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A Systematic Literature Review on AI in Neuromarketing

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ABSTRACT

This study examines the relationship between artificial intelligence (AI) and neuromarketing, emphasizing how cutting-edge technologies like eye tracking, facial coding, and electroencephalography (EEG) go beyond conventional qualitative and quantitative approaches to better understand consumer behavior. Studies that specifically used AI in neuromarketing contexts were the focus of an analysis of articles published between 2023 and 2024 from the Scopus database using a systematic literature review (SLR) methodology informed by PRISMA 2020. Results show that in a variety of industries, such as e-commerce, travel, luxury branding, political campaigns, and education, AI-enhanced neuromarketing dramatically increases prediction accuracy, consumer engagement, and branding efficacy. The review does, however, also point out enduring issues, such as the lack of cross-industry comparisons, inconsistent methodology, dependence on short-term and small-scale studies, and a lack of focus on ethical and cross-cultural issues. Crucially, the findings show a conflict between cognitive and affective outcomes. For example, AI-powered settings like the metaverse increase cognitive engagement but frequently result in increased mental strain and decreased emotional fulfillment. According to the study's findings, while AI-powered neuromarketing holds great promise for transforming marketing management, its long-term implementation necessitates standardized procedures, ongoing validation, and strong ethical protections. By focusing on how emotion and memory encoding, mediated by artificial intelligence and digital experiences, influence consumer behavior, this study helps close current gaps and provides theoretical and practical implications for future marketing tactics.

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1. INTRODUCTION

In order to create value, influence consumer perceptions, and establish enduring bonds between companies and their clients, marketing is essential. Historically, marketing strategies have relied on qualitative techniques such as focus groups and interviews to understand consumer needs and motivations (Jordão et al., 2017; Ramsoy, 2015). Despite offering insightful information, these methods frequently fall short in identifying the unconscious drivers influencing consumer behavior (Jordão et al., 2017; Vlăsceanu, 2014). Similarly, while quantitative techniques like questionnaires and surveys remain prevalent, they often struggle to capture the complex brain processes affecting decision-making (Jordão et al., 2017). Because of these limitations, neuromarketing has emerged—blending methods from psychology and neuroscience to better understand consumers' cognitive and affective responses (Sánchez-Fernández et al., 2021; Cherubino et al., 2019).

In 2002, Ale Smidts first coined the term "neuromarketing" to describe the application of neuroscientific methods—such as functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and eye tracking—to study consumer decision-making processes (Smidts, 2002; Cherubino et al., 2019). These techniques allow researchers to examine both conscious and unconscious responses to marketing stimuli, including advertisements, brands, logos, and pricing strategies, complementing

traditional self-report methods (Bazzani et al., 2020; Cherubino et al., 2019). For instance, eye-tracking enables the analysis of visual attention trajectories that strongly predict purchasing behavior, while EEG provides high temporal resolution for recording brain activity (Martinovici et al., 2023; Wang et al., 2024). The practical relevance of neuromarketing is evident, with companies such as PepsiCo, eBay, and Daimler using these tools to enhance their branding and promotional strategies (Murti & Ghosh, 2023; Entrepreneur, 2022; Cleverism, 2023).

The capabilities of neuromarketing are being significantly enhanced by the integration of artificial intelligence (AI). AI-based tools refine the analysis of neurophysiological data, enabling highly accurate, real-time predictions of consumer attention and emotional responses (Šola et al., 2024). Moreover, AI technologies serve as mediators between emotional appeal, memory encoding, and consumer behavior, strengthening the efficacy of marketing strategies through immersive digital experiences (Social Singh, 2024). Nevertheless, despite these advances, neuromarketing introduces ethical challenges—particularly around privacy, manipulation, and consent—in digital environments governed by regulations such as the GDPR (The Ethics of Neuromarketing, 2025).

