures of individuals. Nevertheless, it should be noted that these methodologies are subject to a number of distinct limitations originating from biases related to social desirability and cognitive barriers. In order to overcome the restrictions of traditional techniques, consumer neuroscience emerges as an innovative discipline that facilitates the understanding of consumers' cognitive and affective processes through the use of neurophysiological tools. To further explore this field, this exploratory study aims to study the usability of two of the most searched online sports retail websites (Nike and Adidas). **Methodology:** The study analyzed the behavior of 20 participants between 18 and 30 years old (55% female and 45% male) during their interaction with the pages while performing five tasks related to online shopping. To address the objective of the study, the researchers used galvanic skin response (GSR) and electroencephalogram (EEG) as neurophysiological tools, and self-reported measures by the respondents. The metrics evaluated from the neuroscience tools were cognitive load and activation in the performance of the different experimental tasks. **Results:** The results show that the Nike website seems to have a higher level of usability than the Adidas website, although the data analyzed are not conclusive about the differences

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between the two websites under study. **Discussion:** The resulting data should be analyzed in relation to the architecture of both websites. **Conclusions:** This work evidences the importance of web usability as a key factor in brand perception and user experience.

Keywords: neuroscience; electroencephalogram (EEG); sports fashion; e-commerce; user experience (UX); usability.

2. INTRODUCTION

In an age where much of human activity takes place online, ensuring the quality of the user-interface interaction becomes vital to keep consumers satisfied. In this way, consumers often become loyal to certain brands, not only because of the intrinsic qualities of their product or service, but also because of the unique and engaging interaction and communication options made by the company (Țichindelean et al., 2021).

The increasing competitiveness between products and services has highlighted the need to emphasize digital strategies in order to create intangible added value for users and potential customers, aimed at building a favorable image of the promoted products (Buvár & Gáti, 2023). One of the tools most used by companies to build customer loyalty are websites, along with social networks. Through these tools, companies increase the number of customers and sales, increase brand recognition, foster company growth and position the brand in the market; consequently, the company becomes more competitive, improving business profitability (Hussain & Ayob, 2023).

Since the birth of websites, researchers and website developers have shown their interest and concern in identifying the best structure and optimal content of a website to attract the interest and preferences of Internet users (Velásquez et al., 2011). In this sense, a system can become obsolete if it does not meet the needs of users and does not offer user-friendly features. For example, a bad experience in the customer journey map can lead the consumer to abandon the website, while a positive experience is the result of all the interactions that the consumer has had through any device and digital channel with respect to the product or service received. In this sense, research on user experience and usability of websites are emerging concerns with respect to web application design and development (Novák et al.,2024).

In Spain, approximately one quarter of total purchases are already made over the Internet. E-commerce turnover in Spain increased in the second quarter of 2024 by 12.8% year-on-year to €23,114 million. Specifically, travel agencies and tour operators, along with establishments related to clothing are the businesses that invoiced the most thanks to e-commerce in Spain in 2024. In addition, in the same period they increased by 13.7% the number of transactions, with a total of more than 422 million (CNMC, 2025).

The fashion industry is a dynamic and constantly evolving sector. In Spain, e-commerce in the fashion sector is growing in turnover by 12.2%, reaching 19.1 million buyers in 2023, setting a new record for the highest figure reached to date, and multiplying by four the accumulated increase in the previous two years, to reach 22.8% of the fashion market in Spain (Kantar, 2024). As for the online positioning of fashion retailers, the Good Rebels report (2023), shows that Zara is the fashion brand that leads the ranking of online searches within the main categories of clothing, followed by Nike and Adidas respectively, confirming the strong presence of sports brands in the field of fashion.

2.1. Impact of web design and content on branding

Over the past two decades, the proliferation of digital technologies has had a significant impact on business operations and how consumers gather information, interact and make purchases (Sağkaya Güngör & Ozansoy Çadirci, 2022). Today, it is almost commonplace to use the web to search for all kinds of information, purchase products and services, and interact socially. Digitalization has become an essential aspect of conventional consumption patterns, enabling significant growth, where companies and organizations seek to position themselves to attract and retain users and customers. To achieve this goal, it is necessary to have an interesting and effective online presence, with more attractive websites than those of the competition (Cherubino et al.,2019). In order to achieve this objective, it is very important to have specific knowledge about the needs of users and potential customers, and to identify how people interact with websites, how they behave when surfing the Internet, what are their preferences, their difficulties and in which areas they focus their attention (Spiliopoulou, 2000).

