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Trends and Evolution of Neuromarketing Research in Understanding Consumer Behavior: A Bibliometric Analysis

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ABSTRACT

Neuromarketing has grown into a prominent interdisciplinary field that bridges neuroscience, psychology, and marketing to understand consumer cognition and emotion beyond self-reported measures. This study conducts a comprehensive bibliometric analysis using Scopus-indexed publications to examine the intellectual structure, thematic evolution, and global development of neuromarketing research. Using VOSviewer, five visualizations—network, overlay, density, author, and country maps—were generated to identify influential works, core research clusters, collaboration patterns, and emerging trends. Highly cited publications such form the conceptual and methodological foundation of the field, while newer studies emphasize neuroimaging advancements, EEG analytics, emotional processing, and ethical implications. Keyword clustering reveals four major themes: neuroimaging methods, consumer decision-making, marketing applications, and ethical considerations. Collaboration analyses indicate strong activity in Europe, the U.S., and China, though geographic disparities persist. Overall, the findings demonstrate that neuromarketing has evolved from conceptual debate toward advanced, technology-driven applications, while ethical issues remain central to its future trajectory. This study contributes a systematic mapping of neuromarketing's development and highlights opportunities for expanded global collaboration, methodological integration, and responsible innovation.

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1. INTRODUCTION

Neuromarketing has emerged as one of the most transformative developments in contemporary marketing research, offering deeper insights into consumer cognition, affect, and decision-making processes. Unlike conventional approaches that rely heavily on self-reported attitudes or behavioral observations, neuromarketing integrates neuroscience tools—such as EEG, fMRI, MEG, eye-tracking, and biometrics—to capture subconscious responses that traditional methods often fail to detect. Foundational works such as [1]–[3] highlight neuromarketing's promise in uncovering hidden drivers of consumer preferences, enabling marketers and researchers to decipher emotional and cognitive reactions that shape

purchasing behavior. This paradigm shift has positioned neuromarketing as a multidisciplinary bridge connecting psychology, neuroscience, economics, and marketing strategy.

The conceptual boundaries and scope of neuromarketing were established early by scholars like Lee, Broderick, & Chamberlain (2007), who formalized the theoretical agenda for future research. Their contributions helped define neuromarketing not merely as a set of tools, but as a scientific approach to understanding how consumers evaluate brands, advertisements, and products at a neural level. Subsequent studies—such as those by [2], [4], [5] expanded this perspective by demonstrating how neural indicators can reveal preferences that consumers are unwilling or unable to articulate. As the field matured, researchers increasingly explored diverse applications including advertising effectiveness, product design, brand perception, and emotional engagement, confirming neuromarketing's growing relevance and versatility in consumer research.

Rapid methodological advancements have further enriched the discipline. Innovations in EEG analysis, as demonstrated by [6], [7], provide sophisticated techniques for decoding real-time brain activity, making neuromarketing more accessible, accurate, and scalable. Parallel progress in MEG, eye-tracking, and multisensory biometrics has encouraged researchers to adopt multimodal approaches to capturing emotional and cognitive responses. Studies such as [6], [8] illustrate how combining physiological and neural measurements increases the validity of insights derived from neuromarketing experiments. Consequently, this methodological evolution has strengthened the scientific rigor of neuromarketing research and expanded its potential in both academic and industry contexts.

Nevertheless, the rapid expansion of neuromarketing has also prompted critical discussions regarding ethics, consumer privacy, and the responsible use of neural data. Scholars [9], [10] emphasize the need for regulatory frameworks and ethical guidelines to prevent misuse of neurodata in manipulative or intrusive marketing practices. As debates continue about the appropriate boundaries between scientific inquiry and commercial application, the field is challenged to maintain transparency and uphold ethical integrity while scaling its use in real-world settings. These discussions reveal that neuromarketing is not only a technological innovation but also a domain requiring thoughtful governance and multidisciplinary collaboration.

Given its increasing prominence, the evolution of neuromarketing as a scientific field warrants systematic investigation. While many studies have provided conceptual and methodological contributions, a comprehensive bibliometric analysis is needed to map publication trends, influential authors, dominant research themes, collaborative networks, and shifts in theoretical development over time. Bibliometric techniques offer an objective and quantitative means of identifying research clusters, intellectual structures, and emerging directions within the field. This approach is particularly valuable as neuromarketing continues to expand across global academic communities, evidenced by diverse author networks and country-level collaborations reflected in recent visualizations.

