

Chygryn, Olena; Shevchenko, Kateryna; Tuliakov, Oleh

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Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics

Düsternbrooker Weg 120

24105 Kiel (Germany)

E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)

<https://www.zbw.eu/>

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Neuromarketing as a Mechanism of Communication with the Consumer: The Case for Small Business

Olena Chygryn¹, , Kateryna Shevchenko², , Oleh Tuliakov³, 

^{1,2} Department of Marketing, Sumy State University, Ukraine

³ Department of Psychology, Political Science and Sociocultural Technologies, Sumy State University, Ukraine

* Corresponding author: Olena Chygryn, o.chygryn@biem.sumdu.edu.ua

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Abstract: Neuromarketing is a modern tool for researching consumer reactions to advertising stimuli and identifying relevant consumer behaviour patterns. Conducting neuromarketing research using eye tracking technology allows us to obtain objective data on consumer perceptions of advertising, websites, product packaging, etc. This article is devoted to studying the structural and content environment of the marketing category and neuromarketing research on advertised materials via the eye-tracking method. The analysis of publishing activity on the topic of neuromarketing carried out with the help of Scopus tools and the VOSviewer toolkit showed a trend of increasing interest from the scientific community in the use of neurotechniques and technologies in the study of consumer behaviour since 2004. The results of the analysis of the structural and content environment have shown the growing interest of scientists in the detailed study of consumer reactions to a product, brand, site, and advertisement, with further conclusions regarding their preferences and priorities. The work revealed that in the field of neuromarketing, there are methods that can be conditionally divided into those that register activity in the brain (neurological) and those that register activity outside the brain (biometric). The characteristics of these methods make it possible to choose the most appropriate method of eye tracking for evaluating consumers' reactions to advertising posters. Pupil Labs Invisible mobile eyetracker was used as the main tool for neuromarketing research. According to the results of the two stages of the experiment, heatmaps were obtained, which are described by the key metrics of the study: fixations and points of view, heatmaps, areas of interest, and time spent. With the help of research, the most profitable designs of advertising posters for consumers were determined. The influence of different colors and their combinations on the brain activity of potential consumers was analysed. As a result, a conclusion was made regarding the optimal placement of such key elements on the poster as the logo, and the price, the colour range of the presented materials and the fonts that were used were determined. The application of the obtained results of marketing research made it possible to obtain information about how consumers perceive visual stimuli, which, in the future, will be the basis for perfecting marketing communication strategies with the target audience of consumers.

Keywords: neuromarketing; consumers; eye tracking; heatmap; consumer behavior.

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1. Introduction. The modern market is characterized by rapid changes and intensified competition, requiring companies to constantly improve their marketing strategies and tools (Pérez et al., 2024; Sola et al., 2024; Alsharif et al., 2022). The use of neuromarketing research is gaining popularity among scientists and marketers (Oklander et al., 2024; Akan et al., 2024; Singh et al., 2023). In particular, the relevant areas are the following: research on the level of environmental awareness and green consumer culture, encouraging and ensuring the attention of the target audience to environmental campaigns and stimuli (Romero-Luis et al., 2023; Clayton et al., 2020; Gerst et al., 2021; Santoso et al., 2024); analysis of the placement of a set of functions that should be displayed in the web environment on company websites; research on their impact on consumer behaviour, lead generation, and decision-making about product purchase (Lee et al., 2023; application of neuromarketing research in various industries (Brdar, 2023; Chen et al., 2023; Liao et al., 2019; Ma et al., 2018; Ozkara et al., 2021); research on neurophysiological parameters of consumers to predict the buying behaviour of consumers; and assessment of their emotional state (Gill et al., 2022; Aldayel et al., 2020; Meyerding et al., 2020). In turn, Biswas et al. (2022) update the possibilities of applying neuromarketing research for developing countries. They analyse the challenges researchers and marketers face and focus their efforts on promoting neuromarketing technologies and practices for such countries. A significant number of scientific studies (Cardoso et al., 2022; Gunawan et al., 2023; Leung et al., 2021) emphasize the expediency of using neuroscience to research consumer behaviour, form marketing strategies, and engage in targeted communication with the target audience. Thus, the authors analyse the relationship between "neuroscience" and "advertising" and identify research gaps and new scientific directions to serve as a new methodological basis for building relevant marketing strategies. In turn, scientists (Girişken, 2020; Panteli et al., 2024; Oberoi et al., 2024) emphasize the importance of conducting neuromarketing research in implementing startups since startup companies do not fully use neuromarketing marketing tools in the new era due to the high cost of technology and equipment. One of the most promising directions in this context is using neuromarketing as an effective tool for communication with consumers (Lyu et al., 2023; Parkhomenko et al., 2024). The relevance of the chosen research topic lies in the fact that neuromarketing studies address not only the external reactions of consumers to marketing influences but also their internal, unconscious processes (Ramos-Galarza et al., 2024; Kim et al., 2023). This allows you to increase the effectiveness of marketing campaigns, focusing on the real needs and wishes of the target audience. Eye tracking is a new and objective way of observing people's behaviour. Eye movement can be a clue to audience cognition and perception. Unlike a questionnaire survey, which relies on subjects' self-reports, an eye tracker can obtain subjects' actual responses to stimulation by observing their eye movements (Yüksel, 2023). Neuromarketing research includes the following key aspects: neurophysiological, psychological, technological, behavioural, cognitive, emotional, and social dimensions and interaction analysis. These aspects allow a more in-depth look at the impact of neuromarketing on consumers, develop more effective strategies for interacting with the audience, and increase business competitiveness. The aim of this paper is to investigate the structural and content environment of the marketing category and to carry out a neuromarketing study of advertised materials using the eye-tracking method. The originality of the research lies in the application of Pupil Labs Invisible mobile eye-tracker technology to study the behaviour of potential consumers of a small business enterprise and the use of key metrics to describe the reactions of respondents intending to improve the advertising of printed products of the enterprise and optimize the marketing strategies of communication with consumers.