The concern for the quality of websites emerged almost at the same time as the creation of websites. Relevant interface design and human-computer interaction professionals such as Nielsen (2000) warned about the need for sites to comply with certain attributes to guarantee an optimal user experience. The evaluation of web quality was thus born, a process which Drăgulănescu described as complex, comprising concepts such as quality, truthfulness and accuracy, and in which "evaluative judgments are often followed by important deliberation and decision-making processes" (Drăgulănescu, 2002, p. 247).

In short, the aim is to achieve sites or products that are easier to use and better meet the real needs of customers. This is especially relevant for websites, where a user who feels uncomfortable or has difficulty getting around may decide to switch to another website that better meets his or her expectations. In this sense, human-computer interaction research emerges as a key need in today's digital environment.

2.2. User Experience (UX) and Usability

Human-computer interaction (HCI) is a multidisciplinary field of study that focuses on the development, evaluation and dissemination of technology to meet user needs by optimizing the way users and technology interact (Hoffman et al., 2001). The main components of HCI are user experience (UX) and user interface (UI) designs.

The user interface (UI) is the way in which a user can communicate with the system through a computer or mobile device, taking into account that the interface design must meet the needs of the people who intend to use the UI. On the other hand, user experience (UX) refers to how the user feels with any artifact before and after using it (Briones-Villafuerte et al.,2022). Usually UX is used to check the satisfaction level of the UI adaptation, taking into account that a good UX lies in the quality of the interaction and the experience that the interface provides to the receiver (end user) (Hussain et al., 2018).

User experience (UX) is defined as "a person's perceptions and responses resulting from the use or anticipated use of a product, system or service" (ISO, 9241-210:2019, 3.7). Specifically, "user perceptions and responses include users' emotions, beliefs, preferences, perceptions, comfort, behaviors, and achievements that occur before, during, and after use." Likewise, user experience is a consequence of the brand image,

presentation, functionality, system performance, interactive behavior and support capabilities of a system, product or service. It is also a consequence of the user's internal and physical state, resulting from previous experiences, attitudes, skills, abilities, capabilities and personality; and the context of use" (ISO, 9241-210:2019, 3.7). User experience combines the technical components of the product with the cognitive processes that occur when a user interacts with the product, emphasizing overall emotional impacts and user satisfaction (Capdevila et al., 2021).

A fundamental aspect of user experience (UX) is usability**.** The term usability viewed as a process is defined as follows: the degree to which a system, product or service can be used by a given set of users to achieve a given set of objectives in a specific context of use, in an effective, efficient and satisfactory manner [ISO, 9241-11:2018, 3.1.1.] It is the most widely used paradigm in the product design industry and describes the demand and use of interactive products and systems. It is also a quantifiable quality inherent in all products and services that people interact with (Capdevila et al., 2021). In general, usability can be defined as an indicator of product usability, which includes information architecture, ergonomics and accessibility, among other aspects.

The terms UX and usability are interrelated and often used interchangeably, to measure whether user requirements are met, but there is a significant difference between the two terms (Wechsung et al., 2008). UX is concerned with the complete experience of a user while using a system which is more inclined towards their emotional views, whereas usability evaluates the quality of their use of a system based on general criteria of effectiveness, efficiency and satisfaction (Rusu et al., 2015). A positive and satisfying user experience helps users to use the system comfortably and trust it (Schmidt, 2010). Similarly, a good usable system helps users to perform system functions accurately and pleasantly, as well as to improve system productivity (Wallace et al., 2013). Thus, from both user and business perspectives, user experience and usability are of significant importance in the design and development of information systems (McNamara & Kirakowski, 2006).

2.3. Usability evaluation measures

A system gains user acceptability and loyalty when it is able to provide high quality user experience and usability (Islam et al., 2020). Therefore, usability testing is vital in human-computer interface design and it allows web designers to collect usability data systematically for interface evaluation and improvement (Liu & Wu, 2023). If these measures are not evaluated, it is uncertain whether the system accurately satisfies the user's requirements.