Therefore, this study conducts a bibliometric analysis of neuromarketing research to systematically explore its developmental trajectory, influential contributions, thematic patterns, and global research landscape. By examining citation structures, keyword networks, author collaborations, and temporal research evolution, this study aims to provide a comprehensive overview of how neuromarketing has progressed over time and where it is heading. The findings are expected to contribute both theoretically—by clarifying the knowledge structure of the field—and practically, by guiding future researchers, marketers, and policymakers in understanding the opportunities and challenges surrounding

neuromarketing's expanding role in consumer behavior research.

2. METHODS

2.1 Design

This study employed a bibliometric research design to systematically analyze the development, structure, and intellectual patterns of neuromarketing literature. Bibliometric analysis offers an objective and quantitative means of examining scientific publications, including citation structures, thematic networks, and co-authorship collaborations. This approach is particularly appropriate for mapping an emerging and rapidly evolving field such as neuromarketing, where conceptual boundaries, methodological approaches, and research clusters continue to expand. The methodological procedures adopted in this study encompass data collection, data cleaning, analytical techniques, and visualization.

2.2 Data Source and Search Strategy

All publication data for this study were retrieved from the Scopus database, which is one of the most comprehensive academic indexing platforms for peer-reviewed literature. The search strategy was designed to capture the full spectrum of neuromarketing-related studies. Keywords such as "neuromarketing," "consumer neuroscience," "EEG in marketing," "neuroimaging in consumer behavior," and "brain-based marketing research" were used in various combinations to ensure that all relevant publications were included. To maintain analytical consistency, only articles published in academic journals were selected, while conference papers, notes, book chapters, and editorials were excluded. The search results were exported in CSV format, containing bibliographic information such as authors, titles, abstracts, keywords, affiliations, source titles, references, and citation counts. These data formed the basis for all subsequent bibliometric analyses, including citation mapping, keyword clustering, and collaboration networks.

2.3 Data Cleaning and Standardization

Before conducting the bibliometric analysis, the raw data underwent a systematic cleaning and normalization process to ensure accuracy and reliability. Author names were standardized to resolve inconsistencies in spelling, initials, and naming variations that could fragment citation or co-authorship networks. Keywords were harmonized to combine synonymous or semantically equivalent terms—for example, "neuromarketing" and "neuro-marketing" or "consumer neuroscience" and "neuroscience in marketing." Institutional affiliations were also normalized to consolidate cases where universities appeared under multiple naming formats. Duplicate records were identified and removed to prevent inflation of publication or citation counts.

This standardization process was essential for achieving precise clustering and accurately reflecting the intellectual landscape of neuromarketing. It also ensured that visualizations generated by bibliometric software were valid and interpretable.

2.4 Analytical Tools and Procedures

The cleaned dataset was processed using VOSviewer, a widely used bibliometric analysis tool capable of generating visual representations of scientific literature, including co-

authorship patterns, citation networks, keyword co-occurrences, and intellectual structures. Through its intuitive map-based interface, VOSviewer enabled the study to examine influential publications, collaborative author groups, and thematic clusters. Citation analysis was conducted to identify foundational articles—such as those by Ariely & Berns (2010), Lee et al. (2007), and Morin (2011)—that shaped neuromarketing's theoretical and methodological development. Co-authorship and country-level collaboration networks were also assessed to understand international research linkages, while keyword co-occurrence mapping revealed dominant themes including EEG-based studies, emotional processing, ethical considerations, and consumer decision-making.

Temporal evolution analysis further highlighted shifts in neuromarketing research, from early conceptual debates to advanced applications involving neuroimaging technologies, machine learning integration, and real-world marketing contexts. To maintain analytical rigor, the study included only peer-reviewed journal articles indexed in Scopus and excluded non-journal publications or those lacking sufficient metadata. The visual outputs generated—network, overlay, density, author, and country maps—were subsequently interpreted to identify thematic patterns, structural relationships, and emerging developments. These visualizations served as the analytical foundation for the Results and Discussion section, enabling a comprehensive assessment of neuromarketing's intellectual landscape.