The article has the following structure: a literature review section, where a bibliometric study of the "neuromarketing" category was conducted with the help of Scopus tools and the VOSviewer toolkit; a methodology section, which describes the approach and tools of the neuromarketing research, the metrics of the eye-tracking research, and the selected respondents; a research results section, which includes a description of the main stages of the research, characteristics of the respondents' behavior, and obtained key metrics of neuromarketing research; and a conclusions section, which summarizes the obtained key results and provides recommendations and suggestions for enterprises to improve positioning strategies and communication with the target audience.

2. Literature Review. Using the Scopus analytics toolkit made it possible to investigate the dynamics of publications devoted to neuromarketing research. Figure 1 shows the dynamics of published scientific documents on the keyword "neuromarketing" from 2004 to 2023.

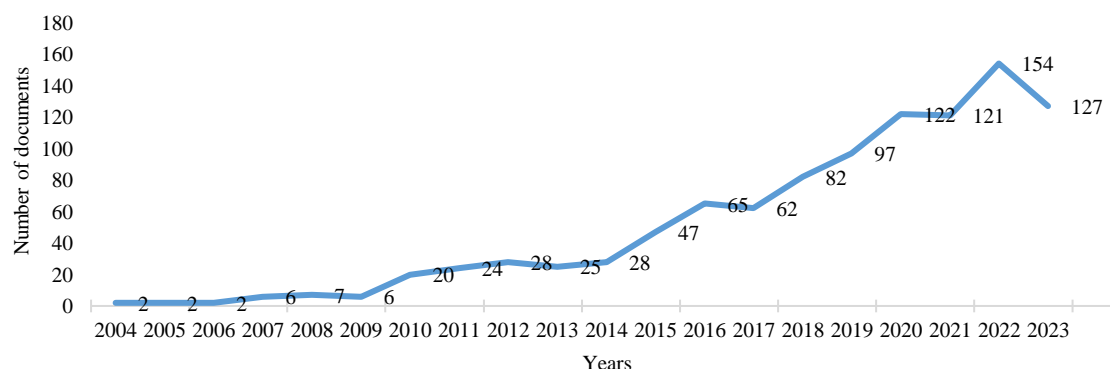


Figure 1. Dynamics of published scientific documents by the keyword "neuromarketing"

Sources: developed by the authors based on the Scopus database.

According to the results, scientific articles on "neuromarketing" began to be published in 2004. Until 2011, there was little interest in this topic—2-7 documents per year. Since 2011, a trend towards an increase in the number of publications of articles by scientists has been observed. Currently, the largest number of documents are published in 2022. These countries, such as Spain, Italy, India, and China, are affiliated with scientific publications. Figure 2 presents the top 10 universities by the number of published scientific articles for the keyword "neuromarketing".

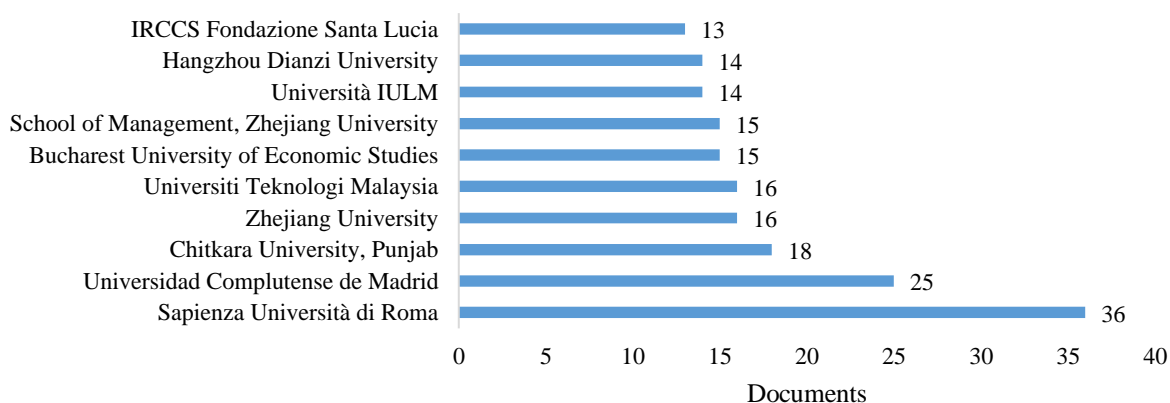


Figure 2. Top 10 universities by the number of published scientific articles on the keyword "neuromarketing"

Source: developed by the authors based on Scopus.

According to the results, the largest number of documents published by Sapienza Università di Roma, Italy, is 36. Second is the university that published 25 scientific articles—Universidad Complutense de Madrid, Spain. In third place is Chitkara University, Punjab, India, with 18 published documents. The top 10 universities in terms of the number of published scientific articles for the keyword "neuromarketing" also include the following institutions: Zhejiang University, China (16); Universiti Teknologi Malaysia (16); Bucharest University of Economic Studies, Romania (15); School of Management, Zhejiang University, China (15); Università IULM, Italy (14); Hangzhou Dianzi University, China (14); and IRCCS Fondazione Santa Lucia, Italy (13).

Using the VOSviewer toolkit made it possible to analyse the structural and content environment of the neuromarketing category. A bibliometric analysis of 1038 scientific documents placed under the keyword "neuromarketing" was carried out using the VOSviewer toolkit and based on the data of the scientific metric database Scopus. The analysis covered trends in socioeconomic scientific research and research on the development of neuromarketing. The results identified 8 clusters (Figure 3) that united key concepts by thematic proximity.