According to the literature review, the three main principles for measuring usability as a process are efficiency, effectiveness and satisfaction (Gonzalez-Sanchez et al., 2012). Effectiveness is defined as the accuracy and completeness with which users are able to achieve their own goals; efficiency is defined as the costs, in terms of effort or time, incurred by a user to achieve their own goals; and satisfaction is defined as users' subjective feelings about their experience of using a system (Wixon & Wilson, 1997).

With these principles in mind, different types of methods have been proposed for UX and usability evaluation, which are mainly classified into subjective methods and objective methods, and are mostly concerned with user involvement (Zaki & Islam, 2021). On the

one hand, subjective methods are usually defined as those that include data from the user's personal opinions and assumptions after the interaction, such as rating a system based on how well it meets the user's requirements; while objective methods are usually measured by metrics of user performance during the interaction (e.g., task accuracy, error frequency, task completion time, etc.) (Robinson et al*.,* 2018).

Researchers have frequently used both methods to assess user experience and usability. For example, Biduski et al. (2020) evaluated the UX of a mobile health app using questionnaires. On the other hand, Staiano et al. (2012) evaluated the UX of some multimedia playback applications using questionnaires (subjective method) and performance metrics (objective methods). In contrast, Khan and Dominic (2014) adopted airline web diagnostic tools through objective metrics such as page load time, page size, traffic, etc.

2.4. Neurophysiological usability evaluation measures

Traditional methods for analyzing web surfers' behavior on the web have focused on self-report measurements and web usage mining techniques. In self-report questionnaires, these rely heavily on subjects' ability to describe their levels of attention, emotions, or behavioral intentions in relation to the tasks performed (Gountas et al., 2019). In addition, self-report measures analyze conscious responses, but the validity of these assessments is often biased by cognitive or social desirability constraints (Poels & Dewitte, 2006). Aiming to overcome these limitations, academic and commercial research has been employing various biometric measures and technologies for UX and usability research.

Consumer neuroscience facilitates empirical research techniques to measure non-conscious preferences and cognitive and affective processes, as well as decision-making in consumer research (Harris et al., 2018). Therefore, numerous studies use neuroscientific methodologies applying multiple neurophysiological tools such as electroencephalogram (EEG), galvanic skin response (GSR), heart rate, and eye-tracking (ET), among others (Harris et al., 2018).

By measuring physiological and behavioral responses, researchers can gain insight into users' emotional states and cognitive processes during interactions with technology. The choice of biometric measures and technologies depends on the specific research questions and the context of the UX evaluation. For example, EEG and GSR may be suitable for assessing emotional responses to audiovisual content, while eye tracking and facial expression analysis may be more appropriate for assessing aspects of visual design (Soleymani et al., 2012). Zaki and Islam (2021), have conducted a literature review with the aim of exploring the use of neurological and physiological measures to perform objective assessments of usability and user experience (UX) of information systems on a variety of software platforms and focused on different contexts. The authors have found that EEG analysis as a neurological measure plays a predominant role for UX assessment, particularly in the field of e-commerce applications (Yadava et al., 2017). For physiological measures, ECG/heart rate variability plays a key role, followed by eye tracking (Jankowski et al., 2016), facial expression (Trindade et al.,2018) and galvanic skin response (Ural et al., 2019).

3. OBJECTIVES

The main objective of this research is to evaluate and compare the usability of two most searched sports retail websites pages (Nike and Adidas), trying to identify differences in designs, elements and structures that increase usability. Additionally, this study sought to assess the manner in which these brands presented sustainability as a concept on their websites, exploring the extent to which their online presence aligned with sustainability-oriented principles.

4. METHODOLOGY

In order to achieve the proposed research objectives, a mixed experimental design combining neuroscience tools and classical techniques such as observation and questionnaire was proposed. In this way, the aim is to detect the differences in the signals obtained through different neuroscience tools (electroencephalogram and galvanic skin response), caused by the tasks proposed in the web tour of the selected brands, as well as in the user's own experience. Table 1 details the architecture of the Nike and Adidas websites focusing on the main menu.

Table 1. Schematic architecture of the websites analyzed.

