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REVIEW ARTICLE

A SYSTEMATIC REVIEW ON NEUROMARKETING IN PHARMACEUTICAL INDUSTRIES

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ABSTRACT

Neuromarketing has garnered significant academic and commercial interest due to advancements in neural recording techniques and interpretation algorithms, making it an effective tool for deciphering consumers' implicit responses to marketing stimuli. This article presents a pioneering systematic review of neuromarketing within the pharmaceutical advertising domain. The study commences with an in-depth exploration of the background and rationale for conducting this review, followed by clearly articulated objectives and research questions. A thorough literature review provides insights into neuroscientific perspectives relevant to consumer behavior and decision-making, laying the foundation for the methodology section. Here, the search strategy, inclusion and exclusion criteria, study selection process, and data synthesis methods utilized in this systematic review are delineated. The systematic review section is structured around key themes, including an analysis of neuromarketing techniques applied in advertising within the pharmaceutical sector and specific types of pharmaceutical advertisements.

Additionally, the review investigates the methodologies employed in neuromarketing practices, offering an overview of commonly utilized techniques. Furthermore, the review discusses the implications of neuromarketing approaches in pharmaceutical advertising, highlighting practical applications and emerging trends. The discussion section critically examines key findings concerning the effectiveness of

neuromarketing in pharmaceutical advertising, outlining both the strengths and limitations of these approaches. Ethical considerations inherent in neuromarketing techniques are also explored, alongside a gap analysis identifying areas for future research and development. In conclusion, this systematic review provides valuable insights into the applications of neuromarketing in pharmaceutical advertising, offering recommendations for future directions and enhancements in this dynamic field.

***Keywords**: Neuromarketing, Pharmaceutical drugs advertising, Neuromarketing techniques, Pharmaceutical Advertising, Consumer behaviour*

INTRODUCTION

Marketing involves creating, communicating, and delivering value to satisfy customer needs, with two main types: B2B (business-to-business) and B2C (business-to-consumer). B2B marketing focuses on businesses and uses the 7 P's (product, price, place, promotion, people, process, and physical evidence), while B2C targets individual consumers. Emerging trends include C2B (consumer-to-business) and C2C (consumer-to-consumer) marketing, emphasizing flexibility and the sharing economy through platforms like e-commerce[1]. Traditional market research relies on self-report methods like questionnaires and focus groups but can be biased and unreliable.

Neuromarketing, a field introduced by Ale Smidts in 2002, offers deeper insights by using neuroscience and biometric technologies to assess consumers' subconscious responses to stimuli. Key aspects include emotion, attention, and memory, which help marketers create more effective strategies by understanding how the brain reacts to advertising [2,3]. This interdisciplinary field bridges marketing and neuroscience, aiding in predicting consumer behavior in a rapidly changing marketplace [4].

A systematic review is vital to consolidate knowledge in neuromarketing, identify research gaps, and assess study quality. This helps guide marketers in choosing effective techniques, supports evidence-based decision-making, and contributes to theory development and future research directions.

The review focuses on:

1. Common neuromarketing techniques used in pharmaceutical advertising.

2. The link between brain activity and consumer decision-making in this context.
3. The effectiveness of neuromarketing in influencing consumer behavior.
4. Strengths and limitations of neuromarketing in pharmaceutical advertising.
5. Gaps in current research and future research directions.

Neuromarketing is an emerging field that combines marketing strategies with insights from neuroscience to understand consumer decision-making[5]. The Foundation of neuromarketing is built on the "three-brain" model, as outlined by Renvoisé and Morin, which divides the brain into:

1. Neocortex (Thinking Brain): Responsible for logical analysis and rational decision-making.
2. Limbic System (Emotional Brain): Influences preferences subconsciously through emotions and feelings.
3. Reptilian Brain (Old Brain): Governs survival instincts and basic functions, playing a key role in evaluating risks and needs.

Companies leverage neuromarketing to design advertisements that target these areas, particularly the reptilian brain[6]. Strategies include focusing on self-preservation, using contrasts to capture attention, emphasizing beginnings and endings, and relying on emotional and visual cues to make advertisements more memorable and impactful[5].

Emotional advertising has been shown to outperform rational advertising, particularly in memory retention. Techniques such as fMRI and EEG analyses reveal brain regions involved in decision-making, like the striatum and ventromedial prefrontal cortex, providing deeper insights for companies to enhance consumer engagement.