3. Methodology and research methods. The mode of operation of the eye tracker is based on observing eye movements using an internet camera or specialized LEDs placed in the corners of the screen. The camera determines the location of the eyeballs (more precisely, the pupils), which are illuminated by infrared light invisible to the naked eye. Infrared radiation is reflected in the eyes and creates reflections in physics called "Purkinje images". These reflections are visible reflexes in the pupils (Fig. 4). These reflections can be tracked using a camera. By observing the reflection of the diodes on the eye, it is possible to determine where the person using the device is looking (Wąsikowska, 2014).



Figure 4. Tracking the movement of the pupils using an eye tracker
Sources: developed by the authors.

The Pupil Labs Invisible mobile eye-tracker will be used in subsequent studies. Pupil Invisible has removed the barriers associated with eye tracking, making it the first real off-the-shelf eye tracker: no calibration, no setup, easy to use, with the look and feel of regular glasses (Figure 5).



Figure 5. Invisible Pupil Labs
Sources: developed by the author based on Bihavioural Lab (2024).

Pupil Invisible glasses connect to a Companion device (Android phone) using a USB-C cable. The Companion device powers the glasses and receives raw sensor data for storage and further processing. These glasses must be used with the Pupil Invisible Companion application to create recordings, preview real-time gaze and world video, stream data over the network, configure media, select templates, and preview and upload recordings to the Pupil Cloud (Invisible. 2024). Measuring gaze direction and visual scanning of the environment is an important aspect of research, and eye tracking is one of the most effective methods. This method is particularly interesting for qualitative and quantitative research because it allows us to use unconscious processes guided by our preferences and biases in the analysis process.

The experiment results in a group of metrics that characterize eye-tracking processes and summarize information (Table 1). This approach makes it possible to better understand the meaning of gaze direction measurement in the context of various studies and practical applications in the modern research environment.

Applying these metrics to marketing and design research helps to better understand how consumers perceive visual stimuli, allowing for improved advertising strategies, web design, and product planning. Such an analysis increases communication effectiveness and has a greater impact on the target audience. In this study, the Pupil Labs Invisible mobile eye tracker, which can be used in real time and with the help of which it is possible to record a person's behaviour during the study, was used. It breaks down the barriers associated with eye tracking, providing a calibration-free, setup-free, easy-to-use, out-of-the-box eye tracking device with the look and feel of regular glasses.

Table 1. Main metrics used in eye-tracking technology

Name of the metric	Characteristic
Fixations and points of view	Fixation and gaze points are primary indicators of considerable interest and are often used in eye-tracking research. They reflect what the eyes focus on during a specific time. When a series of viewpoints are very close to each other in time and space, it forms a fixation. Eye movements between fixations are usually called saccades.
Heatmaps	Heatmaps are visualization tools that show the general distribution of eye fixation points in an analysed image or stimulus. These maps are usually displayed using a colour gradient superimposed on the image under study. The colours red, yellow, and green are used to represent changes in the number of viewpoints that have been directed at different parts of the image. Using heatmaps is a simple and quick method of visualizing which parts of an image or stimulus attract more attention than others. Such maps can be compared between individual research participants and groups of participants, which allows a better understanding of how different categories of the population react to a stimulus and how their attention is distributed between different elements.
Areas of Interest (AOI)	Area of Interest is a tool for selecting and analysing specific areas in an image. It allows you to define specific locations for which analysis is performed separately and various metrics are calculated. These metrics are useful for comparing the performance of different areas of an image, website, or user interface. They help understand which elements attract more attention or how users interact with different stimulus parts.
Time to First Fixation (TTFF)	Time to first fixation quantifies the time it takes a respondent (or the average time across all respondents) to see a particular region of interest (AOI) from stimulus onset. TTFF can indicate bottom-up stimulus-driven search or top-down attention-driven search (e.g. when respondents actively choose what to focus on in a website or image). It is an essential eye-tracking metric because it helps to understand which aspects of the visual scene respondents prefer.
Time spent (Dwell Time)	Time occupied or spent in an area of interest (AOI) reflects the amount of time respondents devote to that region. Depending on the situation, increased time spent on a particular part of the image may indicate increased motivation and attention, as respondents may refrain from viewing other elements that may be less appealing.
Ratio	The ratio reflects how many respondents paid attention to a particular area of interest (AOI). This indicator indicates which parts of the image attract the most or least attention and those areas that remain unvisited. Analysis of the ratio of views between different groups can reveal which image elements are most attractive to various categories of participants
Fixation sequences	Sequences of fixations are displayed due to perceptual spatial and temporal information, showing where and when the participant observes the visual scene. This helps to form an idea of the participant's priorities when he observes the image. The order of attention is a crucial metric in eye tracking because it reflects a person's interests and visible elements on the screen or in the environment. The latter fixation is often an indicator of choice in financial decision-making tasks (e.g., option A over option B/C, etc.).
Revisits	The number of repeated views indicates the number of times the participant-directed their attention to a specific location, defined as an area of interest (AOI). This allows the researcher to determine which areas appealed to the participant repeatedly (positive, negative or neutral) and which were noticed but abandoned. A participant may be interested in a specific part of an image because of the aesthetics, complexity, or even irritation it causes.
First Fixation Duration	When examining a visual scene with the eyes, saccade movements are performed before the participant stops at a specific part of the image and fixes it. First capture time provides information on how long the first capture lasted. This information can be precious when used with the time-to-first-fix metric, which shows how quickly a scene aspect attracts attention. It is also helpful for region of interest (AOI) analysis, as it provides information about how long the first fixation lasted in a particular region, which can be compared to other regions. This helps determine the first impression of the areas of interest.
Average Fixation Duration	Average fixation time indicates how long each fixation lasted on average and can be calculated for both individuals and groups of participants. This can be an essential measure in any study and can be interesting when comparing different stimuli. If one image has a significantly longer average fixation duration than the other, it may be worth investigating the reasons for this phenomenon. Comparisons between regions of interest (AOIs) help determine which parts of the image were focused on more than others.