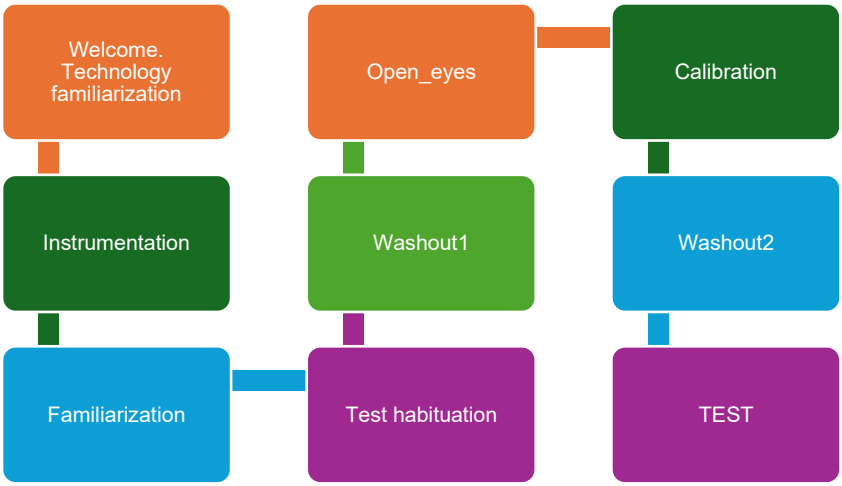
	Nike	Adidas
Main categories	5 categories: "New products", "Men", "Women", "Children", "Offers".	7 categories: "Shoes", "Men", "Women", "Children", "Sports", "Lifestyle", "Sale".
Subcategories	Few subcategories (3-4 per category).	More subcategories (4-5 per category).
Approach	Simple and intuitive, minimalist.	Detailed, with more segmentation by sport and lifestyle.
Size of categories	Smaller and more compact.	Larger and more prominent.
Additional elements	Store search, technical support, registration, login.	Help, returns, gift card, registration.
Footer	Organized in three sections: "Resources", "Help", "Company".	More extensive, it includes support, sports, information and social networks.
Overall design	Minimalist.	Segmented.

Source: Elaborated by the authors.

The experiment consists of the completion of five tasks on the website of one of the companies under analysis: Nike and Adidas. Each of the tasks lasts approximately one minute. In addition, participants will complete a self-reported questionnaire before and at the end of the tasks in order to measure the efficiency, success and level of difficulty, as well as the perception of sustainability of the brands. In addition, the entire experiment was subjected to a non-participant observation technique in which a second researcher acted as an evaluator of the execution of the tasks to extract measures of their effectiveness and degree of compliance.

The experiment was carried out in the neuroscience laboratory of a university in Madrid, in compliance with ethical regulations and confidentiality guarantees. Participants were informed about the experiment and signed their consent before starting the experiment. The sensors were then fixed and calibrated.

Figure 1. Diagram of the neurophysiological phase of the experiment.



Source: Elaborated by the authors.

The fieldwork was carried out during May and June 2023. The convenience sample was finally composed of 20 young people aged between 18 and 32 years, of whom 9 (45%) were men and 11 (55%) women. All of them were undergraduate and master's degree students in social sciences at a university in the Community of Madrid (CAM, in Spanish). This sample size is within accepted standards and is usual in the design of experiments in the field of neuroscience (Crespo-Tejero et al., 2023).

4.1. Stimuli

For the experiment, 5 different tasks were selected to be performed by the participants. These tasks are related to common activities in the online shopping process and would be the following:

- T1: Search for the cheapest women's running shoes.
- T2: Registration in the brand's community.
- T3: Search for return policies.
- T4: Search for the brand's sustainability policies.
- T5: Search for the men's sweatshirt made with sustainable materials.

These actions will be carried out from the website of the selected brands: Nike website (https://www.nike.com/es/) and Adidas website (https://www.adidas.es/).

4.2. Variables and measures that were analyzed

The experimental design included the collection of two different types of measures: both explicit or self-reported (subjective) measures and neurophysiological (objective) measures.

1. Explicit self-reported measures: collected by means of two independent questionnaires, different variables were measured from two approaches:

- From the Evaluator's point of view:

a) Success / Failure. The level of success will be determined if the user manages to perform the action in the allotted time (1 minute). In case he/she exceeds the time, the task will be established as a failure.

b) Efficient / Not Efficient. The efficiency level will be evaluated according to the search route followed by the user to reach the achievement of the task. In case he/she chooses the longest route, it will be a non-efficient task.