3. RESULTS AND DISCUSSION

3.1 Citation Structure and Influential Works

Table 1. Citation Analysis

Citations	Author	Title
702	Ariely, D., & Berns, G. S. (2010)	Neuromarketing: The hope and hype of neuroimaging in business
533	Lee, N., Broderick, A. J., & Chamberlain, L. (2007)	What is 'neuromarketing'? A discussion and agenda for future research
371	Morin, C. (2011)	Neuromarketing: The New Science of Consumer Behavior
219	Yadava, M., Kumar, P., Saini, R., Roy, P. P., & Prosad Dogra, D. (2017)	Analysis of EEG signals and its application to neuromarketing
193	Fugate, D. L. (2007)	Neuromarketing: A layman's look at neuroscience and its potential application to marketing practice
192	Zurawicki, L. (2010)	Neuromarketing: Exploring the brain of the consumer
188	Lim, W. M. (2018)	Demystifying neuromarketing
169	Fisher, C. E., Chin, L., & Klitzman, R. (2010)	Defining neuromarketing: Practices and professional challenges
157	Vecchiato, G., Astolfi, L., De Vico Fallani, F., Toppi, J., Aloise, F., Bez, F., ... & Babiloni, F. (2011)	On the Use of EEG or MEG brain imaging tools in neuromarketing research
153	Stanton, S. J., Sinnott-Armstrong, W., & Huettel, S. A. (2017)	Neuromarketing: Ethical Implications of its Use and Potential Misuse

The citation analysis shows that neuromarketing is built upon a small number of highly influential publications that shaped its conceptual, methodological, and ethical foundations. Ariely & Berns (2010), with 702 citations, stands out as the most impactful work for critically examining the opportunities and limitations of neuroimaging in business contexts. Similarly, seminal studies by Lee et al. (2007) and Morin (2011)—cited 533 and 371 times respectively—formalized the definition, boundaries, and scientific positioning of neuromarketing while emphasizing its ability to access subconscious consumer responses. Additional foundational contributions from Zurawicki (2010), Fugate (2007), and Lim (2018) further strengthened the theoretical underpinnings of the field, helping broaden its acceptance within mainstream marketing science.

Complementing these conceptual developments, methodological advancements are evident in works such as Yadava et al. (2017) and Vecchiato et al. (2011), which highlight increasing sophistication in EEG and MEG applications and signal a shift toward more precise neural measurement tools. At the same time, ethical considerations have become a central theme, with Fisher et al. (2010) and Stanton et al. (2017) underscoring the need for responsible governance in the use of neural data for commercial purposes. Together, these citation patterns reveal that neuromarketing evolves around three key intellectual pillars: conceptual foundations that define its scope, methodological innovations that expand its analytical capabilities, and ethical frameworks that ensure its responsible application. These pillars demonstrate that neuromarketing functions not only as a scientific pursuit but also as a normative field requiring ongoing scrutiny and ethical oversight.