Source: Developed by the authors based on (10 Most, 2024).

Thirty-four people (16 men and 18 women), who are representative of student youth, were invited to participate in the experiment. All the participants had yet to see the photo or visit the analysed institution before the start of the study. The object of the study was a public food establishment, and the object of the study was the establishment's advertising creatives in 12 pieces with different combinations of images and information about dishes.

4. Results. In the first stage of the research, 6 photos of various dishes from the establishment (burger, salad, etc.) were used, as presented in Figure 6. The first-stage task was to determine which product offers consumers respond to. This is necessary to develop advertising creatives further and run advertisements. Before starting the experiment, the study participants were familiar with the characteristics and conditions of using Pupil Labs Invisible glasses. Next, the participants put on the glasses and take a position in front of the board on which the advertising posters are placed. The duration of the viewing of the photos was not limited.



Figure 6. Advertising posters of the restaurant "Queen"

Sources: developed by the authors.

Heatmaps were constructed from the participants' eye-tracking database using Pupil Labs Invisible and a software toolkit. The results of the heatmapmap construction show how much visual attention is given to advertising posters. Heatmap and fixation point data were obtained from the first 10 seconds of viewing the photo after the first exposure. Advertising posters 1, 2, and 6 became the most attractive. The redder the menu area was, the more fixation the participants had on it. The green zones had fewer fixations (Figure 7).

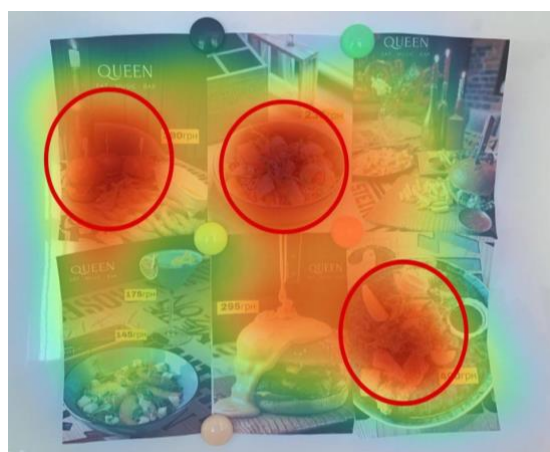


Figure 7. Heatmap of the first stage of the research

Sources: developed by the authors.

The heatmaps obtained at the first stage can be described by the following indicators:

- Fixations and points of view. The most significant number of fixations or points of view were found in three zones. The upper left area was the most attractive to participants, followed by the upper central area (middle) and the lower right area.

• **Heatmap.** This study used a heatmap as the leading indicator because this visualization method presented the results. This map shows three primary colours—red, yellow and green—that reflect changes in the number of viewpoints directed at different areas of the images.

• **Areas of interest.** By analysing the results, it can be concluded that the main areas of interest of the participants were zones with images of dishes. These advertising posters attracted the participants' attention precisely because of the food presented on them.

• **Time Spent.** The average time participants spent on research was approximately 1 minute. Analysing the time spent by respondents in individual areas of interest, it can be noted that they spent the most time in three zones—the upper left zone, the central upper zone and the lower proper zone.

The first version of the poster was excluded from consideration since the traditional practice of reading any messages starts from left to right. Therefore, the first poster was the most popular. A second poster was taken as an option for further research.

In the second stage of the research, a photo of a Billanciere salad was displayed, and the price of the dish and the logo of the establishment were placed in different ways (different colours, font sizes, scale of the logo, location of elements in the photo), which are presented in Figure 8.



Figure 8. Advertising posters of the restaurant "Queen"

Sources: developed by the authors.

For the second stage of the study, the photo located in the upper central part (middle) was chosen because it includes a diverse color palette and has more free space for experimentation with the logo and price (Figure 9).

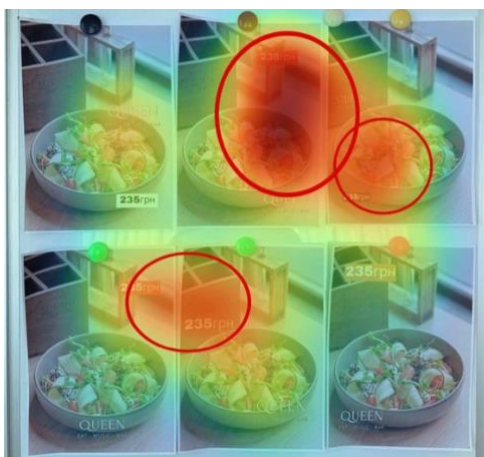


Figure 9. Heatmap of the second stage of the research

Sources: developed by the authors.

The following metrics describe the results of the second stage of the study:

- Fixations and points of view—the largest number of fixations or points of view were found in the three zones. The top centre region was the most attention-intensive region, followed by the top right and bottom left regions.

- The heatmap is the main metric used in this study. This map reveals three main colours—red, yellow and green—that reflect changes in the number of gaze points directed at different areas of the images. The area that received the most attention is marked in red, the area of less interest in yellow, and the area of least interest in green.

- Analysis of the areas of interest revealed that the main areas of interest of the participants were the areas where the price was highlighted in red or where the price increased in size. Additionally, the price highlighted in black attracted attention, but it was the smallest in size.

- Time Spent – The average time participants spent on the study was approximately 1 minute. By analysing the time respondents spent in certain areas of interest, it can be noted that they spent the most time in three zones—the upper central area, the upper right area and the lower left area.