- From the Subject's point of view**:**

a) Difficulty Level. Using a 5-position Likert scale, the participant will indicate the level of difficulty experienced in each of the tasks. Being 1 the easiest level and 5 the most difficult level.

b) Perceived Efficiency. The participant will indicate whether he/she considers that he/she has been efficient in the development of the task, with a 5-position Likert scale.

c) Perceived Sustainability. The user will indicate the level of perception of sustainability of the brand after performing the indicated tasks. A Likert scale (1-5) will be used, with 1 being the most negative level and 5 the most positive.

Neurophysiological measures: two different consumer neuroscience techniques were used: skin conductance (GSR) and electroencephalogram (EEG), all monitored by devices provided by BitBrain Technologies. This company specializing in neurotechnology has already collaborated in numerous previous academic investigations such as, for example, that of Fernandez-Lores et al. (2024).

Galvanic skin response (GSR) measures the electrodermal response by assessing the increase in sweat gland activity upon exposure to a specific stimulus. Therefore, skin conductance amplitude provides a direct measure of the subjects arousal (Venkatraman et al*.*, 2015), in English arousal. The GSR device used in the present study to obtain arousal or arousal was the BitBrain GSR ring, a wireless device for real-time monitoring of electro-dermal and cardiac activity. Values are set between +100 and -100.

The electroencephalogram (EEG) is a non-invasive instrument that provides information from areas below the cortex and helps to understand how the brain responds to various stimuli (du Plessis, 2011). Brain activity was recorded using the wearable and mobile BitBrain Dry-EEG with 12 channels at a sampling rate of 256Hz, while impedances >100dB @50Hz, >50GΩ. For the experiment, 12 electrodes, 12 A×EEG (Fp1, Fp2, AF7, AF8, F3, F4, P3, P4, PO7, PO8, O1, O2), REF (A1) and DRL (Fpz) were used. The electroencephalogram makes it possible to determine the measurement of the cognitive load metric, understood as the cognitive resources used to perform a task or visualize a stimulus (values between 0 and 100).

Figure 2. Summary of variables collected in the experiment.

Source: Elaborated by the authors.

5. RESULTS

Initially, the results obtained with the various techniques are subjected to independent analysis. Therefore, the signals that were collected using the neuroscience devices enabled the following results to be extracted for each task.

Table 2. Comparison of results: duration and neurophysiological measures.

TASK	**CONTENT**	**DURATION**		**ACTIVATION**		**COGNITIVE LOAD**	
		NIKE	ADIDAS	NIKE	ADIDAS	NIKE	ADIDAS
T1	Search for cheapest running shoes for women	01:02	00:58	M=1.96 DT=39.96	M=-3.12 DT=27.66	M=31.82 DT=5.89	M=32.17 DT=32.17
T2	Registration in the brand community	00:27	00:38	M=1.57 DT=14.74	M=3.57 DT=47.02	M=27.23 DT=5.24	M=30.82 DT=7.24
T3	Search for return policies	00:26	00:23	M=2.60 DT=22.30	M=6.20 DT=32.43	M=30.60 DT=6.55	M=31.81 DT=7.26
T4	Search for brand sustainability policies	00:40	01:10	**M=13.39 DT=27.45**	**M=-6.31 DT=21.74**	M=29.29 DT=9.74	M=29.87 DT =7.69
T5	Men's sweatshirt search, made from sustainable materials.	01:05	01:10	**M=-15.61 DT=23.02**	**M=11.67 DT=30.69**	M=29.25 DT=8.97	M=29.94 DT =6.62
Statistic t **T4. Activation metric. t= -1.76 *.** **T5. Activation metric. t= 2.008 * T5.** *Significance level: 0.05							

Source: Elaborated by the authors based on metrics provided by BitBrain Technologies.

As can be seen, participants took less time to complete tasks 2, 4 and 5 on the Nike website. Task 4 stands out, where the biggest differences are found, with subjects taking 30 seconds longer on average to solve the task than on the Adidas website.

Regarding the analysis of the activation metric, the results show that there are significant differences between the Adidas and Nike websites in tasks 4 and 5. Specifically, in task 4, the mean activation is lower in the Adidas website, i.e. the task was performed in a calmer way than the Nike website. However, on task 5, the activation scores are lower on the Nike website, reflecting that Adidas customers had more stress in solving the task.

With respect to the cognitive load metric, no significant differences were found between the two websites in any of the tasks performed. Consequently, the cognitive resources used by the participants are similar in both websites.