3.2 Keyword Network and Thematic Clusters

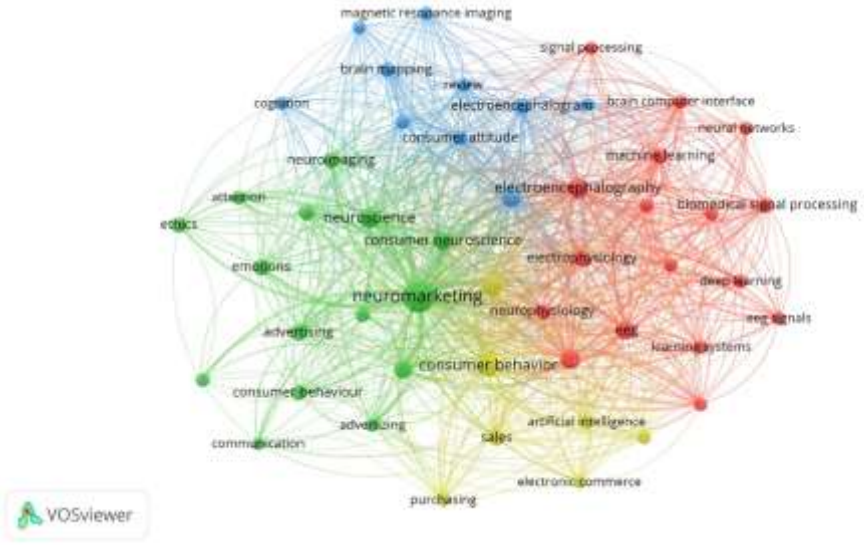

Figure 1. Network Visualization
Source: Data Analysis Result, 2025

The keyword co-occurrence network reveals four major clusters that define the dominant research themes in neuromarketing, beginning with neuroimaging and EEG-based measurement, reflected in frequent terms such as EEG, brain activity, attention, and emotion, which highlight strong interest in electrocortical responses to marketing stimuli. The second cluster focuses on consumer decision-making and emotion, emphasizing themes like preference formation, emotional processing, and behavioral intention. The third cluster pertains to marketing and branding

applications, encompassing topics such as advertising effectiveness, brand perception, and consumer engagement. The fourth cluster centers on ethics and professional practice, with keywords like ethics, privacy, and data protection indicating growing concern over the implications of brain-based marketing technologies. Collectively, these clusters demonstrate that neuromarketing research is both multidisciplinary and increasingly sophisticated, integrating psychology, neuroscience, and consumer behavior into interconnected knowledge domains.

3.2.1 Overlay Visualization

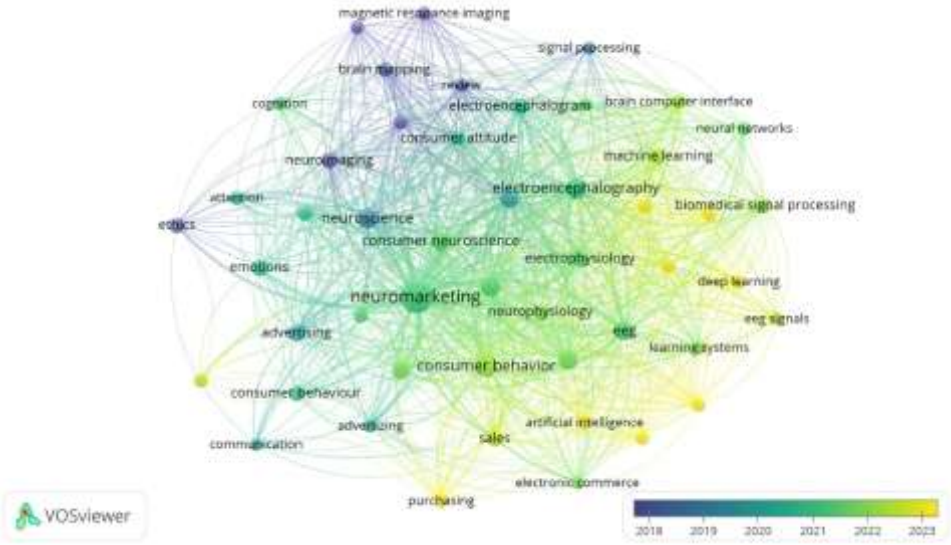

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

The overlay map illustrates the temporal evolution of neuromarketing research, showing that earlier studies prior to 2012 primarily focused on conceptual definitions and methodological exploration, as reflected in terms such as "neuromarketing," "neuroimaging," and "consumer neuroscience," while more recent publications shift toward advanced applications and emerging issues, incorporating terms like "machine learning," "engagement metrics," "ethical implications," and "decision neuroscience." This progression indicates a clear movement from foundational theory-building toward practical, technology-driven inquiry, underscoring neuromarketing's transition into an applied scientific field with growing commercial relevance.