Recent applications showcase the cross-sector adaptability of neuromarketing. In tourism marketing, eye-tracking and facial coding are employed to evaluate destination websites and advertisements, revealing how visual design influences emotional engagement (Muñoz-Leiva et al., 2019). In luxury brand marketing, research highlights that dynamic logos outperform static designs—thanks to movement and visual saliency, which strengthen emotional connection and improve brand recall (Jian et al., 2022; Yang et al., 2024). Additionally, AI-powered eye-tracking demonstrates efficacy in digital content, such as online and PDF magazines, where it analyzes reading patterns to help publishers optimize layout and enhance user engagement (Šola, Qureshi, & Khawaja, 2024). Together, these studies illustrate how neuromarketing enriches customer experiences across both digital and traditional domains.

Despite these developments, there are still gaps in cross-cultural analysis, standardized methodologies, and long-term consumer studies. The study offers a deeper understanding of how consumers interact with marketing stimuli by analyzing emotion and memory encoding in consumer behavior, with AI and digital experiences acting as mediators. It also offers insights for enhancing marketing management through the integration of AI-driven analytics and neuroscience.

2. Literature review

S. no.	Title	Author(s)	Year	Methodology	Findings	Conclusion
1	From E-Commerce to the Metaverse: A Neuroscientific Analysis of Digital Consumer Behavior	Alessandro Fici, Marco Bilucaglia, Chiara Casiraghi, Cristina Rossi, Simone Chiarelli, Martina Columbano, Valeria Micheletto, Margherita Zito, Vincenzo Russo	2024	A mixed-methods pilot study comparing the metaverse (Second Life) and conventional e-commerce (EC) platforms within subjects using neurophysiological measures (EEG, skin conductance, BVP) and self-report questionnaires (perceived enjoyment, informativeness, ease of use, cognitive effort, and flow).	1) Compared to traditional e-commerce, Metaverse (SL) elicited higher levels of cognitive engagement; 2) SL was more mentally taxing, requiring more memory effort and workload; and 3) SL did not elicit strong positive emotional responses, which led to a worse overall shopping experience.	Future consumer neuroscience research is encouraged, and businesses should optimize cognitive and affective elements in metaverse shopping spaces before investing. The metaverse offers higher cognitive engagement, but at the expense of increased mental demand and lower emotional satisfaction.
2	Predicting Behaviour Patterns in Online and PDF	Hedda Martina Šola; Fayyaz Hussain	2024	AI-enhanced eye-tracking study: Predict, a neuromarketing AI	1) AI eye-tracking revealed information about clarity, focus, engagement, and	With its high potential for improving content design and future

	Magazines with AI Eye-Tracking	Qureshi; Sarwar Khawaja		eye-tracking program, was trained on a dataset of 180,000 participants, totaling 100 billion data points; Tobii X2-30 was used to test three college magazines in PDF and online formats; R and SPSS were used for statistical analysis (ANOVA, Welch's t-tests, Pearson correlations).	cognitive demand; 2) Results demonstrated extremely high accuracy (97–99%); 3) Proven accuracy and resilience of AI eye-tracking forecasts	automated dataset research, AI-powered eye-tracking is a very dependable tool for forecasting attention-related consumer behavior across magazine formats.
3	Neuroscientific Analysis of Logo Design: Implications for Luxury Brand Marketing	Hedda Martina Šola; Sarwar Khawaja; Fayyaz Hussain Qureshi	2025	This multi-method neuromarketing study compared three logo designs using Predict v.1.0 and included AI-powered eye tracking (n=255 k), EEG (n=45 k), implicit testing (n=9 k), memory testing (n=7 k), qualitative surveys (n=297), saliency map analysis, and emotional response evaluation.	1) Dynamic elements demonstrated a strong link between cognitive demand and engagement, enhancing emotional connection and recall; 2) Logos with prominent dynamic icons captured and sustained attention better than static or subtly dynamic ones; 3) Effectiveness varied—the most pronounced dynamic icons produced stronger associations with luxury and brands.	Dynamic logo designs, particularly those featuring unique, moving icons, improve brand recall, attention, and emotional engagement in luxury marketing; these findings lead to new methodological standards in neuro-branding research and offer brand managers useful advice.
4	Cognitive Perception of Native Advertising in the Spanish and Portuguese Digital Press	Fernando Zamith; Luis Mañas-Viniegra; Patricia Núñez-Gómez	2021	60 young Spanish and Portuguese readers participated in a neuromarketing study that used eye tracking and galvanic skin response (GSR) to compare in-feed native advertisements with content recommendation ads. The stimuli were taken from Correio da Manhã, Diário de Notícias(Portugal), and El País, El Mundo (Spain).	Youth were more visually drawn to in-feed native advertising than to content recommendation ads, but the emotional impact was more strongly correlated with the content than the ad format.	Young readers are more effectively drawn in by in-feed native advertising, but presentation style is not as important as content for emotional impact.
5	Facial biometrics and emotions: What	Marco William Martínez	2024	Using face-reading (facial coding) on 80 Costa Rican	Face-reading technology detects anger and sadness in	Facebook posts with just images and no text are