In the context of social media, neuromarketing shows that ads with minimal editorial content and featuring celebrities gain more attention. Neuromarketing is becoming increasingly sophisticated with technology, using neural networks and neuroscience-based metrics to predict ad effectiveness[7-9].

This approach helps companies understand consumer behaviour and create stronger emotional connections through targeted advertising strategies. Table 1 shows various examples of neuromarketing strategies, modes of action, and their prospective effect on customers.

Table 1: Various examples of neuromarketing strategies, mode of action, and their prospective effect on customers

Sr. No.	Strategy	Mode of action	Effect on customers
1.	Utilising visual and audio to promote items	Direct effect on the brain of an individual	- Strong bass draws people's attention to dark items unconsciously. - More high -frequency music draws the listener's attention to bright items. - When it comes to attraction, white is more appealing than black.
2.	Advertising that emphasizes scarcity is the most effective.	Persuading individuals through advertising campaigns.	- Gain frames are statements like "Grab the latest edition today," while loss frames are phrases like "Don't miss out on the new edition." - People who seek uniqueness respond better to messages about what they'll miss if they don't bu y, while those less focused on uniqueness prefer hearing about the benefits of purchasing.
3.	Using gentle incentives to guide consumer behaviour on the internet.	Offering rewards to customers is an effective method to encourage repeat business.	- Stores of ten use delayed rewards, such as awarding points for each purchase, which can later be redeemed for store credit, to encourage customers to return. - Short-term rewards can motivate people to stay focused while they work toward their long-term goals.
4.	Developing a streamlined approach to product design.	Providing top -notch and distinctive packaging choices.	- An analysis of various packaging choices for products. - Volvo and Hyundai have employed analogous methodologies to identify the components of new car mo dels that resonated with consumers.
5.	Generating a multi - sensory incongruity.	Products and packaging that mimic the appearance of other materials.	- Leading brands involve consumers in multi-sensory experiences. - This indicates that they deliver a brand exp erience beyond visual elements, incorporating senses like smell and taste. When two sensory signals don't align, it's termed a mismatch.

6.	Forecasting future achievements using neuroscience.	Shaping the commercial success of a product.	- Impacts investment decisions, time allocation, and human and financial resource management.

MATERIALS AND METHODS

Search Strategy and Terms

A systematic literature review was conducted to evaluate neuromarketing's role in pharmaceutical advertising. A search on PubMed, Scopus, and ScienceDirect identified 19,497 articles, which were narrowed to 1,000 based on relevance. 110 were selected for detailed analysis. The review examined the significance, techniques, advantages, disadvantages, ethical considerations, and future prospects of neuromarketing in pharmaceutical advertising, ensuring data reliability through quality assessment tools. This provided insights into neuromarketing's impact on marketing strategies and consumer behaviour in the pharmaceutical industry.

Inclusion Criteria

- Primary research articles published in peer-reviewed journals between 2004 and April 2024.
- Studies focused on marketing aspects involving brain or physiological mechanisms, consumer behaviour, psychology, or neurology.
- Articles using neuroimaging techniques (EEG, fMRI, PET) or physiological measures (ET, GSR) for marketing insights.
- Only English-language articles.
- Studies providing relevant insights into neuromarketing.

Exclusion Criteria

- Articles published before 2004 or after April 2024.
- Duplicates across databases.
- Studies lacking sufficient methodological details.
- Articles not offering clear insights on neuromarketing techniques or their impact on consumer behaviour.

Study Selection Process

1. Reviewed all titles, removing duplicates and irrelevant articles based on exclusion criteria.
2. Evaluated the abstracts of the remaining articles, eliminating those that did not meet the exclusion criteria.
3. We proceeded with full-text screening for the articles that remained after abstract evaluation.
4. For the qualified articles, checked their reference lists and searched for any subsequent publications that cited them.

5. Compiled this comprehensive list and conducted another round of title and abstract screening using the established criteria

6. Repeated this process iteratively until the compiled list from step 5 no longer contained articles that met the criteria for full-text screening.

Data Synthesis

In the data synthesis phase, key insights from 110 shortlisted articles on neuromarketing in the pharmaceutical industry were analyzed. Using an aggregative approach, the review evaluated the significance, advantages, disadvantages, and ethical considerations of neuromarketing techniques like EEG, fMRI, and PET. The synthesis provided a comprehensive overview of neuromarketing's impact on pharmaceutical advertising, ensuring reliability and validity through quality-assessed studies. The PRISMA flow diagram shown in Figure 1 shows the extensive literature selection process in the following sections.