3.2.2 Density Visualization

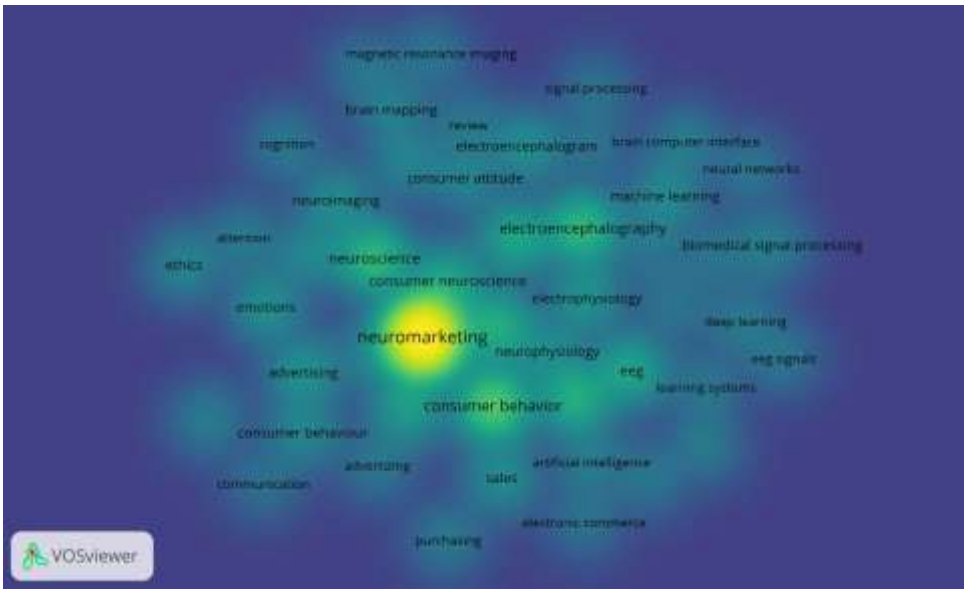

Figure 3. Density Visualization
Source: Data Analysis Result, 2025

The density map highlights keywords with the highest co-occurrence intensity—such as EEG, consumer behavior, emotion, attention, and decision-making—indicating that these high-density areas represent the conceptual core of neuromarketing research and reflect the field's primary focus on understanding the affective and cognitive processes underlying consumer actions. This visual concentration reinforces the literature's consistent emphasis on linking neural responses with behavioral outcomes, demonstrating how neuromarketing integrates brain activity measures with consumer decision-making insights.

3.3 Author Collaboration Patterns

3.3.1 Author Visualization

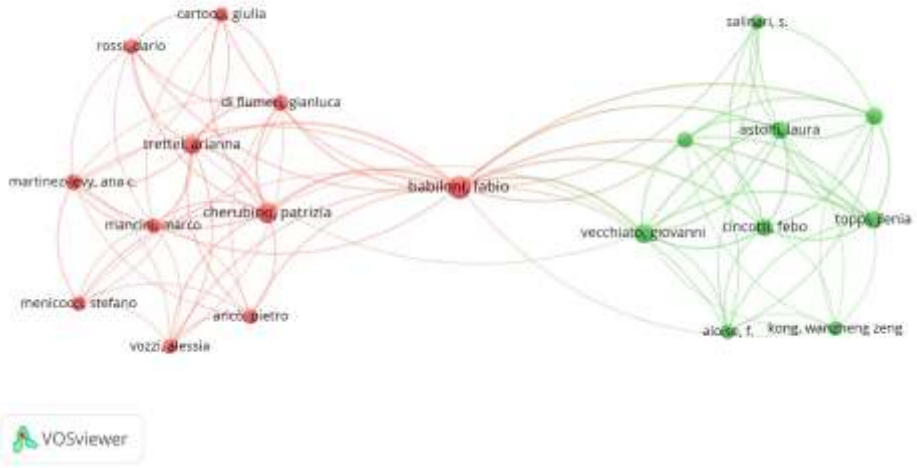

Figure 4. Author Visualization
Source: Data Analysis Result, 2025

The author network reveals several tightly connected clusters that indicate strong collaboration patterns among neuromarketing scholars, with prominent groups of co-authors—particularly those specializing in EEG and MEG techniques—demonstrating active cooperation among neuroscientists, engineers, and marketing researchers, which highlights the multidisciplinary character of the field. At the same time, the network also shows noticeable fragmentation, as many researchers operate within isolated clusters rather than forming a cohesive research community, a pattern typical of emerging scientific domains and one that suggests significant opportunities for expanding global collaboration to develop more unified frameworks and standardized methodological approaches.