	types of Facebook posts awaken users' emotions?	Mora; Mariano Mora Arrieta		Facebook users, this quantitative-exploratory descriptive neuromarketing study assesses the emotional reactions to various post types.	posts that contain images but no text.	more likely to make people feel angry or depressed, which suggests that image-only posts might not be as effective emotionally.
6	AI Eye-Tracking Technology: A New Era in Managing Cognitive Loads for Online Learners	Hedda Martina Šola; Fayyaz Hussain Qureshi; Sarwar Khawaja	2024	AI-enhanced eye-tracking study applied to two online lecture videos (Oxford Business College & Utrecht University) using Predict software (trained on neuroscience data from 180,000 participants); analysis using R, t-tests, and Pearson correlations to relate attention and cognitive demand	AI eye-tracking allows for the detection of cognitive load during learning by providing real-time insights into students' attention and cognitive demand while watching lecture videos.	AI-powered eye-tracking devices have the potential to completely transform online education by giving teachers real-time insight into students' cognitive states and enabling the improvement of course materials for improved learning results.
7	Embracing Artificial Intelligence in the Arts Classroom: Understanding Student Perceptions and Emotional Reactions to AI Tools	Alberto Grájeda; Pamela Córdova; Juan Pablo Córdova; Andrés Laguna-Tapia; Johnny Burgos; Luis Rodríguez; Martín Arandia; Alberto Sanjinés	2024	A mixed-methods study was conducted in which: (1) a 30-item survey covering five dimensions was used to construct and validate a Synthetic Index of Use of AI Tools (SIUAIT); data came from 794 arts students, 9,244 responses, and CFA analysis. (2) Compared emotional responses in AI-enhanced versus conventional lecture-based classes using neuromarketing technologies—eye tracking and facial expression analysis; statistical tests included Kruskal-Wallis, t-tests, and Pearson correlations.	1) Between the first and second semesters of 2023, SIUAIT rose from 58.84 to 60.60, demonstrating the increasing acceptance of AI tools. 2) According to statistical tests, students in AI-enhanced classes expressed noticeably more positive emotions—such as surprise and joy—than those in traditional lectures.	Although training and ethical considerations are still crucial, the use of AI tools in arts education is becoming more and more accepted (as evidenced by rising SIUAIT scores) and improves students' emotional engagement (more joy and surprise).
8	Neuromarketing Actions for the Digital	Soima Rosa Méndez Lazo;	2023	Web analytics tools and user surveys (n=64) using eye-	Expert validation found the suggested neuromarketing action	By improving user experience, usability, and