The study's results indicate the effect of colour on how participants perceive advertising posters. It was found that the most attractive for observations are the areas where the price is indicated with a red fill or where the price is significantly increased without a fill. At the same time, the experiment participants paid less attention to logos but were more interested in information about the prices of meals. Therefore, the optimal solution for attracting the audience's attention is the advertising poster's location, which is in the upper central part. The location of the logo and the price indication with a red fill on the right side of the poster are aimed at maximizing the number of views.

Figure 10 shows the advertising poster that was the best among the respondents of this study. It turned out to be the top central poster. Most of the attention was focused on the right side of the salad and the price.



Figure 10. The best version of the advertising poster among the survey respondents
Sources: developed by the authors.

5. Discussion. The application of the eye tracking method to assess consumers' reactions to the company's advertising materials made it possible to determine which of the presentation materials are the most attractive to consumers. The results obtained in this work do not contradict similar neuromarketing studies on optimizing communication strategies with consumers. Thus, the authors (Cardoso et al., 2024) investigated the possibility of using neuromarketing technologies in the field of tourism, which, in turn, made it possible to formulate and meaningfully describe the category "neurotourism". To improve marketing communications and consider consumers' emotional parameters, the authors of this study (Núñez-Cansado et al., 2024) used the cross-technology of electroencephalography and electrodermal electrodes to analyse consumers' emotional involvement and motivation. The study's results proved the strong effect of consumer involvement and demonstrated differences in the nature and polarity of emotions. In turn, the authors (Mashrur et al., 2024) emphasize the importance of using brain-computer interface technologies, particularly eye tracking, to track the reaction of consumers' eyes and visualize patterns of viewing advertising materials. The paper concludes that neuromarketing technologies can optimize brands' marketing strategies and more objectively predict consumer preferences. Research by scientists (Li et al., 2024) also confirms the expediency of using eye tracking to research the peculiarities of consumer decision-making. The authors built a model with different

variables dependent on eye response to investigate consumer attention related to interface design factors such as brand, endorser, product, and text. Scientists (Sakas et al., 2024) emphasize that eye-tracking technologies will provide additional advantages to marketing strategies, particularly logistics. Using big data and website analysis for large multinational companies made it possible to optimize the regional strategy of logistics companies. At the same time, scientists (Tyagi et al., 2024) also use neuromarketing technologies to improve advertising tactics, particularly to optimize packaging design and to study how the consumer's brain reacts to advertising stimuli. The results of the study do not contradict the conclusions of the authors (Millagala et al., 2024; Ouzir et al., 2024), who note that neuromarketing is a digital marketing strategy in the context of the evolution of communications with consumers, as it provides flexible integration with marketing communication channels and at the same time ensures their personalization and emotional involvement. The conclusions obtained in the study (Li et al., 2024; de Matos, 2024) also indicate the relevance of the neuromarketing approach, within which the study of consumers' visual attention takes place. In particular, the authors of the work, using meta-analysis, compare different versions of the brand, product, and text interface. In turn, scientists (Louro et al., 2024) have studied consumer perceptions of brand goods and services. Using a new model of the emotional accessibility of consumption, which includes factors such as mental accessibility, sensory triggers, experiences, emotions and encouragement, consumers' reactions are demonstrated, and the path of persuasion of neuromarketing is formed.

6. Conclusions. Since 2004, investigations of publications on neuromarketing have shown a growing trend in the scientific community's interest in the use of neurotechniques and technologies for studying consumer behaviour. The rapid pace and significant achievements in consumer behaviour analysis determine the evolution of scientific research in neuromarketing. The growing interest of scientists in the detailed study of consumer reactions to a product, brand, site, and advertisement, along with further conclusions regarding their preferences and priorities, is also monitored. The use of neuromarketing research allows us to understand and influence the psychological and emotional aspects of consumer behaviour. The peculiarity of this approach lies in the ability to detect and respond to unconscious manifestations of consumers, which contributes to the creation of more effective and personalized communication strategies. The work revealed that in the field of neuromarketing, there are methods that can be conditionally divided into those that register activity in the brain (neurological) and those that register activity outside the brain (biometric). The characteristics of these methods make it possible to choose the most appropriate method of eye tracking for evaluating consumers' reactions to advertising posters. The Pupil Labs Invisible mobile eye tracker was used as the main tool in neuromarketing research. Based on the results of the two stages of the experiment, thermal maps were obtained, which are described by several indicators. With the help of research, the most beneficial designs of advertising posters for consumers, the influence of colours on the human brain, and the importance of the correct arrangement of elements on the poster were determined. Applying the results obtained in marketing research will provide information on how consumers perceive visual stimuli, which will allow for the optimization of communication strategies with consumers in the future.

Despite the valuable results, this study has certain limitations due to the use of software, which can be leveraged in future studies. In particular, the time to first fixation ratio, revisits, first fixation duration, and average fixation duration sequences can be used as additional research metrics, which will allow more reasonable conclusions to be drawn regarding the involvement and interest of potential consumers when conducting neuromarketing research.

The results obtained in the study indicate the relevance of this topic and the high level of practical application of the research results. As a future research direction, studies of consumers' visual attention during interactions with online trading platforms, websites, and online stores can be conducted. In addition, the optimization of marketing strategies with the help of modern technologies can combine traditional and neuromarketing innovations. Specifically, research into neuromarketing pricing uses brain scan data to determine the highest possible prices that potential consumers are willing to pay.