3.4 Geographic Distribution of Research

3.4.1 Country Visualization

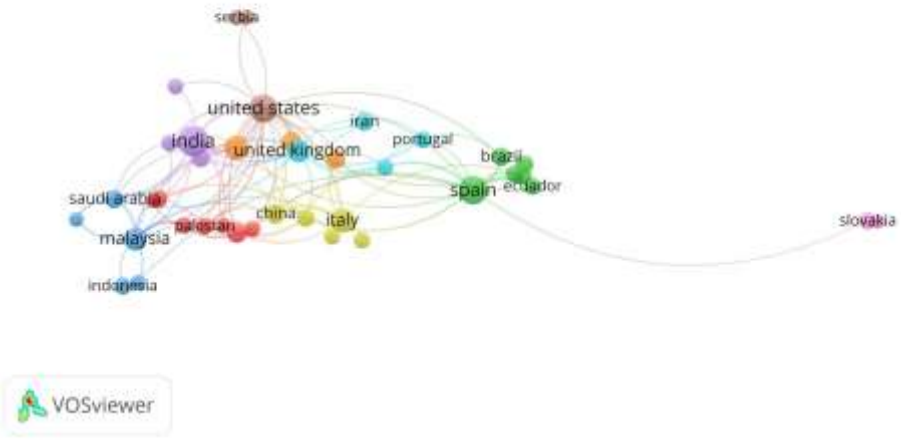

Figure 5. Country Visualization
Source: Data Analysis Result, 2025

The country collaboration map shows that neuromarketing research is predominantly concentrated in technologically advanced nations such as the United States, Italy, the United Kingdom, Germany, and China, where dense collaborative networks are supported by substantial investments in neuroscience laboratories, marketing research centers, and computational tools. The visualization also highlights active international collaborations, with Europe emerging as a central hub for cross-border research, while contributions from developing regions remain limited, reflecting disparities in access to neuroimaging technologies and interdisciplinary research funding. Overall, these patterns suggest that the global diffusion of neuromarketing will depend on expanding technological accessibility and fostering broader collaborative networks that engage emerging economies.

3.5 Discussion

The combined evidence from citation patterns, keyword clustering, author interactions, and country collaboration maps presents a comprehensive picture of neuromarketing's evolution. Early research primarily concentrated on establishing conceptual definitions and assessing the feasibility of neuroimaging tools, while the field has gradually expanded toward more advanced analytical approaches, including real-time emotion tracking and machine learning–based interpretation. Alongside these methodological advancements, ethical considerations have intensified, driven by concerns about consumer manipulation, data privacy, and the responsible

use of neural information—issues that have increasingly drawn scholarly attention.

The visual maps collectively indicate that neuromarketing has progressed beyond its experimental origins and matured into a structured research domain with well-defined intellectual cores. However, collaboration patterns also reveal opportunities for broader integration, particularly in regions with limited access to neurotechnology. Expanding global participation could diversify theoretical perspectives and stimulate methodological innovation. Moreover, the thematic shift from foundational neuroscience toward applied marketing analytics demonstrates neuromarketing's growing relevance in digital, data-driven environments, where businesses rely on deeper insights into attention, emotional resonance, and subconscious drivers of consumer decisions to design more immersive and personalized strategies.

4. CONCLUSION

The bibliometric results demonstrate that neuromarketing has evolved into a structured and increasingly influential field within marketing and behavioral science. Early research primarily focused on defining conceptual boundaries and evaluating the potential and limitations of neural data, as reflected in foundational works by Ariely & Berns (2010), Lee et al. (2007), Morin (2011), and others. As the field matured, methodological sophistication became more prominent through the integration of EEG, MEG, eye-tracking, physiological measurements, and machine learning, enabling deeper exploration of subconscious mechanisms underlying consumer decision-making. These advancements not only refined analytical precision but also broadened the applicability of neuromarketing within academic and commercial contexts.

The analysis of keyword networks and visual mappings confirms the presence of four dominant research clusters—neuroimaging tools, emotional and cognitive processing, marketing applications, and ethical concerns—which together illustrate the multidimensional character of neuromarketing and its capacity to link neural responses with real-world marketing practices. Author and country collaboration maps further reveal that research activity is concentrated in technologically advanced regions such as Europe, the United States, and China, highlighting ongoing disparities in technological access that limit broader global participation. Overall, the study concludes that neuromarketing is transitioning from exploratory experimentation to applied scientific inquiry with increasing practical relevance for marketing, brand communication, and consumer experience research. As the field expands, ethical governance, transparency, and responsible use of neurodata become increasingly critical, underscoring the need for future research to strengthen interdisciplinary integration, enhance global collaboration networks, and develop standardized methodological and ethical frameworks that support both scientific progress and consumer well-being.

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