	Promotion of Tourism in Cuba	Yasser Vázquez Alfonso; Sacha Lazo del Vallín		tracking theory (not yet used), multivariate analysis (MCA), and Delphi method validation with 12 experts (ANOCHI coefficient) comprise the descriptive exploratory mixed-methods.	plan to be highly adequate (ANOCHI = 0.81). Diagnosis found important usability and web-quality issues on the Cubatravel portal, including low attractiveness, poor usability, slow loading, lack of interactive/multimedia features, and poor information architecture.	emotional engagement, applying neuromarketing-informed actions based on eye-tracking principles can greatly improve digital tourism promotion of Cuba through the Cubatravel portal; the expert-validated plan is deemed valuable and feasible.
9	How Online Travel Agencies' Logo Design Promotes Purchase Intention: A Behavioral and Neuroscientific Interpretation of Consumers' Construal Level	Cecelia Natanael Gunawan; Yen-Jung Chen; Liwei Hsu	2023	Shapes, colors, and logo-product relationships are used in this three-part mixed-methods study to understand mind-set congruency effects. It is framed within construal level theory and consists of behavioral experiments and neuroscientific EEG measures.	1) Evidence of natural mindset congruency; 2) Purchase intention influenced by congruence between destination product and logo design under different levels of interpretation; 3) Variations in EEG brainwave activity noted when participants consider logo design	Both behavior and brainwave evidence support the idea that matching a logo's design to a consumer's construal level can influence their intention to buy, underscoring the usefulness of neuromarketing in logo design strategies.
10	Identifying Customer Preferences through the Eye-Tracking in Travel Websites Focusing on Neuromarketing	Ju Yeon Kim; Mi Jeong Kim	2024	In order to examine conscious versus unconscious decision-making, gaze metrics (Region of Interest, fixation durations, and time to concentration) were compared with questionnaire-based preferences in an experimental eye-tracking study involving thirty male participants in their forties who were viewing stimuli from travel websites.	Stimulus 2 had the fastest initial gaze concentration (4.21 s), while Stimulus 3 had the maximal concentration (16.28 s); (3) visual attention (eye movements) correlated with self-reported preferences; (1) the outdoor space image (Image 3) had the highest gaze preference (M = 782.65), followed by furniture and web information.	Customer preferences are in line with visual attention as measured by eye movement: The attention was most drawn to outdoor spatial cues, and the pace of gaze concentration varied. By combining eye-tracking data with questionnaire responses, it is possible to better understand the unconscious factors influencing the choice of travel

						products.
11	Human-Centred Design Meets AI-Driven Algorithms: Comparative Analysis of Political Campaign Branding in the Harris–Trump Presidential Campaigns	Hedda Martina Šola; Fayyaz Hussain Qureshi; Sarwar Khawaja	2025	AOIs (67,429 zones across campaign flyers) were identified using a mixed-methods design that combined AI eye-tracking (Predict, trained on 180,000 screenings) and AI-LLM marketing assistant (CoPilot). The data was analyzed using Python (Pandas, Matplotlib, Seaborn) and the Kruskal–Wallis H-test and Spearman correlation.	(1) AI-enhanced Design 3 performed poorly in text-heavy areas but optimized some AOIs; (2) Human-enhanced Design 1 outperformed on most engagement metrics (total attention, start attention, end attention, and percentage seen); and (3) There is a complex interaction between AI-driven algorithms and human-centered design in the effectiveness of political branding.	In political campaign branding, human-centered designs enhanced by AI insights outperform purely AI-driven designs in terms of viewer engagement, particularly in text-rich contexts. This emphasizes how crucial it is to combine AI tools with human creativity for maximum impact.
12	Neuromarketing: Understanding the Effect of Emotion and Memory on Consumer Behavior by Mediating the Role of AI and Customers' Digital Experience	Hasan Beyari; Tareq N. Hashem; Othman Alrusaini	2024	837 MENA-region consumers completed an online survey; mediation analysis looked at memory encoding and emotional appeal → AI and Digital Experience → Consumer Behavior	Though this mediation is not absolute—product, pricing, marketing strategy, and environment also affect results—AI and digital experience significantly mediate the relationship between emotional appeal/memory encoding and consumer behavior.	Digital experiences must arouse positive emotions and facilitate memory encoding in order to effectively influence consumer behavior; AI-enhanced, customized, immersive visuals can promote recall and future purchase decisions.
13	Bridging Neuromarketing and Data Analytics in Tourism: An Adaptive Digital Marketing Framework for Hotels and Destinations	Thomas Krabokoukis	2025	The three-stage cyclical Tourism Adaptable Digital Marketing Framework (TADMF), which combines data analytics and neuromarketing principles to maximize digital marketing for hotels and destinations, is introduced as a conceptual framework.	(1) Continuous feedback and improvement are made possible by the three-stage cycle of attraction, engagement, and conversion; (2) Hotels are able to implement dynamic pricing and tailored recommendations; (3) Storytelling and user-generated content help destinations increase emotional engagement; (4) The	TADMF outperforms conventional linear models by providing a flexible and dynamic basis for improving digital marketing in the travel industry. It creates opportunities for further research on customer journey optimization using AR, VR,