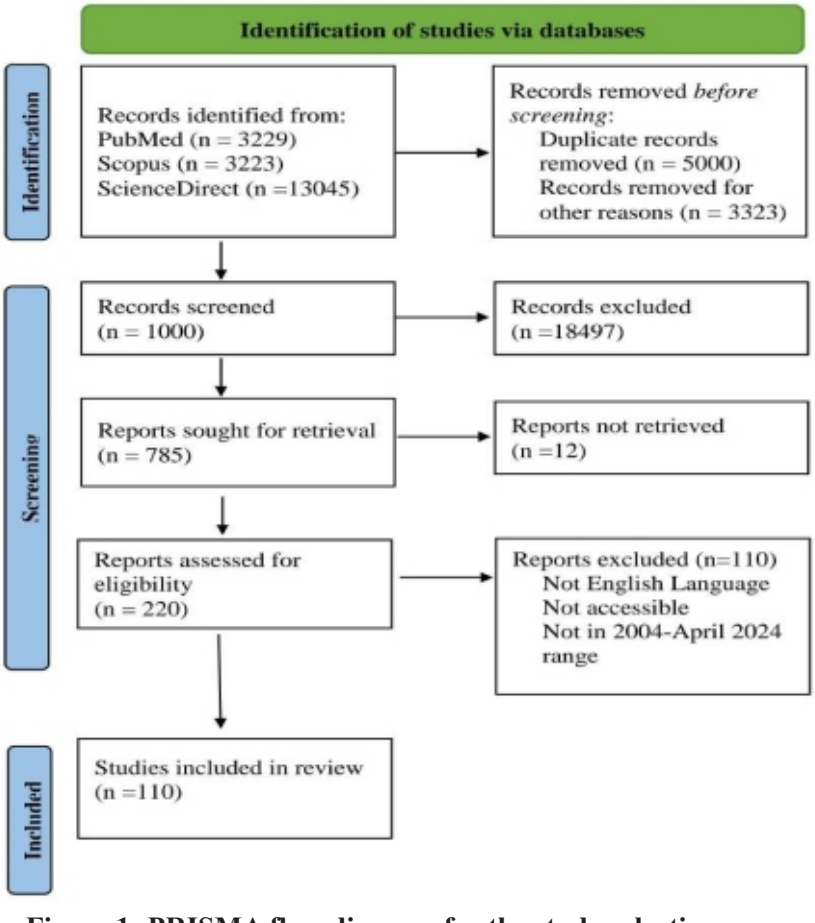


Figure 1: PRISMA flow diagram for the study selection process

SYSTEMATIC REVIEW

Advertising

Pharmaceutical drug advertising is controversial, balancing health promotion (e.g., vaccinations) with marketing products that may not address core health issues[10-12]. Authorities work to protect consumers, as advertisements focus on sales rather than education, raising concerns about potential drug misuse[13]. The pharmaceutical industry heavily invests in marketing new, high-priced drugs, which can harm consumers[6,14]. Neuromarketing techniques in ads, due to their persuasive nature, are debated and often considered for restriction. Drug advertising is regulated by international and local laws, ensuring that new drugs undergo a thorough review by regulatory bodies like the FDA, EMEA, and MHLW[6,15]. A SWOT analysis was conducted to assess the impact of neuromarketing in advertising new health technologies, which is shown in Figure 2.