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References

1. *10 Most Used Eye Tracking Metrics and Terms*. iMotions. [\[Link\]](#)
2. Akan, S., & Atalik, O. (2024). The Impact of Flight Attendants' Attractiveness on Perceived Service Quality: An EEG Perspective. *Marketing and Management of Innovations*, 15(1), 178-194. [\[Google Scholar\]](#) [\[CrossRef\]](#)
3. Aldayel, M., Ykhlef, M., Al-Nafjan, A. (2020). Deep Learning for EEG-Based Preference Classification in Neuromarketing. *Applied Sciences*. 10(4), 1525. [\[Google Scholar\]](#) [\[CrossRef\]](#)
4. Alsharif, A. H., Salleh, N. Z. M., Abdullah, M., Khraiwish, A., & Ashaari, A. (2023). Neuromarketing tools used in the marketing mix: A systematic literature and future research agenda. *Sage Open*, 13(1), 21582440231156563. [\[Google Scholar\]](#) [\[CrossRef\]](#)
5. Alsharif, A. H., Salleh, N. Z. M., Al-Zahrani, S. A., & Khraiwish, A. (2022). Consumer behaviour to be considered in advertising: A systematic analysis and future agenda. *Behavioral Sciences*, 12(12), 472. [\[Google Scholar\]](#) [\[CrossRef\]](#)
6. Behavioural Lab (2024). [\[Link\]](#)
7. Biswas, A., Mashrur, F. R., Rahman, K. M., Miya, M. T. I., Sarker, F., & Mamun, K. A. (2022, March). An overview of neuromarketing research in developing countries: Prospects and challenges. In *Proceedings of the 2nd International Conference on Computing Advancements* (pp. 149-155). [\[Google Scholar\]](#) [\[CrossRef\]](#)
8. Brdar, I. (2023). Mind Over Palate: Unveiling the Role of Neuromarketing in the Food Industry. *Scientific journal" Meat Technology"*, 64(1), 50-60. [\[Google Scholar\]](#) [\[CrossRef\]](#)
9. Cardoso, L., Araújo, A., Silva, R., de Almeida, G. G. F., Campos, F., & Santos, L. L. (2024). Demystifying neurotourism: An interdisciplinary approach and research agenda. *European Journal of Tourism Research*, 36, 3618-3618. [\[Google Scholar\]](#) [\[CrossRef\]](#)
10. Cardoso, L., Chen, M. M., Araújo, A., de Almeida, G. G. F., Dias, F., & Moutinho, L. (2022). Accessing neuromarketing scientific performance: Research gaps and emerging topics. *Behavioral Sciences*, 12(2), 55. [\[Google Scholar\]](#) [\[CrossRef\]](#)
11. Chen, T., Lin, Z., Ren, K., & Ren, T. (2023). Neuromarketing research and EEG signal analysis. In *International Conference on Computer Graphics, Artificial Intelligence, and Data Processing (ICCAID 2022)* (Vol. 12604, pp. 959-967). SPIE. [\[Google Scholar\]](#) [\[CrossRef\]](#)
12. Clayton, S., & Karazsia, B. T. (2020). Development and validation of a measure of climate change anxiety. *Journal of environmental psychology*, 69, 101434. [\[Google Scholar\]](#) [\[CrossRef\]](#)
13. de Matos, C. M. (2024). An Investigation Into Sound and Music in Branding: Premises and Practices of Production. In *Building Strong Brands and Engaging Customers With Sound* (pp. 99-124). IGI Global. [\[Google Scholar\]](#) [\[CrossRef\]](#)
14. Duque-Hurtado, P., Samboni-Rodriguez, V., Castro-Garcia, M., Montoya-Restrepo, L. A., & Montoya-Restrepo, I. A. (2020). Neuromarketing: Its current status and research perspectives. *Estudios gerenciales*, 36(157), 525-539. [\[Google Scholar\]](#) [\[CrossRef\]](#)
15. Gerst, M. D., Kenney, M. A., & Feygina, I. (2021). Improving the usability of climate indicator visualizations through diagnostic design principles. *Climatic Change*, 166(3), 33. [\[Google Scholar\]](#) [\[CrossRef\]](#)
16. Gill, R., & Singh, J. (2022). A Proposed LSTM-Based Neuromarketing Model for Consumer Emotional State Evaluation Using EEG. *Advanced Analytics and Deep Learning Models*, 181-206. [\[Google Scholar\]](#) [\[CrossRef\]](#)
17. Girışken, A. Ç. (2020). Neuromarketing Insights for Start-Up Companies. In *Analysing the Strategic Role of Neuromarketing and Consumer Neuroscience* (pp. 168-184). IGI Global. [\[Google Scholar\]](#) [\[CrossRef\]](#)
18. Gunawan, C. N., Chen, Y. J., & Hsu, L. (2023). How online travel agencies' logo design promotes purchase intention: a behavioral and neuroscientific interpretation of consumers' construal level. *Asia Pacific Journal of Tourism Research*, 28(1), 19-35. [\[Google Scholar\]](#) [\[CrossRef\]](#)
19. Invisible - Home - Pupil Labs Docs. *Pupil Labs Docs*. [\[Link\]](#)
20. Kim, J. Y., & Kim, M. J. (2024). Identifying customer preferences through the eye-tracking in travel websites focusing on neuromarketing. *Journal of Asian Architecture and Building Engineering*, 23(2), 515-527. [\[Google Scholar\]](#) [\[CrossRef\]](#)
21. Kotler, S., Mannino, M., Kelso, S., & Huskey, R. (2022). First few seconds for flow: A comprehensive proposal of the neurobiology and neurodynamics of state onset. *Neuroscience & Biobehavioral Reviews*, 143, 104956. [\[Google Scholar\]](#) [\[CrossRef\]](#)
22. Lee, C. K. M., Au, M. Y., & Keung, K. L. (2023, December). EEG-based Online Purchase Decisions and Preferences in Neuromarketing Considering Eco-design. In *2023 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 1748-1752). IEEE. [\[Google Scholar\]](#) [\[CrossRef\]](#)
23. Leung, C. H., & Pang, E. (2021). Improved Electroencephalogram Measurement for Neuromarketing Research. *International Journal of Technology, Knowledge and Society*, 17(1), 33. [\[Google Scholar\]](#) [\[CrossRef\]](#)
24. Levallois, C., Smidts, A., & Wouters, P. (2021). The emergence of neuromarketing investigated through online public communications (2002–2008). *Business History*, 63(3), 443-466. [\[Google Scholar\]](#) [\[CrossRef\]](#)