					model provides scalability and adaptability across tourism contexts by facilitating the integration of online and offline interactions.	and AI technologies.
14	Neuro-Insights in Marketing Research: A PRISMA-Based Analysis of EEG Studies on Consumer Behavior	Junhai Wang; Ahmed H. Alsharif; Norzalita Abd Aziz; Ahmad Khraiwish; Nor Zafir Md Salleh	2024	53 EEG-based consumer behavior studies from Web of Science were analyzed using bibliometrics and a systematic review using PRISMA. Trends in stimuli types, publication venues, countries, and application areas were also looked at.	49% of EEG studies (26 articles) were related to advertising.	In neuromarketing research, EEG is a potent and widely used tool that offers genuine insights into consumer behavior that conventional reporting techniques frequently overlook. The analysis identifies promising frontier areas for further research, including social neuroscience and consumer personality, and highlights noteworthy scholarly activity.
15	Neuromarketing: Evaluating Consumer Emotions and Preferences to Improve Business Marketing Management	Ian Mei Zeng; João Alexandre Lobo Marques	2023	40 participants participated in an experimental neuromarketing study that used GSR sensors, eye tracking, and facial expression analysis on two GuandingTeahouse video advertisements. A survey was then administered.	Consistency between the first and second product choice surveys was 76.2%. Ads 1 and 2 had ~76% attention, with GSR peaks of 60 and 55. - Ad 1: 19 participants' engagement time was 11.1%; Ad 2: 31 participants' engagement time was 9.6% Ad 2 drew more participants despite having a lower engagement rate, suggesting that its marketing was more appealing.	Participants found Ad 2 more appealing even though its engagement duration was shorter, indicating that attraction and engagement time aren't always related. Ads can be successfully personalized using neuromarketing tools based on behavioral and emotional reactions.

16	Artificial Intelligence in the Context of Digital Marketing Communication	Santa Bormane; Egita Blaus	2024	Examine a paper that focuses on AI applications in digital marketing and associated regulatory frameworks using bibliometric analysis, the monographic method, and secondary data analysis.	Machine learning (ML), computer vision, robotics, speech recognition, natural language processing (NLP), cloud computing, and virtual reality (VR) are among the recognized forms of AI; applications include social media, email, digital ads, PR, sales, review marketing, and neuromarketing. Benefits include time and money savings, round-the-clock operation, customization, and highly effective data processing; Risks include data privacy, compliance, and viability. protection, cybersecurity, psychological manipulation, skill gaps, automation, third-party dependency.	Although AI has revolutionary advantages for digital marketing communication, such as efficiency and personalization, it also brings with it serious drawbacks, including operational risks, ethical conundrums, and regulatory compliance, which emphasize the need for careful, informed adoption.

3. Research methodology

In accordance with PRISMA 2020 guidelines, this study uses a Systematic Literature Review (SLR) methodology. The information is gathered from the Scopus database by means of a Boolean search string that blends terms associated with artificial intelligence (e.g., "AI," "machine learning," "deep learning," "emotion AI," "facial coding," "EEG," "eye tracking," and "voice analysis") and neuromarketing (e.g., "neuromarketing," "consumer neuroscience," and "neuroanalytics"). Only peer-reviewed journal articles published in English between 2023 and 2024 are included in the search. Studies that use AI methods in neuromarketing contexts like branding, advertising, or consumer behavior analysis are the main focus of the inclusion criteria. Reviews, editorials, book chapters, theses, works written in languages other than English, duplicates, and research that does not specifically use both AI and neuromarketing tools are among the exclusion criteria. Titles, abstracts, and full texts are used to screen the final collection of articles.