Finally, task 3 related to return policies does not present a clearly better pattern in one of the analyzed websites. Consequently, when the task was performed on the Nike website, a reduced level of activation and workload was observed, although a greater time investment was made. On the other hand, on the Adidas website, the task generated greater stress and took longer without using various resources.

Next, the analysis was extended by focusing on tasks 4 and 5, which show significant differences in the activation metric. For this purpose, a segmentation was made according to the results of the non-participant observation carried out by the evaluators. Thus, the segments "Success-Efficient" (the user has managed to perform the task correctly within the estimated time), "Success-Inefficient" (the user has managed to perform the task correctly using the longest search route) and "Failure" (the user has not performed the task or has exceeded the estimated time) have been taken into account.

Table 3. Segmentation results task 4

SEGMENTATION	**N**		**ACTIVATION**		**COGNITIVE LOAD**	
	NIKE	ADIDAS	NIKE	ADIDAS	NIKE	ADIDAS
Success-efficient	6	5	M=15.31 DT=32.41	M=8.01 DT=21.74	M=28.42 DT=8.44	M=30.66 DT=10.50
Success-inefficient	2	2	M=16.68 DT=0	M=-3.52 DT=9.60	M=45.65 DT=0	M=32.92 DT=3.72
Failure	2	3	M=6.01 DT=25.19	M=--32.03 DT=19.71	M=23.31 DT=7.72	M=26.51 DT=3.33
All	10	10	M=13.39 DT=27.45	M=-6.31 DT=21.74	M=29.29 DT=9.74	M=29.87 DT=7.69

Source: Elaborated by the authors based on metrics provided by BitBrain Technologies.

Regarding task 4, localization of sustainability policies, in both websites most of the participants complete the task successfully and efficiently. In addition, in the case of the activation variable, it can be seen that the Adidas website has generated greater peace of mind for the user in all segments. On the other hand, Nike has presented a positive peak, i.e., a level of stress due to a bad user experience in those participants "successful-efficient". The "failures" have had a negative level of activation, in other words, the participant has not been stressed. The workload variable in both brands presents high values (30 approx.), with Adidas standing out above Nike in the "success-efficient" and "failure" segments; consequently, the participants have used numerous resources to accomplish the task, and even a large part of them have failed.

Table 4. Segmentation results task 5.

SEGMENTATION	**N**		**ACTIVATION**		**COGNITIVE LOAD**	
	NIKE	ADIDAS	NIKE	ADIDAS	NIKE	ADIDAS
Success-efficient	5	6	M=-18.44 DT=31.50	M=12.06 DT=39.43	M=27.40 DT=6.98 M=30.72	M=30.72 DT=6.75
Success-inefficient	2	1	M=-12.85 DT=13.27	M=-8.15 DT=0	M=35.94 DT=14.79	M=23.28 DT=0
Failure	3	3	M=-11.28 DT=1.33	M=17.51 DT=10.18	M=28.09 DT=12.21	M=30.59 DT=7.65
All	10	10	M=-15.61 DT=23.02	M=11.67 DT=30.69	M=29.25 DT=8.97	M=29.94 DT=6.62

Source: Elaborated by the authors based on metrics provided by BitBrain Technologies.

In relation to task 5, purchase of sustainable sweatshirt, the participants who fail the task are in both websites, very few. For the activation variable, the Nike website has offered a positive experience as seen in the negative activation generated in the three segments. It is also observed that the level of stress increases progressively from the success-efficient segment to the segment of the participants who fail. In contrast, Adidas generates positive activation in two of the three segments analyzed. Positive activation indicates that the participant has suffered stress during the performance. In the workload variable, again, both websites present workloads with high numbers (approx. 20-25), but Adidas continues to outperform Nike in the efficient success and failure segments, meaning that the tasks have involved the use of numerous resources, producing some cases of "failure".

The following is a summary of the results being analyzed in task segments 4 and 5 (Table 5).

Table 5. Summary of segmentation results.

TASK	BRAND	SUCCESS-EFFICIENT	FAILURE
Task 4	Nike	= activation = cognitive load	↓ activation ↓ cognitive load
	Adidas	↑activation = cognitive load	↓ activation ↓ cognitive load
Task 5	Nike	↓ activation ↓ cognitive load	↑ activation ↑ cognitive load
	Adidas	= activation ↑ cognitive load	↑ activation ↑ cognitive load

Source: Elaborated by the authors.