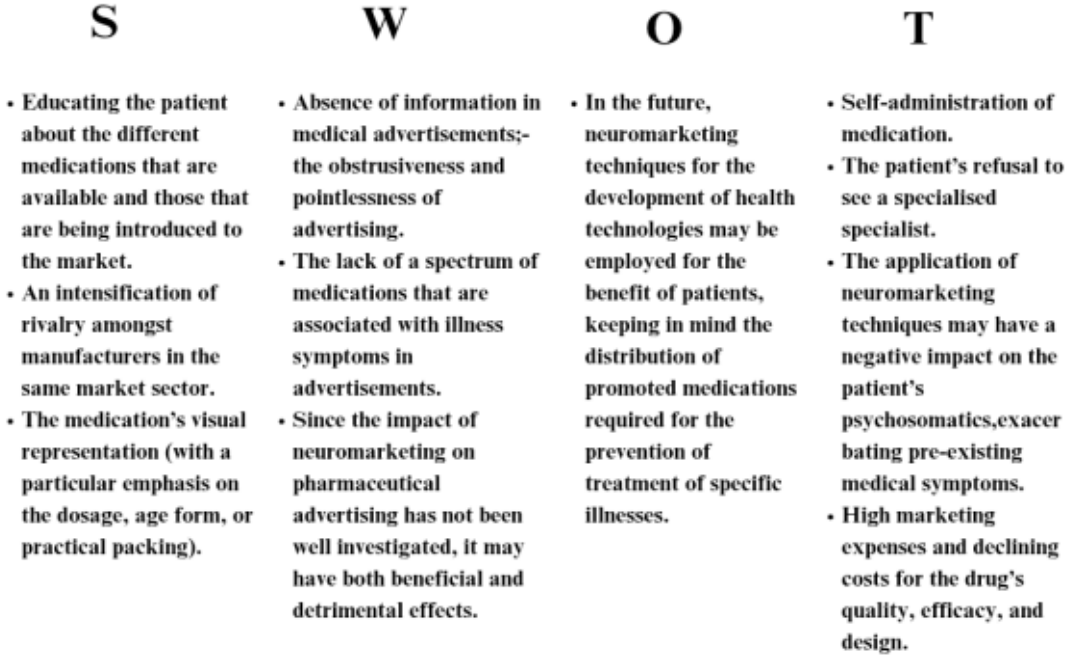


Figure 2: SWOT Analysis for neuromarketing in advertising

Types of Pharmaceutical Advertisements:

1. Direct-to-Consumer (DTC) Advertising: Includes help-seeking ads (informing about medical conditions without naming products), reminder ads (mentioning product name but not its use), and product claim ads (naming the product and making efficacy claims) [16]. Notable campaigns like "Lipitor"

and "Viagra" have demonstrated DTC's ability to educate and engage consumers[17-19].

2. Professional Advertising (DTP): Targets healthcare professionals, introducing new medications and providing details about the efficacy and side effects, as seen in Pfizer's "Lyrica" and Roche's "Tamiflu" campaigns[20-22].

3. Disease Awareness Campaigns: Focus on educating the public about conditions and treatment options, such as Janssen's schizophrenia awareness and Lilly's depression campaign[23,24].

4. Sponsorship and Event Advertising: Involves sponsoring relevant events, like Roche's support for the "American Society of Hematology" meeting, to engage specific audiences.

How is an applied neuromarketing study performed?

The process requires a series of specific steps to ensure the study is conducted accurately, which are shown in Figure 3[25]. These steps are as follows:

1. Client Briefing: Understand the client's goals.

2. Define Sample: Use a sample of at least 40 participants.

3. Choose Technologies: Select equipment based on desired data outcomes.

4. Develop Experimental Protocol: Design stimuli, control for bias, and consider neuroscience principles.

5. Organize Field Work: Conduct field activities, including a pilot test, in a well-equipped lab.

6. Data Collection: Use reliable technology for measurements.

7. Interpret Results: Analyse data to answer client questions and compile it into a final report.

Figure 3: All you need to know about neuromarketing

Overview of Neuromarketing Techniques

Neuromarketing strategies leverage neuroscientific methods to understand subconscious consumer behaviour, as 95% of decisions are made subconsciously. Techniques such as fMRI, EEG, galvanic skin response, and eye tracking are commonly used, each with benefits and drawbacks [26]. An overview of neuromarketing techniques is mentioned below in Table 2. These methods help reveal consumer emotions, expectations, and restrictions, making marketing more effective. Neuromarketing techniques are divided into two categories, which are shown in Figure 4:

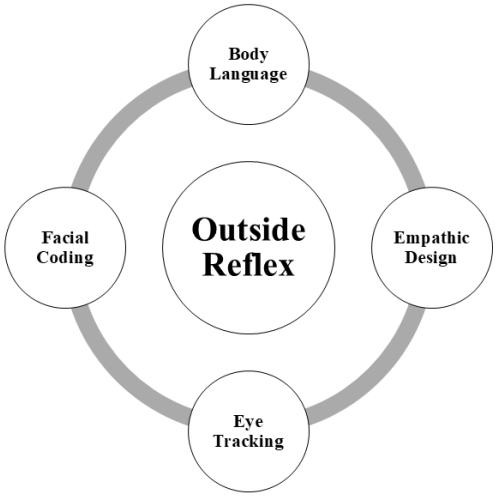
1. Outside Reflex Techniques: These include body language, empathic design, facial coding, and eye tracking. They measure external reactions like body movements, facial expressions, and eye gaze to understand consumer behaviour.