4. Research Gap

Even though artificial intelligence is increasingly being used in neuromarketing, there are still a number of gaps in the literature. Few cross-industry comparisons that could validate findings more broadly are present in existing studies, which are mostly restricted to particular domains like online learning, advertising, tourism promotion, and logo design. The majority of research is short-term, experimental, and frequently based on small sample sizes, which limits generalizability and ignores patterns of long-term consumer behavior. Furthermore, there is no standardized methodological framework, which makes it challenging to replicate or compare results across contexts, even though many studies use multi-method approaches like EEG, eye tracking, and facial coding. The disparity between cognitive and emotional results is another issue. Research regularly shows that although AI tools improve cognitive engagement, they may also result in increased mental strain and decreased emotional fulfillment, especially in immersive settings like the

metaverse. AI-powered consumer tracking raises ethical and privacy issues that are still poorly understood, which raises concerns about manipulation and legal compliance. Lastly, there is a dearth of cross-cultural research on how various consumer groups might react differently to AI-driven neuromarketing interventions because the majority of current studies are regionally focused in Europe, East Asia, and the MENA region.

5. Discussions

Compared to conventional self-report techniques, the reviewed literature highlights how artificial intelligence is revolutionizing neuromarketing practices, especially through tools like facial coding, AI-powered eye-tracking, and EEG that offer deeper insights into unconscious consumer behavior. Research continuously shows that AI technologies improve consumer engagement, prediction accuracy, and branding efficacy, but they also highlight significant drawbacks. The need to balance the cognitive and affective aspects of consumer experiences is demonstrated by the fact that, although metaverse shopping environments increase cognitive engagement, they also result in lower emotional satisfaction and a greater mental workload. Similarly, research indicates that posts with only images can elicit negative emotions, casting doubt on the notion that visual content invariably produces favorable results. As demonstrated by political campaign branding and arts education, where human-centered designs outperformed purely AI-driven strategies, the literature also highlights the complementary nature of AI-driven insights and human creativity. This implies that rather than taking the place of human judgment in marketing, AI should be used as an augmentation tool. Additionally, new frameworks in education and tourism suggest a move away from passive observation and toward dynamic, real-time consumer experience design, where content optimization is directly influenced by attentional and emotional feedback loops. However, enduring flaws are highlighted by the dearth of standardized methodologies, the paucity of longitudinal studies, and the inadequate consideration of ethical and cultural factors. These drawbacks imply that although AI-enhanced neuromarketing has a great deal of promise to transform consumer interaction, its responsible and sustainable implementation will necessitate more rigorous methodology, long-term verification, and robust ethical protections.

6. Conclusions

This study conducted a systematic review of recent research on the combination of artificial intelligence (AI) and neuromarketing, emphasizing how cutting-edge instruments like eye tracking, facial coding, and EEG offer more profound insights into consumer behavior than conventional self-report methods. The review found that in addition to increasing consumer engagement and prediction accuracy, AI-enhanced neuromarketing broadens its applications in a variety of industries, such as e-commerce, travel, political campaigns, luxury branding, and education. These results highlight the growing significance of integrating AI analytics with neuroscientific tools to identify both conscious and unconscious factors influencing consumer decision-making.

However, the review also found important obstacles that prevent the field from reaching its full potential. The generalizability of studies is diminished by their continued fragmentation, short duration, and frequent use of small sample sizes. Furthermore, cross-study comparisons are challenging due to the absence of standardized methodologies, and ethical issues pertaining to privacy, psychological manipulation, and regulatory compliance are still not adequately addressed. Crucially, studies reveal a persistent conflict between cognitive and affective outcomes. For instance, metaverse shopping encourages participation but frequently leads to mental exhaustion and decreased emotional fulfillment. These inconsistencies emphasize the necessity of well-rounded strategies that take into account the affective and cognitive aspects of the customer experience.

Overall, this study finds that, when used properly, AI-powered neuromarketing has the potential to revolutionize marketing management. Future research must place a high priority on cross-cultural analysis, longitudinal studies, methodological standardization, and ethical protections in order to make sustainable progress. By filling in these gaps, neuromarketing can develop into a strong and dependable field that enhances company performance while also taking into account the welfare of customers in the digital age.

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