25. Li, X., Luh, D. B., & Chen, Z. (2024). A Systematic Review and Meta-Analysis of Eye-Tracking Studies for Consumers' Visual Attention in Online Shopping. *Information Technology and Control*, 53(1), 187-205. [\[Google Scholar\]](#) [\[CrossRef\]](#)
26. Liao, W., Zhang, Y., & Peng, X. (2019). Neurophysiological effect of exposure to gossip on product endorsement and willingness-to-pay. *Neuropsychologia*, 132, 107123. [\[Google Scholar\]](#) [\[CrossRef\]](#)
27. Louro, F. G., & Barboza, R. A. (2024). Neuromarketing: exploring the unconscious side of consumption. *Brazilian Journal of Marketing*, 23, 252-275. [\[Google Scholar\]](#) [\[CrossRef\]](#)
28. Lyu, D., Mañas-Viniegra, L. (2023). Tendencias emergentes en neuromarketing: análisis bibliométrico con CiteSpace (2017- 2021). *Index.comunicación*, 13(2), 75-95. [\[Google Scholar\]](#) [\[CrossRef\]](#)
29. Ma, Y., Jin, J., Yu, W., Zhang, W., Xu, Z., & Ma, Q. (2018). How is the neural response to the design of experience goods related to personalized preference? An implicit view. *Frontiers in Neuroscience*, 12, 760. [\[Google Scholar\]](#) [\[CrossRef\]](#)
30. Mashrur, F. R., Rahman, K. M., Miya, M. T. I., Vaidyanathan, R., Anwar, S. F., Sarker, F., & Mamun, K. A. (2024). Intelligent neuromarketing framework for consumers' preference prediction from electroencephalography signals and eye tracking. *Journal of Consumer Behaviour*, 23(3), 1146-1157. [\[Google Scholar\]](#) [\[CrossRef\]](#)
31. Meyerding, S. G., & Mehlhose, C. M. (2020). Can neuromarketing add value to the traditional marketing research? An exemplary experiment with functional near-infrared spectroscopy (fNIRS). *Journal of Business Research*, 107, 172-185. [\[Google Scholar\]](#) [\[CrossRef\]](#)
32. Millagala, K., & Gunasinghe, N. (2024). Neuromarketing as a Digital Marketing Strategy to Unravel the Evolution of Marketing Communication. In *Applying Business Intelligence and Innovation to Entrepreneurship* (pp. 81-105). IGI Global. [\[Google Scholar\]](#) [\[CrossRef\]](#)
33. Núñez-Cansado, M., Méndez, G. C., & Juárez-Varón, D. (2024). Analysis of the residual effect using neuromarketing technology in audiovisual content entrepreneurship. *Sustainable Technology and Entrepreneurship*, 3(3), 100069. [\[Google Scholar\]](#) [\[CrossRef\]](#)
34. Oberoi, S., Kansra, P., & Awasthi, V. (2024). A Bibliometric Analysis on Research Trends in Neuromarketing: Current Status and Future Directions. *Digital Influence on Consumer Habits: Marketing Challenges and Opportunities*, 79-92. [\[Google Scholar\]](#) [\[CrossRef\]](#)
35. Oklander, M., Yashkina, O., Zlatova, I., Cicekli, I., & Letunovska, N. Y. (2024). Digital Marketing in the Survival and Growth Strategies of Small and Medium-Sized Businesses During the War in Ukraine. [\[Google Scholar\]](#) [\[CrossRef\]](#)
36. Oliveira, P. M., Guerreiro, J., & Rita, P. (2022). Neuroscience research in consumer behavior: A review and future research agenda. *International Journal of Consumer Studies*, 46(5), 2041-2067. [\[Google Scholar\]](#) [\[CrossRef\]](#)
37. Ouzir, M., Lamrani, H. C., Bradley, R. L., & El Moudden, I. (2024). Neuromarketing and decision-making: Classification of consumer preferences based on changes analysis in the EEG signal of brain regions. *Biomedical Signal Processing and Control*, 87, 105469. [\[Google Scholar\]](#) [\[CrossRef\]](#)
38. Ozkara, B. Y., & Bagozzi, R. (2021). The use of event related potentials brain methods in the study of conscious and unconscious consumer decision making processes. *Journal of Retailing and Consumer Services*, 58, 102202. [\[Google Scholar\]](#) [\[CrossRef\]](#)
39. Panteli, A., Kalaitzi, E., Fidas, C.A. (2024). A review on the use of eeg for the investigation of the factors that affect Consumer's behavior. *Physiology & Behavior*, 278, 114509. [\[Google Scholar\]](#) [\[CrossRef\]](#)
40. Parkhomenko, N., Starchon, P., Vilcekova, L., & Olsavsky, F. (2024). Digitalization of Marketing as an Innovation Tool for Customers' Evaluation. *Marketing and Management of Innovations*, 15(1), 120-130. [\[Google Scholar\]](#) [\[CrossRef\]](#)
41. Pérez, M.Q., Martínez, E.T., López Bernal, S. L., Prat, E.H., Del Campo, L. M., Maimó, L.F., Celdrán, A.H. (2024). Data fusion in neuromarketing: Multimodal analysis of biosignals, lifecycle stages, current advances, datasets, trends, and challenges. *Information Fusion*, 105, 102231. [\[Google Scholar\]](#) [\[CrossRef\]](#)
42. Ramos-Galarza, C., & Bolaños-Pasquel, M. (2022, December). Why Do We Buy Things that We Don't Need: Reflections from Neuropsychology. In *International Conference on Marketing and Technologies* (pp. 431-438). Singapore: Springer Nature Singapore. [\[Google Scholar\]](#) [\[CrossRef\]](#)
43. Romero-Luis, J., Carbonell-Alcocer, A., Levratto, V., Gertrudix, M., Casado, M. D. C. G., & Hernandez-Remedios, A. (2023). Design and assessment of an experimental model for evaluating the effectiveness of audiovisual products on the circular economy aimed at promoting environmental awareness. *Journal of Cleaner Production*, 423, 138820. [\[Google Scholar\]](#) [\[CrossRef\]](#)
44. Sakas, D. P., Reklitis, D. P., & Trivellas, P. (2021, December). Digital Marketing Strategy for Competitive Advantage Acquisition Through Neuromarketing in the Logistics Sector. In *International Conference on Business Intelligence & Modelling* (pp. 95-102). Cham: Springer International Publishing. [\[Google Scholar\]](#) [\[CrossRef\]](#)
45. Santoso, S. (2024). Consumer Behaviour: Impact of Social and Environmental Sustainability. *Marketing and Management of Innovations*, 15(1), 229-240. [\[Google Scholar\]](#) [\[CrossRef\]](#)