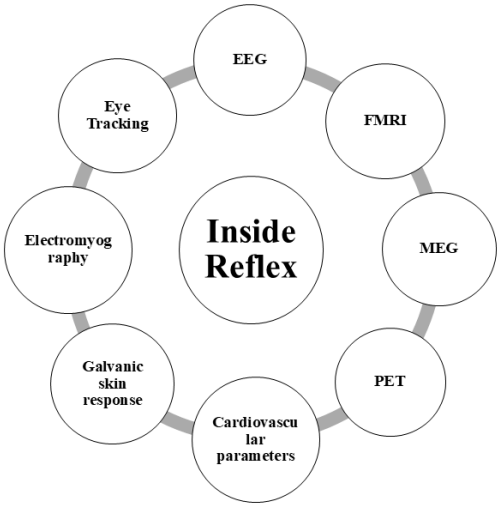
2. Inside Reflex Techniques: These focus on brain scanning (EEG, MEG, fMRI) and physiological measurements like heart rate and galvanic skin response. These methods monitor brain activity

and physiological reactions to marketing stimuli, providing deeper insights into emotional and cognitive responses.

Each method offers unique insights, and combining these techniques yields more comprehensive results for understanding consumer behaviour and improving marketing strategies[27]

Outside Reflex Neuromarketing Techniques





Inside Reflex Neuromarketing Techniques

Figure 4: Neuromarketing Techniques

Table 2: Overview of neuromarketing techniques

	Eye-tracking	EEG	Facial coding	fMRI	Physiological measures	Implicit Measures
How it works	Uses infrared light to detect a person's eye movements in real-time.	Detects the minuscule electrical charges produced by the activation of brain cells.	Identifies emotions from people's facial expressions and knows what they mean.	Detects the variations in blood flow brought on by changes in brain activity.	It covers a range of physiological measurement techniques.	Gather implicit preference information from non-conscious sources.
What it measures	Monitoring attention using pupil dilation, eye location, and eye movement	Cognitive functions, such as computations, to forecast a decision.	Human emotions as revealed via facial expression analysis.	Neural correlates of every consumer motivation.	Pupil dilation, heart rate, respiration, and galvanic skin reaction	Based on an examination of reaction times.
What it reveals about customers	Determines which products draw a customer's interest and focus.	Records the degree of stimulus, emotional arousal, and memory.	All-encompassing feelings such as joy, sorrow, shock, and terror.	Recall, emotional reactions, and degree of involvement.	Arousal is a term used to describe a range of emotions, including tension and enthusiasm.	The degree to which people are motivated, like, and associate a brand.

Implications of neuromarketing approaches in practice

Neuromarketing uses neuroscience techniques to evaluate the effectiveness of marketing materials, like ads and packaging, by analyzing brain responses. Studies show that consumer preferences, such as a liking for products with rounded edges, are linked to brain areas like the insula, which is involved in pain perception. This insight can guide product design.

Neuromarketing also reveals subconscious motivations that traditional methods may miss. For example, fMRI research by Martin Lindstrom found that emotional and personal associations with brands often differ from conscious preferences . Additionally, research on pricing strategies shows that consumers respond better to absolute savings (e.g., "$10 off") rather than percentage discounts, especially for tangible goods. These findings help optimize marketing and promotional

strategies . Some neuromarketing companies are listed in Table 3, which gives an idea of the data sources used by the companies for their products.