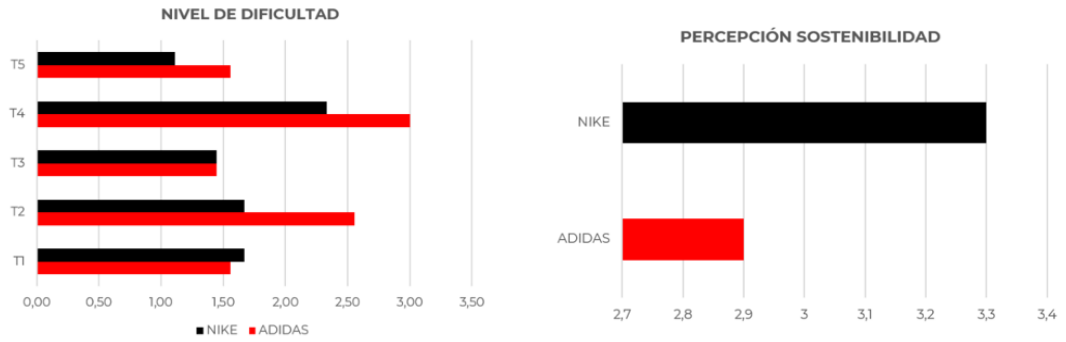
In task 4, the results indicate that the segment of participants who have been more efficient present intermediate levels of cognitive load in both marks. However, the activation results show that in the case of Adidas activation is higher than in Nike. On the other hand, subjects who have failed in the task present low levels of activation and cognitive load in both brands.

In task 5, the results indicate that the segment of participants who have been more efficient in Nike obtain the lowest levels of activation and cognitive load. Likewise, in the case of Adidas, the most efficient segment presents intermediate levels of activation and high levels of cognitive load. As for the analysis of the participants who have failed, in both tasks they present high levels of activation and cognitive load.

In summary, the results do not show a clear trend in the analysis of the success-efficient segment. Moreover, in the case of subjects who have failed in the task, the data show contradictory results in the two tasks.

Finally, an analysis of the responses reported by the participants about the experience in the questionnaires has been carried out. As can be seen in Figure 3, tasks 2 (web registration) and 4 (sustainability policies) are substantially more complex for users of the Adidas website. Task 5 (sustainable sweatshirt) maintains low levels of complexity. However, individuals consider the Adidas website to continue to be of a higher degree of difficulty in contrast to Nike. Finally, task 3 (returns) presents the same perceived complexity for participants.

Figure 3. Analysis of questionnaires on the levels of difficulty and perception of sustainability.



Source: Elaborated by the authors.

6. CONCLUSIONS

The objective of this study was to analyze the differences found between the usability of the websites of two international brands with a high global value in the sports market. For this purpose, innovative tools from the field of neuromarketing have been used to offer results related to the activation and cognitive load of the participating individuals in their experience as users of the e-commerce of both companies. In addition, the experiment was complemented with observational and self-reported data on the level of difficulty, perceived efficiency and perceived sustainability of both brands.

The results show that, analyzing the duration time of the tasks and the perceived level of difficulty of the subjects, Nike's website presents better usability. In this sense, in three of the five tasks the results were in favor of Nike. On the contrary, Adidas only in task 1, search for women's running shoes, obtained better scores in the questionnaires by the participants. This higher level of perceived difficulty already leads to the supposition that Adidas users experience a worse user experience on the web. In addition, task 3 shows similar results on both pages. This result is confirmed by the neurophysiological data, in which this task maintains very similar levels of activation and cognitive load in both websites.

However, the analysis of the neurophysiological variables does not show such uniform results. On the one hand, significant differences were identified between the two websites in the activation variable in tasks 4 and 5, but with contradictory results depending on the type of task. That is, in one type of task (4), the Nike website shows a better browsing experience for the subject, while in another type of task (5), it is the Adidas website that generates a calmer and less stressful experience for the participants. These results, together with those obtained in task 3, suggest that the type of task plays a relevant role in the user experience. It can thus be hypothesised that there are substantial differences in the user experience if the task is somewhat more common and presents a certain level of standardization. For example, buying a product or informing the user about the possible return options would fall into this category, as opposed to seeking information about other policies, such as sustainability policies, which are not usually among the primary activities of a user on any website. In this sense, e-commerce managers should

pay special attention to updating designs and architecture as the user experience evolves, as it is seen as something very dynamic.