46. Singh, P., Alhassan, I., & Khoshaim, L. (2023). What Do You Need to Know? A Systematic Review and Research Agenda on Neuromarketing Discipline. *Journal of Theoretical and Applied Electronic Commerce Research*, 18(4), 2007-2032. [\[Google Scholar\]](#) [\[CrossRef\]](#)
47. Šola, H. M., Qureshi, F. H., & Khawaja, S. (2024). Exploring the Untapped Potential of Neuromarketing in Online Learning: Implications and Challenges for the Higher Education Sector in Europe. *Behavioral Sciences*, 14(2), 80. [\[Google Scholar\]](#) [\[CrossRef\]](#)
48. Tyagi, S., Tyagi, M., Srivastava, A. K., & Saluja, S. (2024). Neuroscience Marketing: A New Age Marketing. In *Building Organizational Resilience With Neuroleadership* (pp. 215-229). IGI Global. [\[Google Scholar\]](#) [\[CrossRef\]](#)
49. Wąsikowska, B. (2014). The Application of Eye Tracking in Business. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Wydział Nauk Ekonomicznych i Zarządzania*. [\[Google Scholar\]](#)
50. Yüksel, D. (2023). Investigation of Web-Based Eye-Tracking System Performance under Different Lighting Conditions for Neuromarketing. *Journal of Theoretical and Applied Electronic Commerce Research*, 18(4), 2092-2106. [\[Google Scholar\]](#) [\[CrossRef\]](#)
51. Zhu, Z., Jin, Y., Su, Y., Jia, K., Lin, C. L., & Liu, X. (2022). Bibliometric-based evaluation of the Neuromarketing Research Trend: 2010–2021. *Frontiers in psychology*, 13, 872468. [\[Google Scholar\]](#) [\[CrossRef\]](#)

Нейромаркетинг як механізм комунікації зі споживачем: кейс для малого бізнесу.

Олена Чигрин, Сумський державний університет, Україна

Катерина Шевченко, Сумський державний університет, Україна

Олег Туляков, Сумський державний університет, Україна

Нейромаркетинг є сучасним інструментом для дослідження реакції споживачів на рекламні стимули та виявлення відповідних моделей поведінки. Проведення нейромаркетингових досліджень із використанням технології відстеження очей дозволяє отримати об'єктивні дані про сприйняття споживачами реклами, веб-сайтів, упаковок товарів тощо. Стаття присвячена вивченню структурно-змістовного середовища категорії «нейромаркетинг» та дослідженню рекламних матеріалів методом айтрекінгу. Аналіз публікаційної активності на тему нейромаркетингу, проведений за допомогою інструментів Scopus Analytics та VOSviewer, показав тенденцію зростання інтересу наукової спільноти до використання нейротехнік і технологій у вивченні поведінки споживачів з 2004 року. Результати аналізу структурно-змістовного середовища продемонстрували зростаючий інтерес науковців до детального вивчення реакції споживачів на продукти, бренди, сайти та рекламу з подальшими висновками щодо їхніх уподобань і пріоритетів. У роботі досліджено, що в галузі нейромаркетингу існують методи, які можна умовно поділити на ті, що реєструють активність у мозку (неврологічні), та ті, що реєструють активність поза мозком (біометричні). Характеристики цих методів дозволили обрати найбільш прийнятний метод айтрекінгу для оцінки реакції споживачів на рекламні постери. Інструментарій Pupil Labs Invisible mobile eyetracker використовувався як основний інструмент нейромаркетингових досліджень. За результатами двох етапів експерименту були отримані теплові карти, які описуються ключовими метриками дослідження: фіксації, точки зору, теплова карта, зони інтересу та витрачений час. Дослідження виявило найвигідніші дизайни рекламних плакатів для споживачів. Було проаналізовано вплив різних кольорів та їх поєднань на мозкову діяльність потенційних споживачів. У результаті зроблено висновки щодо оптимального розміщення таких ключових елементів на плакаті, як логотип та ціна, визначено кольорову гамму представлених матеріалів та використані шрифти. Застосування отриманих результатів маркетингових досліджень дозволило отримати інформацію про те, як споживачі сприймають візуальні стимули, що в майбутньому стане основою для вдосконалення стратегій маркетингової комунікації з цільовою аудиторією споживачів.

Ключові слова: нейромаркетинг; споживачі; айтрекінг; теплова карта; споживацька поведінка.