Table 3: List of neuromarketing companies and their product offerings

Company	Product Offering	Data Sources
Brain Intelligence	Measure the emotional reactions, moods, and perceptions triggered by various stimuli like media advertisements and product packaging.	Eye tracking, EEG, Galvanic skin Response; EMG; Implicit Association Test
Buyology	Collect quantitative data on emotions, moods, and perceptions in response to different types of stimuli, including media ads, produ ct packaging, and the shopper or user experience.	Go/No-Go Association T, implicit association test, EMG, fMRI, EEG, Eye Tracking.
FKF Applied Research	Monitors real -time emotional responses to stimuli, providing marketers with insights into customer attitudes.	fMRI
Forebrain	Examines the subconscious reactions consumers have to marketing cues and advises companies on leveraging this for better communication.	EEG; Eye Tracking
Innerscope Research	Examining both conscious and subconscious reactions to media and packaging.	Facial Coding, Eye Tracking, Biometrics, EEG, fMRI, Voice Analysis
Institute of Sensory Analysis	Identify emotions elicited by advertising through techniques like Eye Tracking, EEG, EMG, MRI, and GSR to improve user interfaces and the overall consumer experience.	Eye Tracking, EEG, EMG, fMRI, GSR
Keystone Network	Examines various elements of the consumer experience to gain insights into subconscious behavior.	Eye Tracking/Observation Cameras, EEG, GSR
Merchant Mechanics	Eye Tracking, EEG, EMG, and MRI are used to understand what customers think, feel, say, and do, exploring the scientific basis for the biometric variations in these behaviors.	Eye Tracking, EEG, EMG, fMRI, Biometrics

Mind Lab International	Investigate subconscious at titudes to uncover the underlying factors that drive consumer motivations and decision -making, revealing how they engage with marketing and its intended messages.	Implicit Association Test, EG, Eye Tracking Biometrics, EMG
MSW Research	Offers research and consulting grounded in neuroscience and other methodologies to craft compelling advertising messages and build more enduring, profitable brands.	Facial Coding, Eye tracking, GSR, EEG
Neurensics	Gaining insights into consumer behavior by tracking brain responses to various marketing stimuli involving all the senses.	fMRI, Eye Movements
Neuro-Insight	Focus on understanding how the brain reacts to messages delivered through branding and media channels.	EEG/SST
NeuroFocus	Analyse real-time subconscious and conscious reactions to grasp how consumers respond to marketing efforts.	EEG; Eye Tracking
Neurosense	Offer online consumer tests that enable the analysis of subconscious thought patterns, along with consulting services based on the results of these tests.	Implicit Reaction Speed Tests; fMRI
Neurospire	Studies the brain mechanisms underlying attention, memory, emotion, and decision-making.	EEG; Eye Tracking
Nielsen Neuro	Use neuroscience tools to reveal the subconscious elements of consumer decision-making.	EEG; Biometrics; Facial Coding; Implicit Association Testing; Eye Tracking; fMRI
One-to-One Insight	Employs EEG technology to understand how consumers react to media without prior interaction or experience.	EEG
Sales Brain	Centers on utilizing neuromarketing research to enhance the sales process.	EEG, Eye Tracking, Facial Imaging, Biometrics
Sands Research	Produces neurological data in a marketing setting to gauge levels of emotional engagement.	EEG, Eye Tracking, Biometrics

Applications of Neuromarketing

Neuromarketing offers valuable insights into consumer behavior and emotional responses across various marketing domains:

1. Branding: Techniques like fMRI and EEG help marketers understand subconscious consumer reactions to branding elements, fostering emotional connections and brand loyalty. Sensory branding, incorporating colors, sounds, and aromas, enhances the overall brand experience[32,33].

2. Advertising: Neuromarketing aids in developing effective ad campaigns by analyzing brain responses, allowing marketers to create targeted ads that resonate with consumers' desires, ultimately boosting brand loyalty and sales [11].

3. Digital Ecosystem: By examining brain activity in response to digital marketing, neuromarketing helps optimize campaigns for better engagement and conversions. It enables personalized marketing messages that enhance overall digital strategy effectiveness [34,35].

4. Packaging Design: Neuromarketing identifies emotional responses to packaging elements, guiding the creation of appealing designs that stand out and effectively communicate product information [36,37].

DISCUSSION

Key Findings on Neuromarketing in Pharmaceutical Advertising

Neuromarketing in pharmaceutical advertising offers significant advantages by measuring emotional responses, identifying attention-grabbing elements, and optimizing messages for better brand recall. It helps marketers understand subconscious decision-making, enhances brand differentiation, and supports personalized marketing strategies. However, ethical concerns related to privacy, consent, and potential manipulation must be addressed. Long-term studies are needed to assess neuromarketing's impact on consumer behavior, and cultural considerations are essential for global campaigns.