On the other hand, the analysis of the segmentation of the tasks that show significant differences allows further study of the neurophysiological variables that characterize each of the segments. In the "success-efficiency" segment, the Nike website presents better results, although minimal, with lower values in the activation and cognitive load variables, which improves the user experience. However, and surprisingly, in the case of the "failure" segment, the pattern is contradictory in the two tasks being analyzed. In one task, failure is associated with a pleasant subject experience, with low levels of activation and cognitive load; but in another task the opposite is obtained. A possible explanation for the failure of subjects with low activation and cognitive load could be the discouragement or despondency of the participant, who, unable to solve the task, decides to give up and the levels of activation and attention decrease.

The results that were analyzed are not conclusive about the differences between the two websites under study; however, the Nike website seems to have a higher level of usability than the Adidas website, as it is simpler and does not involve a high workload. This aspect should be analyzed in relation to the architecture of both websites. Thus, although the patterns of both websites are similar in terms of structure, the Nike website presents a simpler, minimalist and intuitive pattern, which can improve user navigation. On the contrary, the Adidas website presents a more segmented pattern, with a greater number of categories and subcategories, which could explain the worse user experience on the website.

With respect to the perception of sustainability, it is important to note that the results suggest that the better experience on the Nike website positively affects this attribute. Thus, the participants' self-reported response is considerably better for this brand and the neurophysiological results are also better, although not in such an emphatic way. Nevertheless, Nike's superior usability leads us to believe that, to some extent, it provides a greater vision of sustainability for the brand, so it is beneficial in terms of image.

The results of this study suggest some important issues for marketing and communication professionals. On the one hand, it shows that Nike is doing a good job on its website. The U.S. company provides a positive shopping experience, which has a positive impact on the overall brand image and, specifically, on attributes of great relevance today, such as sustainability. And in turn, it indirectly has a positive impact on turnover and loyalty levels.

On the other hand, the Adidas website has shown lower levels of usability. Thus, participants were not able to execute the tasks as easily. In addition, these difficulties may have led to a perception of sustainability also below that of Nike. Thus, although the website of the German brand Adidas did not give rise to excessively negative results, nevertheless, areas for improvement were identified in order to offer a favorable shopping experience. For example, it would be interesting to delve deeper into the optimal levels of categories/subcategories to ensure a smooth and pleasant user experience, as well as the overall organization of the menu.

From a practical perspective, these findings can be of great use to digital marketers and UX/UI designers. The relationship between usability and perceived sustainability

highlights the importance of intuitive and optimized web design not only to improve user experience, but also to reinforce strategic brand values. In this sense, companies can benefit from neuroscientific and user experience studies to adjust the design of their platforms and maximize the positive impact on brand perception.

A key aspect for UX/UI designers to consider is the balance between simplicity and functionality. While a more minimalist website, such as Nike's, has proven to offer a smoother experience, it is essential that simplification does not affect information accessibility or navigability. In the case of Adidas, a reorganization of the menu and a reduction in category complexity could significantly improve the user experience without compromising the depth of content.

For digital marketers, these results suggest that good usability can translate into increased positive perception of strategic attributes such as sustainability, which can impact customer loyalty and sales conversion. In turn, this emphasizes the importance of conducting user testing and neuroscientific analysis in the optimization of digital platforms, ensuring that each design element is aligned with the brand's identity and objectives.

Future lines of research could expand this study by replicating the experiment with a larger and more diverse sample, incorporating a wider range of ages to analyze possible intergenerational differences in the perception of web usability and user experience. Additionally, it would be pertinent to include a wider range of tasks, both in quantity and typology, in order to evaluate how different types of interactions influence user experience. Finally, it is suggested to carry out studies in the context of brands belonging to sectors other than sports fashion, which would allow to deepen the understanding of these concepts and explore their applicability in different markets.

In short, this work demonstrates the importance of web usability as a key factor in brand perception and user experience. The tools employed facilitate the acquisition of valuable information pertaining to the cognitive and emotional dimensions of navigation, thereby generating novel prospects for the continuation of research and the refinement of these components for the benefit of companies and consumers. The evolution of user expectations and needs makes it essential to continue exploring innovative solutions that integrate functionality, simplicity and efficiency in web design.

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