Limitations of Neuromarketing Approaches

Neuromarketing faces challenges, including a lack of reliability and validity in results, high costs of research, and potential manipulation of findings[4,38,39]. The field's popularity has not translated into sufficient academic literature, and the timing and context of marketing stimuli can affect individual responses[26].

Advantages of Neuromarketing Approaches

Neuromarketing integrates behavioural neuroscience to reveal consumer

behaviours that traditional methods might miss. It aids in advertising, brand development, and product design, enhancing the overall shopping experience[40]. Innovative applications, such as virtual stores, provide realistic marketing exposure to consumers[41,42].

Ethical Considerations

Ethical discussions around neuromarketing focus on human dignity, privacy, and the potential for manipulative advertising practices[43,44]. It is essential to ensure reliability and mitigate risks through ethical oversight. Although some argue neuromarketing aims to improve products rather than manipulate consumers, privacy concerns persist, leading to calls for stricter regulations[26,45].

Gap Analysis

Neuromarketing is still developing, with gaps in standard methodologies, ethical guidelines specific to healthcare, and the reliability of its techniques in predicting consumers. Privacy and data protection remain significant concerns, and there is a need for clearer regulatory compliance. Accessibility to neuromarketing technologies is limited, particularly for smaller companies, and the scarcity of comprehensive studies in the pharmaceutical sector poses challenges. Examples of successful neuromarketing applications in other industries include:

1. Coca-Cola: Utilizes neuromarketing for branding and product design, improving consumer appeal through extensive research[46-49].
2. Airbnb: Leverages user-generated content to enhance credibility and trust[50].
3. Walmart: Adjusts store layout based on consumer behaviour insights to optimize product sales[51].
4. IKEA: Employs psychological tactics in in-store design to influence purchasing decisions[52,53].
5. Nike: Uses emotional marketing strategies involving prominent figures to resonate with consumers[54-56].

Future Research Directions

Future directions in neuromarketing research are centered on leveraging advanced technologies, exploring cultural nuances, and addressing ethical concerns. One key area is the application of Artificial Intelligence (AI). AI and machine learning can analyze large datasets from social media, online browsing, and purchase histories to better understand customer behaviour and preferences. In the pharmaceutical industry, this could lead to personalized marketing messages and offers, improving customer engagement and conversion rates.

Another promising direction is the integration of multi-modal neuroimaging techniques. While functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) are

commonly used, incorporating other methods like magnetoencephalography (MEG), near-infrared spectroscopy (NIRS), and transcranial magnetic stimulation (TMS) could offer a more nuanced understanding of how marketing stimuli affect brain responses. This integration can help pharmaceutical companies design more effective campaigns that resonate with consumers' neural responses. Cross-cultural studies in neuromarketing can provide insights into cultural differences in consumer behaviour, helping pharmaceutical companies create marketing strategies that are sensitive to these variations. This approach can guide more targeted campaigns in different regions, improving global marketing efforts.

Addressing ethical concerns is also crucial. Research focusing on the development of neuromarketing ethics can ensure that these techniques are used responsibly, with attention to privacy and autonomy. Lastly, the incorporation of behavioural economics into neuromarketing research can offer a deeper understanding of consumer decision-making. By combining insights from psychology, economics, and neuroscience, pharmaceutical companies can develop more effective and ethical marketing strategies that align with consumer needs and preferences. These future research directions offer a comprehensive approach to enhancing the impact of neuromarketing in the pharmaceutical industry while ensuring ethical practices and respect for consumer privacy.

CONCLUSION

Neuromarketing has attracted considerable attention from both academic researchers and the general public. Although there are relatively few scientific studies in this field, existing evidence indicates that neuroimaging could be advantageous in several marketing contexts. For marketing professionals, neuroimaging could be intriguing because it may offer faster and potentially less expensive insights compared to conventional marketing methods while also uncovering unique perspectives on consumer perceptions that might otherwise remain hidden. Among the various devices for recording brain signals, EEG is gaining popularity in neuromarketing studies, especially for analyzing television commercials (TVCs), owing to its high temporal resolution and cost-effectiveness.

However, the claim that neuroimaging is more cost-effective than traditional marketing approaches seems overstated. Nonetheless, ongoing progress in neuroimaging analysis, including techniques like multi-voxel pattern analysis (MVPA), could soon enable the extraction of subtle information about consumer preferences. This ability could improve sales strategies following product design, but the most profound impact might occur during the product development phase.

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